UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NEW ENGLAND REGION
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BOSTON, MASSACHUSETTS 02109-3912

FACT SHEET

DRAFT NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT TO DISCHARGE TO WATERS OF THE UNITED STATES PURSUANT TO THE CLEAN WATER ACT (CWA)

NPDES PERMIT NO.: **NH0001473**

PUBLIC COMMENT PERIOD: **September 30, 2015 – November 28, 2015**

PUBLIC NOTICE NO.: **NH-008-15**

NAME AND ADDRESS OF APPLICANT:

Public Service Company of New Hampshire
P.O. Box 330
Manchester, NH 03105

NAME AND ADDRESS OF FACILITY WHERE DISCHARGE OCCURS:

Schiller Station
400 Gosling Road
Portsmouth, NH 03801

RECEIVING WATER: **Piscataqua River (USGS Hydrologic Basin Code: 01060003)**

CLASSIFICATION: **Class B**

SIC CODE: **4911** NAICS Code(s): **221112**

CURRENT PERMIT
ISSUED: **9-11-1990**
EFFECTIVE: **10-11-1990**
EXPIRED: **10-10-1995**
APPLICATION REC: **6-1-1995**
RENEWED APP REC: **9-13-2010**

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1. Proposed Action, Facility Type, and Location of Discharge and Water Withdrawal

Schiller Station, located on the southwestern bank of the Piscataqua River in Portsmouth, New Hampshire, is a four-unit, 163 megawatt (MW) steam electric generating facility (referred to hereinafter as either Schiller Station, Schiller, the Facility, or the Station). The Station is owned and operated by Public Service of New Hampshire (PSNH), a subsidiary of the Northeast Utilities System ("NU"). Recent media reports indicate that NU has changed its corporate name, as well as the name of PSNH and its other subsidiaries, to Eversource Energy (Eversource). Schiller Station began generating electricity in 1952.

The Station's three main generators are designated as 4, 5, and 6; all rated at 48 MW each. Units 4 and 6 are equipped with dual fuel boilers capable of firing either pulverized bituminous coal or #6 fuel oil. Unit 5 was converted to a dual fuel fluidized bed boiler that burns wood chips and/or other low grade wood products for its primary fuel. The remaining unit, designated CT-1, is a 19 MW combustion turbine fired with #1 fuel oil that is typically operated only during periods of highest seasonal peak demand. When operating at peak capacity, Schiller Station can produce enough energy to supply 65,000 homes.

Historically, Schiller Station has functioned as a base-load power plant. Schiller's wood-burning unit has maintained a capacity factor of around 80 percent, but conditions have changed for Schiller's coal-burning units in recent years due to fluctuations in the availability and cost of various types of fuel. Lower prices for natural gas have led to greatly reduced capacity factors for coal-burning units, including Schiller. (Oil-burning units already had low capacity factors due to the relatively high price of oil.) In 2011 and 2012, the capacity factor for Schiller's coal-burning units dropped off to around 10 percent for much of the year, with increased operation during the cold winter months. In essence, these units run during periods of peak demand, especially during the winter. In 2014, extreme cold weather, further shifts in relative fuel prices, and limitations on the natural gas transmission system that restrict natural gas imports into the region, led to winter peak operations approaching 80 percent. After the winter, however, the units' capacity factor dropped off again to around 10 percent or less.

As part of its process for generating electricity, Schiller Station uses an open-cycle (or "once-through") cooling system. The Facility withdraws water from the Piscataqua River through its cooling water intake structure (CWIS) and uses it to condense the steam sent through the electrical generating turbines. As a result, the water absorbs the Facility's waste heat produced in the electrical generating process. This heats up the water and Schiller then discharges this thermal effluent to the Piscataqua River.

Under Sections 301(a) and 402(a) of the Federal Clean Water Act (CWA), Schiller Station may not discharge pollutants to, or withdraw water for cooling from, the Piscataqua River unless authorized to do so by a National Pollutant Discharge Elimination System (NPDES) permit. The Region 1 office of the U.S. Environmental Protection Agency (referred to hereinafter either as EPA, EPA-New England, Region 1, or the Region) is the governmental authority that issues NPDES permits to facilities in New Hampshire, such as Schiller Station. Still, the Region may not issue a permit to a New Hampshire facility unless the New Hampshire Department of Environmental Services (NHDES) either certifies that the conditions in the permit are stringent enough to assure, among other things, that the discharge will not cause the receiving water to violate the New Hampshire Surface Water Quality Regulations (NH-Standards) or waives its right to certify as set forth in 40 CFR §124.53.

Schiller Station's current NPDES permit authorizes the Facility to withdraw water for cooling purposes from, and to discharge pollutants to, the Piscataqua River. See Attachment A showing a map of the Facility including outfall locations. The Station is permitted to discharge non-contact cooling water, operational plant wastewater, process water, and runoff. The majority of stormwater runoff on the site is commingled with non-stormwater, so much of the runoff from the site is regulated under this individual permit. To address any directly discharged stormwater, PSNH has drafted a Stormwater Pollution Prevention Plan and the Station will file a Notice of Intent (NOI) to cover these outfalls under the Multi-Sector General Storm Water Permit.

Region 1 last issued the Station's NPDES permit (NH0001473) on September 11, 1990. This permit expired on September 10, 1995, but was administratively continued because the Station submitted a timely and complete application for permit reissuance. *See* 40 C.F.R. § 122.6(a). On September 13, 2010, the Region received an updated permit application from PSNH, as per the Region's request. The Station remains subject to the 1990 permit until EPA issues a new one.

EPA currently intends to reissue the Facility's NPDES permit. This draft permit proposes to continue to authorize the intake of cooling water and discharge of cooling and process water, subject to the conditions specified in the permit and discussed in this Fact Sheet.

2. Description of Discharge

Refer to Section 6.2 of this fact sheet for a description of the discharges associated with each outfall location. Attachment B further describes the discharge, based on the applicant's quantitative discharge data (from November 1990 to April 2014). Attachment C presents a schematic drawing depicting the flow of water at the Facility and its various discharges.

3. Receiving Water Description

Schiller Station withdraws water from and discharges to the lower Piscataqua River. The Piscataqua is an approximately 13-mile-long tidal river which empties into Portsmouth Harbor/ Atlantic Ocean. The tide in this river is semi-diurnal with an average period of 12.4 hours. The lower portion of the Piscataqua River has been characterized as a well-mixed estuary. Tidal flushing requires six to 12 tidal cycles (3 to 6 days) and tidal mixing forces cause the water column to be vertically well mixed. In the vicinity of Schiller Station (within a 0.5 mile radius), center river channel depths range from 42 ft to 75 ft below Mean Low Water (MLW) with a median depth (as defined by area) of 18 ft. Also within the lower Piscataqua River, the river has maximum sweeping flow velocities of approximately 4.9 feet per second (fps) during ebb tide and 4.4 fps during flood tide. The peak tidal flows are approximately 117,000 cubic feet per second (cfs).

The Piscataqua River is classified as a Class B water body pursuant to the State of New Hampshire's Surface Water Quality Regulations (N.H. Code of Administrative Rules, Env-Wq 1703.01) and N.H. RSA 485-A:8. Class B waters are "considered as being acceptable for fishing, swimming and other recreational purposes and, after adequate treatment, for use as water supplies." (RSA 485-A:8, II).

Section 303(d) of the CWA requires states to identify those water-bodies that are not expected to meet surface water quality standards after the implementation of technology-based controls and, as such, require the development of total maximum daily loads (TMDL). The section of the Piscataqua River that Schiller Station discharges into (Lower Piscataqua River – South) is on the 2012 CWA 303(d) list for polychlorinated biphenyls (PCB's), mercury, dioxin, and estuarine bioassessments.

4. Limitations and Conditions

The effluent limitations and all other requirements described herein may be found in the Draft Permit. The bases for the limits and other permit requirements are described below. The Discharge Monitoring Report (DMR) data for the period of November 1990 through April 2014 were reviewed as part of developing the Draft Permit. This time period is referred to in this Fact Sheet as the "monitoring period".

5. Permit Basis: Statutory and Regulatory Authority

5.1 General Requirements

The CWA prohibits the discharge of pollutants to waters of the United States without authorization from an NPDES permit, unless such the discharge is otherwise authorized by the statute. 33 U.S.C. §§ 1311(a), 1342(a)(1). In addition, the NPDES permit for a discharger must include appropriate requirements on withdrawals of water for cooling through a facility's cooling water intake structure. 33 U.S.C. § 1326(b). The NPDES permit is the mechanism used to implement technology and water quality-based effluent limitations and other requirements, including monitoring and reporting requirements, at the facility-specific level. *See* 33 U.S.C. § 1342(a). This draft NPDES permit was developed in accordance with various statutory and regulatory requirements established in or pursuant to the CWA and any applicable federal and state regulations. The regulations governing the EPA NPDES permit program are generally found at 40 C.F.R. Parts 122, 124, 125, and 136.

EPA bases NPDES permit limits on applicable technology-based and water quality-based requirements. 33 U.S.C. § 1342(a)(1). Permit limits must, at a minimum, satisfy federal technology standards, but also must satisfy any more stringent water quality-based requirements that may apply. *See* 33 U.S.C. §§ 1311(b), 1326(b), 1342(a)(1); 40 C.F.R. §§ 122.44, 125.3(a). Put differently, as between technology-based and water quality-based requirements, whichever is more stringent governs the permit. In some specific, limited circumstances, however, a permittee may seek a variance from technology-based and/or water quality-based requirements. For example, a permittee may seek alternative, variance-based thermal discharge limits under CWA § 316(a). 33 U.S.C. § 1326(a). In addition, when setting permit limits, EPA must consider the requirements in the existing permit in light of the CWA's "anti-backsliding" requirements, which generally bar new permits from relaxing limits as compared to the limits in an earlier permit, unless a specific anti-backsliding exception applies. *See* 33 U.S.C. § 1342(o); 40 C.F.R. § 122.44(l).

5.2 Technology-Based Requirements

Technology-based treatment requirements represent the minimum level of control that must be imposed under Sections 301(b) and 402 of the CWA *(see also* 40 C.F.R. §§ 122.44(a), 122.44(b)(3), 125.3(a). Technology-based limits are set to reflect the pollutant removal capability of particular treatment technologies that satisfy various narrative treatment technology standards set forth in the CWA. These standards, in essence, define different levels of treatment capability. Specifically, pollutant discharges must be limited to a degree that corresponds with the best practicable control technology currently available (BPT) for certain conventional pollutants, the best conventional control technology (BCT) for other conventional pollutants, and the best available technology economically achievable (BAT) for toxic and non-conventional pollutants. *See* 33 U.S.C. §§ 1311(b)(1)(A), (b)(2)(A), (E) and (F); 40 C.F.R. § 125.3(a). For "new sources" of pollutant discharges, *see* 40 C.F.R. §§ 122.2 (definition of "new source) and 122.29(a), discharges of pollutants must be limited to a degree corresponding to the "best available demonstrated control technology" (BADCT). *See* 33 U.S.C. §§ 1316(a) and (b). Moreover, CWA § 316(b), 33 U.S.C. § 1326(b), requires that the location, construction, design and capacity of cooling water intake structures reflect "the best technology available for minimizing adverse environmental impact" (BTA).

In general, the statute requires that facilities like Schiller Station comply with technology-based effluent limitations as expeditiously as practicable, but in no case later than March 31, 1989 (see 40 C.F.R. §125.3(a)(2)). Since the statutory deadline for meeting applicable technology-based effluent limits has already passed, NPDES permits must require immediate compliance with any such limits included in the permit. When appropriate, however, schedules by which a permittee will attain compliance with new permit limits may be developed and issued in an administrative compliance order under CWA § 309(a) or some other mechanism.

For CWISs, EPA has recently changed its interpretation of the applicable compliance deadline for meeting BTA requirements under CWA § 316(b). Because CWA § 316(b) cross-references CWA §§ 301 and 306, EPA formerly interpreted § 316(b) to incorporate the compliance deadlines from those provisions. *See, e.g., Cronin v. Browner,* 898 F. Supp. 1052 (S.D.N.Y. 1995); *EPA General Counsel's Opinion No. 41* (1976). EPA has changed this interpretation and now interprets the absence of a specific compliance date being specified in the text of § 316(b) to mean that EPA may re-interpret the statute not to impose a specific compliance deadline and, instead, to require that compliance with BTA requirements be achieved as soon as practicable. *See* 79 Fed. Reg. 48359. As a result, NPDES permits may contain appropriate compliance schedules for achieving compliance with BTA requirements. This is reflected in EPA's recently promulgated regulations applying CWA § 316(b)'s BTA standard to existing facilities. *See* 79 Fed. Reg. 48433, 48438 (40 C.F.R. §§ 125.94(b)(1) and (2) ("The Director may establish interim compliance milestones in the permit."), and 125.98(c)). Compliance schedules are discussed in more detail in Section 10 of this document.

When EPA has promulgated national effluent limitation guidelines (ELGs) applying the statute's narrative technology standards (such as the BAT standard) to pollutant discharges from a particular industrial category, then those ELGs provide the basis for any technology-based effluent limits included in NPDES permits issued to individual facilities within that industrial category. 33 U.S.C. §§ 1342(a)(1)(A) and (b). *See also* 40 C.F.R. §§ 122.43(a) and (b), 122.44(a)(1) and 125.3(c)(1). In the absence of a categorical ELG, however, EPA develops technology-based effluent limits by applying the narrative technology standards on a case-by-case, Best Professional Judgment (BPJ) basis. *See* 33 U.S.C. § 1342(a)(1)(B); 40 C.F.R. §§ 122.43(a), 122.44(a)(1), 125.3(c)(2). When developing technology-based effluent limitations, EPA considers the terms of the particular technology standard in question, as specified in the statute and regulations, *id.*, along with the various factors enumerated in the statute and regulations for each specific technology standard. *See* 33 U.S.C. § 1314(b); 40 C.F.R. § 125.3(d). In developing ELGs, EPA's analysis is conducted for an entire industrial category or sub-category. In the absence of an ELG, EPA develops technology-based limits on a BPJ basis for a particular permit by conducting the analysis on a site-specific basis. One federal court has explained BPJ-based permitting as follows:

> [i]n what EPA characterizes as a 'mini-guideline' process, the permit writer, after full consideration of the factors set forth in section 304(b), 33 U.S.C. § 1314(b), (which are the same factors used in establishing effluent guidelines), establishes the permit conditions 'necessary to carry out the provisions of [the CWA].' § 1342(a)(1). These conditions include the appropriate ... BAT effluent limitations for the particular point source. ... [T]he resultant BPJ limitations are as correct and as statutorily supported as permit limits based upon an effluent limitations guideline.

NRDC v. EPA, 859 F.2d 156, 199 (D.C. Cir. 1988).

<u>ELGs for the Steam Electric Power Generating Point Source Category</u>

EPA promulgated ELGs for the Steam Electric Power Generating Point Source Category (the Steam Electric ELGs) in 1982. *See* 40 C.F.R. Part 423. The Steam Electric ELGs apply to discharges resulting from the operation of a generating unit by an establishment primarily engaged in the generation of electricity for distribution and sale which results primarily from a process utilizing fossil-type fuel (coal, oil, or gas) or nuclear fuel in conjunction with a thermal cycle employing the steam water system as the thermodynamic medium. 40 C.F.R. § 423.10. Schiller Station is a member of this industrial category and is covered by the Steam Electric ELGs. As noted above, after the last permit reissuance Unit 5 was converted to a dual fuel fluidized bed boiler that burns wood chips and/or other low grade wood products for its primary fuel. Hence, this generating unit does not fall within the Steam Electric Power Generating Point Source Category only because it relies on biomass for its fuel source rather than a fossil or nuclear fuel. Nevertheless, EPA concludes that it is reasonable and appropriate to consider the ELGs for the Steam Electric ELGs in developing BPJ-based BAT limits for the Schiller Station facility given that Units 4 and 6 are covered under this ELG and Unit 5 meets all other criteria for classification under this industrial category.

The Steam Electric ELGs, however, establish categorical effluent limitations under the various technology standards (*i.e.*, under BPT, BAT and BCT) for only *some* of the pollutants discharged by facilities in this industry. As noted above, where an applicable categorical effluent limitation has been developed, technology-based permit limits would be based on it. For example, the Steam Electric ELGs set BPT standards for certain pollutants contained in low volume wastes, fly ash and bottom ash transport water, metal cleaning wastes, cooling water, and cooling tower blowdown. In addition, the ELGs set BAT standards for certain pollutants in cooling water, cooling tower blowdown, and chemical metal cleaning wastes. When an applicable categorical standard has not been developed, however, technology-based limits would instead be developed on a BPJ, case-by-case basis. *See* 40 C.F.R. § 125.3(c)(2) and (3). Importantly, the Steam Electric ELGs do not include effluent limitations for discharges of heat. As a result, technology-based effluent limits for thermal discharges must be developed on a BPJ basis.

EPA has proposed regulations to update the Steam Electric ELGs, *see* 78 Fed. Reg. 34432 (June 7, 2013) (Proposed Rule), but they have not yet been finalized and are not in effect.[1] The proposed regulations do not govern the draft permit for Schiller. *See* 40 C.F.R. § 122.43(b). In addition, although the proposed revisions to the ELGs address a variety of pollutants, they do not propose to specify effluent limitations for discharges of heat.

EPA also recently promulgated final regulations setting categorical technology-based requirements under CWA § 316(b) for CWISs at existing facilities. 79 Fed. Reg. 48300-48439 (Aug. 14, 2014) (National Pollutant Discharge Elimination System—Final Regulations To Establish Requirements for Cooling Water Intake Structures at Existing Facilities and Amend Requirements at Phase I Facilities; Final Rule) ("New CWA § 316(b) Regulations"). These standards apply to Schiller Station. The New CWA § 316(b) Regulations specify certain technologies for certain purposes, but also call for continued site-specific decision-making for other purposes. *See, e.g.,* New CWA § 316(b) Regulations, 40 C.F.R. §§ 125.94(c) and (d). The requirements of the new regulations are discussed in more detail farther below.

5.3 Water Quality-Based Requirements

Water quality-based limits are required in NPDES permits when EPA and the State determine that effluent limits more stringent than technology-based limits are necessary to maintain or achieve state or federal water quality standards (WQS). *See* CWA § 301(b)(1)(C), 33 U.S.C. § 1311(b)(1)(C); 40 C.F.R. § 122.44(d). State WQS consist of three parts: (a) designated uses for a water body or a segment of a water body; (b) numeric and/or narrative water quality criteria sufficient to protect the assigned designated use(s); and (c) antidegradation requirements to ensure that once a use is attained it will not be degraded. *See* 40 C.F.R. §§ 131.10 - 131.12. The New Hampshire Surface Water Quality Standards (NHWQS) include these elements.

The NHWQS are collectively spelled out in Chapter 485-A of the New Hampshire statutes,

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[1] EPA cannot be entirely certain about when the updated Steam Electric ELGs will be finalized and what their provisions will be. This uncertainty is unavoidable because the terms of the final regulations may be changed from those of the proposed regulations after EPA completes its analysis, considers public comments and engages in intra-governmental review, such as with the White House Office of Management and Budget. Furthermore, in this case, the Proposed Steam Electric ELG Rule identified a variety of regulatory options that EPA was considering and the Final Rule could select any of these options, or an entirely different option. In addition, we cannot be certain of when the new ELGs will take effect. EPA presently expects to sign a new Final Rule by September 30, 2015, but such targets have had to be pushed back in the past for various reasons. Once signed, there will be some period of time before the regulations are published and then take effect. This length of this lag in effective date can vary from one set of regulations to another. Moreover, there is also always the possibility that litigation over a Final Rule could delay the new rule taking effect. If the Final Rule is in effect at the time that a new Final Permit is issued to Schiller Station, EPA will apply the Final Rule to the extent appropriate.

which governs water quality and the control of water pollution, and in Chapter Env-Wq 1700 of the State's regulations (namely, the "Surface Water Quality Regulations"). The NHWQS include requirements for the regulation and control of toxic constituents and require that EPA criteria, established pursuant to Section 304(a) of the CWA, shall be used unless a site-specific criterion is established.

The State's statutory and regulatory provisions do not specify *numeric* temperature criteria for the State's waters, but do specify *narrative* criteria for heat that are to be applied on a case-by-case basis in order to protect the existing and designated uses of each water body and restore and maintain the chemical, biological and physical integrity of the State's waters. Moreover, specific thermal discharge limits may be needed to ensure compliance with a number of biologically-oriented requirements of the NHWQS.

Chapter 485-A of New Hampshire's statutes governs water quality and the control of water pollution. N.H. Rev. Stat. Ann. § 485-A:1 states (in pertinent part) that:

> [t]he purpose of this chapter is . . . to prevent pollution in the surface and groundwaters of the State and to prevent nuisances and potential health hazards. In exercising any and all powers conferred upon the department of environmental services under this chapter, the department shall be governed solely by criteria relevant to the declaration of purpose set forth in this section.

Classification of the State's water bodies is addressed by N.H. Rev. Stat. Ann. § 485-A:8. The introductory language to this provision states that:

> [i]t shall be the overall goal that all surface waters attain and maintain specified standards of water quality to achieve the purposes of the legislative classification.

In addition, N.H. Code R. Env-Wq 1701.01 of New Hampshire's regulations provides that:

> [t]he purpose of these rules is to establish water quality standards for the State's surface water uses as set forth in RSA 485-A:8, I, II, III and V. These standards are intended to protect public health and welfare, enhance the quality of water and serve the purposes of the Clean Water Act and RSA 485-A. These standards provide for the protection and propagation of fish, shellfish, and wildlife, and provide for such uses as recreational activities in and on the surface waters, public water supplies, agricultural and industrial uses, and navigation in accord with RSA 485-A:8, I and II.

The purposes of the CWA, of course, similarly include restoring and maintaining the biological, chemical, and physical integrity of the Nation's waters, and, wherever attainable, ensuring water quality adequate for the protection and propagation of fish, shellfish, and wildlife, and for recreation, in and on such waters. *See* 33 U.S.C. §§ 1251(a) (introductory language) & (a)(2). Consistent with the stated goals and purposes of New Hampshire's water quality requirements, the NHWQS specify the uses of the state's water bodies that must be protected, and the numeric and narrative water quality criteria that must be satisfied, by any NPDES permit. *See* 33 U.S.C. §§ 1311(b)(1)(C), 1401(a)(1) & (d). These uses and criteria address a variety of issues, including the protection of aquatic organisms.

Thus, the NHWQS regulations mandate that "[a]ll surface waters shall provide, wherever attainable, for the protection and propagation of fish, shellfish and wildlife, and for recreation in and on the surface waters." N.H. Code R. Env-Wq 1703.01(c). *See also* 33 U.S.C. § 1251(a)(2). The regulations also dictate that:

> [a]ll surface waters shall be restored to meet the water quality criteria for their designated classification including existing and designated uses, and to maintain the chemical, physical, and biological integrity of surface waters.

N.H. Code R. Env-Wq 1703.01(b). "Biological integrity" is defined to mean:

> . . . the ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

Id. 1702.7. In addition, the NHWQS regulations specify a water quality criterion for "Biological and Aquatic Community Integrity" that provides as follows:

> (a) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.
>
> (b) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

Id. 1703.19(a) & (b). *See also id.* 1703.04 (criteria in N.H. Code R. Env-Wq 1703.05 through 1703.32 apply to all of the state's surface waters).

Schiller Station discharges to the Piscataqua River, which is classified as a Class B water body under the NHWQS (N.H. Code of Administrative Rules, Env-Wq 1703.01; N.H. RSA 485-A:8(II)). The state requires that Class B waters be "acceptable for fishing, swimming and other recreational purposes and, after adequate treatment, for use as water supplies" (RSA 485-A:8, II). For Class B waters, the state statute also dictates that:

> [t]here shall be no disposal of sewage or waste into said waters . . . [where] such disposal of sewage or waste [would] be inimical to aquatic life or to the maintenance of aquatic life in said receiving waters.

N.H. Rev. Stat. Ann. § 485-A:8(II).[2] Thus, in sum, pollutant discharges to a Class B water body,

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[2] Under this provision, thermal effluent (*i.e.,* wastewater containing waste heat) constitutes a "waste." *See* N.H. Rev. Stat. Ann. § 485-A:2(VI) & (XVI); N.H. Code R. Env-Wq 1702.25 & 1702.51. In addition, *The American Heritage Dictionary* (2d College Ed.) (1982), defines "inimical" to mean, in pertinent part, "injurious or harmful in effect; adverse . . . ." *See also Merriam-Webster's Online Dictionary* (defining "inimical" as "1: being adverse often by reason of malevolence or hostility . . . 2 a: having the disposition of an enemy . . . 2 b: reflecting or indicating hostility . . . .), available at http://www.merriam-webster.com/dictionary/inimical (as of Jun. 29, 2009).

such as the Piscataqua River, may not harm aquatic life (*i.e.*, "be inimical to" or contribute to "detrimental differences" from naturally occurring conditions) or undermine a water body's ability to support and maintain what would otherwise be the natural, balanced community of aquatic life in that water body.

In addition to these biologically-focused requirements, the NHWQS also address thermal discharges specifically. The state statute (N.H. Rev. Stat. Ann. § 485-A:8(II)) mandates, in pertinent part, that:

> [a]ny stream temperature increase associated with the discharge of treated sewage, waste or cooling water . . . shall not be such as to appreciably interfere with the uses assigned to this class. The waters of this classification shall be considered as being acceptable for fishing, swimming and other recreational purposes and, after adequate treatment, for use as water supplies.

In other words, Schiller Station's thermal discharges must not result in in-stream temperatures that "appreciably interfere" with fishing or other specified uses of the river. Furthermore, the State statute (N.H. Rev. Stat. Ann. § 485-A:8(VIII)) also provides that:

> [i]n prescribing minimum treatment provisions for thermal wastes discharged to interstate waters, the department shall adhere to the water quality requirements and recommendations of the New Hampshire Fish and Game Department, the New England Interstate Water Pollution Control Commission, or the United States Environmental Protection Agency, whichever requirements and recommendations provide the most effective level of thermal pollution control.

Given that Schiller Station discharges to an interstate water – namely, the Piscataqua River – this provision requires the NHDES to prescribe treatment requirements for thermal discharges that, at a minimum, adhere to the most effective of the water quality requirements and recommendations for thermal pollution control offered by EPA, NHFGD, and the New England Interstate Water Pollution Control Commission ("NEIWPCC").[3] The NHWQS regulations incorporate these statutory requirements as water quality criteria for ambient temperature, dictating that "[t]emperature in class B waters shall be in accordance with N.H. Rev. Stat. Ann. § 485-A:8, II, and VIII" (N.H. Code R. Env-Wq 1703.13(b)).

From the State water quality requirements discussed above, EPA distilled the following criteria to guide its determination of water quality-based permit limits:

> (a) thermal discharges may not be "inimical to aquatic life";
> (b) thermal discharges must provide, wherever attainable for the protection and propagation of fish, shellfish, and wildlife, and for recreation, in and on the receiving water;
> (c) thermal discharges may not contribute to the failure of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a

[3] (NEIWPCC does not presently review and make recommendations for thermal discharge limits to be included in individual NPDES permits and, thus, is not relevant here.)

species composition, diversity, and functional organization comparable to, and with only non-detrimental differences in community structure and function from, that of similar natural habitats in the region; and
(d) [a]ny stream temperature increase associated with thermal discharge must not appreciably interfere with fishing, swimming and other recreational purposes.

EPA has worked to determine thermal discharge limits that would be necessary to satisfy the NHWQS not only because of its obligations under CWA §§ 301(b)(1)(C) and 1341(a) and (d), but also in light of the above-discussed requirement in N.H. Rev. Stat. Ann. § 485-A:8(II) that NHDES must prescribe limits consistent with the water quality requirements and recommendations of EPA or NHFGD that yield the most effective thermal pollution control measures. In light of the latter requirement, EPA has coordinated with NHFGD and NHDES in considering water quality-based requirements and recommendations for thermal pollution control.

The State's water quality requirements also include requirements for the regulation and control of toxic constituents and require that EPA criteria, established pursuant to Section 304(a) of the CWA, shall be used unless a site-specific criterion is established. NPDES permit limits must be set to assure that these State WQS requirements will be satisfied in the waters receiving the permitted discharge. When using chemical-specific numeric criteria to develop permit limits, both the acute and chronic aquatic-life criteria, expressed in terms of maximum allowable in-stream pollutant concentration, are used. Acute aquatic-life criteria are considered applicable to daily time periods (maximum daily limit), while chronic aquatic-life criteria are considered applicable to monthly time periods (average monthly limit). Chemical-specific limits may be set under 40 C.F.R. § 122.44(d)(1) and are implemented under 40 C.F.R. § 122.45(d).

A facility's design flow is used when deriving constituent limits for daily, monthly or weekly time periods, as appropriate. Also, the dilution provided by the receiving water is factored into this process where appropriate. Narrative criteria from the State's water quality standards may apply to require limits on the toxicity in discharges where (a) a specific pollutant can be identified as causing or contributing to the toxicity but the State has no numeric standard, or (b) the toxicity cannot be traced to a specific pollutant.

Water quality-based effluent limitations are established based on a calculated dilution factor derived from the available dilution in the particular receiving water at the point of discharge. New Hampshire SWQR require that the available effluent dilution be calculated based upon the receiving water lowest observed mean river flow for seven consecutive days, recorded over a 10-year recurrence interval, or 7-day, 10-year low flow (7Q10). Env-Wq 1705.02(d). For tidal waters, New Hampshire SWQR require that the low flow condition shall be equivalent to the conditions that result in a dilution that is exceeded 99% of the time. Env-Wq 1505.02(c). Use of the low flow allows for the calculation of the available dilution under critical flow (worst-case) conditions which, in turn, can be used in the derivation of conservative water quality-based effluent limitations.

As stated above, NPDES permits must contain effluent limits more stringent than technology-based limits when necessary to maintain or achieve State WQS. The permit must address any pollutant or pollutant parameter (conventional, non-conventional, toxic and whole effluent toxicity) that is or may be discharged at a level that causes or has a "reasonable potential" to cause or contribute to an excursion above any water quality standard. *See* 40 C.F.R. §122.44(d)(1). An excursion occurs if the projected or actual in-stream concentration exceeds the applicable criterion or a narrative criterion or designated use is not satisfied. In determining reasonable potential, EPA considers a number of factors, including (a) existing controls on point and non-point sources of pollution; (b) pollutant concentration and variability in the effluent and receiving water as determined from the permit application, monthly DMRs, and State and Federal Water Quality Reports; (c) sensitivity of the species to toxicity testing; (d) known water quality impacts of processes on wastewater; and, where appropriate, (e) dilution of the effluent in the receiving water.

NHWQS also allow for "mixing zones." A mixing zone is an area in which a discharge may be allowed to cause exceedances of water quality standards, assuming a variety of specific criteria are satisfied, including that standards must be attained at the edge of the mixing zone. *See* Env-Wq 1702.27 and 1707.02).

Finally, the NHWQS also apply to NPDES permit requirements for CWISs that withdraw cooling water from the State's waters. This is discussed in greater detail below.

5.4 Section 316(a) of the Clean Water Act

Heat is defined as a pollutant under Section 502(6) of the CWA. 33 U.S.C. § 1362(6). As with other pollutants, discharges of heat (or "thermal discharges") must, in general, satisfy both technology-based standards (specifically, the BAT standard) and any more stringent water quality-based requirements that may apply. As stated above, technology-based limits for thermal discharges must be developed on a BPJ basis. New Hampshire's water quality requirements pertaining to the control of thermal discharges are discussed above.

Beyond technology-based and water quality-based requirements, CWA § 316(a), 33 U.S.C. § 1326(a), authorizes the permitting authority to grant a variance under which thermal discharge limits less stringent than technology-based and/or water quality-based requirements may be authorized if the biological criteria of Section 316(a) are satisfied.

To qualify for a variance under CWA § 316(a), a permit applicant must demonstrate to the permitting agency's satisfaction that thermal discharge limits based on technology and water quality standards would be more stringent than necessary to assure the protection and propagation of a balanced, indigenous population (BIP) of shellfish, fish and wildlife in and on the body of water into which the discharge is made. *See* 33 U.S.C. § 1326(a); 40 C.F.R. §§ 125.70, 125.73(a). The applicant must also show that its requested alternative thermal discharge limits will assure the protection and propagation of the BIP, considering the cumulative impact of its thermal discharge together with all other significant impacts on the species affected. 40 C.F.R. § 125.73(a). *See also* 33 U.S.C. § 1326(a); 40 C.F.R. §§ 125.73(c)(1)(i). If satisfied that the applicant has made such a demonstration, then the permitting authority may impose thermal discharge limits that, taking into account the interaction of the thermal discharge with other pollutants, will assure the protection and propagation of the BIP. *See* 33 U.S.C. § 1326(a); 40 C.F.R. §§ 125.70, 125.73(a) and (c)(1)(i).

While a new facility obviously must make a *prospective* demonstration that its desired future thermal discharges will assure the protection and propagation of the BIP, a facility with an existing thermal discharge can perform either a prospective or a retrospective demonstration in support of its request for a § 316(a) variance. If already operating under a CWA § 316(a) variance, "existing dischargers may base their demonstration upon the absence of prior appreciable harm in lieu of predictive studies." 40 C.F.R. § 125.73 (c)(1). Alternatively, even if there has been prior appreciable harm, the applicant may try to show that there will be no such harm going forward. 40 C.F.R. § 125.73 (c)(1)(ii).

As stated above, if the demonstration is satisfactory to the permitting authority, then it may issue a permit with alternative, variance-based thermal discharge limits. If the demonstration fails to support the requested variance-based thermal discharge limits, however, then the permitting authority shall deny the variance request. In that case, the permitting authority shall either impose limits based on the otherwise applicable technology-based and water quality-based requirements or, in its discretion, impose different variance-based thermal discharge limits that are justified by the permit record (*i.e.,* limits that satisfy the standards of CWA § 316(a)). *See In re Dominion Energy Brayton Point, LLC (Formerly USGen New England, Inc.) Brayton Point Station*, 12 E.A.D. 490, 500 n. 13, 534 n. 68, 552 n. 97 (EAB 2006). *See also* Section 6.5 below for further discussion of this matter.

In addition, it should be mentioned here that "mixing zones" may be used to set thermal discharge requirements pursuant to section § 316(a) of the Act. *See* EPA Decision of the General Counsel, In re Sierra Pacific Power Company, EPA GCO 31 (October 13, 1975). Although a "mixing zone" is a permitting concept or tool generally used in applying State water quality standards, *see* Section 5.3 above, the legislative history of CWA § 316(a) indicates that Congress felt mixing zones could also be used in designing permit limits based on a CWA § 316(a) variance from applicable technology standards. *Id*. This makes common sense in that limits could be designed in a particular case that allow a discharge to cause ambient temperatures or water quality criteria to be exceeded by a certain amount within a certain area on the grounds that the protection and propagation of the relevant BIP would nevertheless be assured. *See* 39 Fed. Reg. 36178 (October 8, 1974) (Preamble to EPA's earlier § 316(a) related regulations).

5.5 Requirements for Cooling Water Intake Structures under CWA § 316(b)

Schiller Station withdraws water from the Piscataqua River through two cooling water intake structures (CWISs). The Facility uses this water for cooling water in its process for producing electricity. Schiller Station's water withdrawals through its CWISs are subject to the requirements of CWA § 316(b). 33 U.S.C. § 1326(b). As discussed previously, CWA § 316(b) mandates that any standard set for a point source under CWA §§ 301 or 306 must "require that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact." This is referred to as the Best Technology Available (BTA) standard. The BTA standard is discussed in more detail in Section 7 below.

5.6 Antibacksliding

A permit may not be renewed, reissued or modified with less stringent limitations or conditions than those contained in the previous permit unless in compliance with the antibacksliding requirements of the CWA. *See* 33 U.S.C. § 1342(o); 40 C.F.R. § 122.44(l). These requirements prohibit new permit conditions from relaxing the requirements of earlier permit conditions, unless certain specified exceptions apply. Therefore, when developing new permit limits, EPA must determine whether the new limits under consideration would be less stringent than the corresponding limits in the prior permit and, if so, whether an exception to the antibacksliding requirements applies.

5.7 Antidegradation

Federal regulations related to state water quality standards, *see* 40 C.F.R. § 131.12, require states to develop and adopt a statewide antidegradation policy which maintains and protects existing instream water uses and the level of water quality necessary to protect them, and which generally maintains the quality of waters that have a quality exceeding the level necessary to support the propagation of fish, shellfish, and wildlife, and to support recreation in and on the water. The New Hampshire Antidegradation Regulations are found at Env-Wq 1708.

5.8 State Certification

Under Section 401(a)(1) of the CWA, 33 U.S.C. § 1341(a)(1), EPA is required to obtain certification from the state in which the discharge is located that the provisions of the new permit will comply with all state water quality standards and other applicable requirements of state law, in accordance with Section 301(b)(1)(C) of the CWA. 33 U.S.C. § 1311(b)(1)(C). *See also* 33 U.S.C. § 1341(d); 40 C.F.R. § 124.53. EPA permits are to include any conditions required in the state's certification as being necessary to ensure compliance with state water quality standards or other applicable requirements of state law. *See* 33 U.S.C. § 1341(d); 40 C.F.R. § 124.55(a)(2). Regulations governing state certification are set out at 40 C.F.R. §§ 124.53 and 124.55. EPA regulations pertaining to permit limits based upon water quality standards and state requirements are contained in 40 C.F.R. § 122.44(d).

6. Explanation of the Permit's Effluent Limitation(s)

6.1 Facility Information

Schiller Station is located on the southwestern bank of the Piscataqua River in Portsmouth, New Hampshire. *See* Attachment A for a map showing the geographical location of the facility and outfalls. The Station is a four-unit, 163 megawatt (MW) steam electric generating facility. The three main generators are designated as 4, 5, and 6; each rated at 48 MW. Units 4 and 6 are equipped with dual fuel boilers capable of firing both pulverized bituminous coal and #6 fuel oil. Unit 5 was converted in 2006 to a dual fuel fluidized bed boiler that is capable of burning both wood and coal, with wood being its primary fuel. The remaining unit, designated CT-1, is a 19-MW combustion turbine fired with #1 fuel oil that is typically operated during periods of highest seasonal peak demand.

The Facility withdraws water from the Piscataqua River via two separate CWISs located on the Piscataqua River to provide cooling water to Units 4, 5, and 6. The CWIS for Unit 4 draws water from an intake tunnel approximately 30 ft offshore from the north bulkhead (Screen House #1). The CWIS for Units 5 and 6 is located within the south bulkhead (Screen House #2). The two CWISs have a combined total maximum design intake flow of 150 million gallons per day (MGD).

Traveling water screens are automatically cleaned screening devices that are used to remove fish and/or floating or suspended debris from a channel of flowing water. In other words they are used to stop fish and other materials from being entrained by the CWIS (*i.e.*, drawn into the power plant through a CWIS along with the water being taken from the river for cooling). Of course, fish that are blocked by the screens are, by definition, impinged on the screens.

Schiller Station's traveling water screens consist of a continuous series of wire mesh panels bolted to frames and attached to two matched strands of roller chains. There is one traveling water screen for Unit 4 and four traveling water screens for Units 5 and 6. Each of the five traveling water screens is a REX (Chain Belt Company) screen. The fish and/or debris-laden mesh panels and shelves are lifted out of the flow and above the operating floor where a pressurized water spray is directed outward through the mesh to remove impinged fish and debris. The spray wash water and fish and/or debris are collected in a rectangular fish return trough which runs along the length of the CWIS and discharges all fish and debris into the Piscataqua River at an elevation of 4 ft above MSL.

River water is primarily used to cool the turbine exhaust steam in the condensers and provide cooling for the heat exchangers in the closed cooling service water systems. Both the condenser and the heat exchangers are non-contact systems. The cooling water bearing the Facility's waste heat is then discharged directly to the Piscataqua River via three outfalls (Outfalls 002, 003, 004).

All of Schiller Station's wastewater (excluding sanitary wastewater and non-contact cooling water) is collected in the Fireside Basin (FSB), which has a capacity of approximately 250,000 gallons and is divided into two equal sections connected by a partition and an overflow weir. The basin fills with wastewater which may contain any or all of the following: demineralized regeneration waste, effluent from the oil/water separator, ash handling runoffs and plant operation drains, dirty water sumps, boiler blowdowns, cooling water system drainage, and wood boiler drains. Wastewater treatment consists of the removal of oily residues and particulates and neutralization of wastewaters. The treated wastewater is discharged into the Piscataqua River through Outfalls 002, 003 and/or 004 along with the cooling water discharges from any operating unit or units.

A schematic drawing of the flow of water at the facility and the various discharges from the facility is presented in Attachment C.

6.2 Description of Permitted Outfalls

The table below lists and describes the facility's outfalls:

Table 6-A: Schiller Station's Outfall Locations

Outfall Number/Location	Description
001 - Weir discharge structure into Piscataqua River	Non-contact cooling water from one of the three operating unit intakes; small portion of roof and yard drains; rarely active
002 - Weir discharge structure into Piscataqua River	Non-contact cooling water discharges and occasional hotwell drains for Unit 4
003 - Weir discharge structure into Piscataqua River	Non-contact cooling water discharges and occasional hotwell drains for Unit 5
004 - Weir discharge structure into Piscataqua River	Non-contact cooling water discharges and occasional hotwell drains for Unit 6
006 - Discharges into Piscataqua River	Six pipes, two from each of the three units; used only for brief equipment overflows usually related to a unit upset; roof drains
011 – Discharges from tank farm into Piscataqua River	Combination of stormwater and heater condensate drains from the Schiller Station Tank Farm
013 - Internal outfall (discharges into 018)	Coal pile runoff basin; emergency overflow
015 - Weir discharge structure into Piscataqua River	Treated effluent from WWTP #1; only operated during essential maintenance of WWTP #2; rarely active
016 - Internal outfall (discharges into cooling water outfalls 002/003/004)	Treated effluent from WWTP #2
017- Internal outfall (discharges into cooling water outfalls 002/003/004)	Identical to 016; only active when metal cleaning wastes are being treated and discharged
018 - Discharges from tank farm into Piscataqua River	Stormwater runoff and heater condensate drips from Newington Station Tank Farm through valved oil/water separator; roof drains
020 - Intake screen spray wash	Initial screen wash to return marine life back to the river; serves Unit 4
021/022 - Intake screen spray wash	Initial screen wash to return marine life back to the river; serves Units 5 and 6 (combined into a single outfall referred to as Outfall 021, eliminating 022)
023 – Parking lot containing two chemical loading zones into the Piscataqua River	Occasional stormwater runoff from a parking lot used for chemical loading and/or unloading

Outfall 001

Effluent discharged from Outfall 001 consists predominantly of non-contact cooling water that is supplied from one of the three operating intakes. The piping for this outfall can also be valved to return the water to one of the operating cooling water systems (Outfall 002) if the facility encounters access issues to the Outfall 001 weir (e.g., winter conditions). The water cools miscellaneous plant equipment such as the influent to the oil/water separator and air compressors. A small portion of the station roof drains and a yard drain also tie into the discharge. While water may occasionally be treated with sodium hypochlorite, the concentrations are regulated by effluent limitations assigned to Units 4, 5, and 6. The maximum daily mass value reported for total residual chlorine (0.4 pounds) represents a maximum concentration of 0.2 mg/l for a two hour chlorination cycle. Ferrous sulfate is no longer used. The temperature rise is less than 5°F. Monitoring for all pollutants is performed at the discharge weir. When available, flow is calculated from a ruler measurement taken at the overflow of the weir outfall. PSNH requests that monitoring be reduced to quarterly oil and grease and flow sampling only.

Outfalls 002, 003, and 004

These outfalls represent the non-contact cooling water discharges and occasional hotwell drain discharges for Units 4, 5, and 6, respectively. Each unit is treated with sodium hypochlorite for a maximum of two hours each day of operation. The maximum daily mass value reported for total residual chlorine (6.0 pounds) represents a maximum concentration of 0.2 mg/l for a two-hour chlorination cycle. Inlet temperatures are measured at the legs feeding into the condenser and outlet temperatures are measured in the discharge legs or at the weir outfall. Flows are based upon pump run times. Ferrous sulfate is no longer used. PSNH has requested that the temperature limits be increased from 95°F/25°C to 100°F/30°C.

Outfall 006

This outfall actually consists of six pipes, two from each of the three units. With the exception of roof drains, the outfall is only used on the rare occasion when there is a brief equipment overflow, usually related to a unit upset. The effluent consists of boiler condensate that can be released from events such as steam blowdowns or a deaerator overflow during a unit startup or a boiler trip. Occasionally the outfall must be activated to perform essential maintenance to blowdown tanks or piping that transfer the water to waste treatment. Except for stormwater, the pipes will typically discharge only a few days per year for less than one hour per event. When the outfall is activated, the pH of the boiler condensate is reported and flow is estimated. PSNH requests no changes to the existing monitoring requirements and permit conditions.

Outfall 011

Effluent consists of a combination of stormwater and heater condensate drains from the Schiller Station Tank Farm. The Schiller Tank Farm consist of two tanks designated as SR #2 and SR #3. SR #2 has a capacity of 80,000 barrels (bbls) and SR #3 has a capacity of 125,000 bbls. Both contain #6 oil only. The #6 oil arrives by ship or barge and can be pumped directly into the Schiller tanks or can be pumped to the Newington tanks and then transferred to the

Schiller tanks. Samples for Outfall 011 can be collected from the end of one of three different pipes that discharge stormwater from the tank farm. Rainfall pH is also recorded to compare to effluent readings. Based upon historical compliance, PSNH requests the monitoring frequency be reduced to quarterly and the pH sampling be reduced to a single grab from any of the three pipes. Flows are estimated based upon drainage area, rainfall and steam used. Given the size of the drainage area, PSNH requests the flow limits be increased from 115,000/230,000 gpd to 300,000/600,000 gpd to accommodate a 10-year, 24-hour storm event of 4.6 inches.

Internal Outfall 013

Outfall 013 discharges emergency overflow (e.g., 10-year, 24-hour storm) from the coal pile runoff basin into Outfall 018. Schiller's normal non-emergency coal pile runoff can be transferred from the collection basin to either the fireside basin or directly to the wastewater treatment facility. This discharge was not regulated in the 1990 permit but flow was estimated and reported, when in use.

Outfall 015

Outfall 015 is treated effluent from WWTP #1 which is only operated during essential maintenance of WWTP #2. Samples are collected at the discharge from the neutralization tank. The outfall has not been necessary for the last several years. PSNH requests no changes to the existing monitoring requirements and permit conditions.

Internal Outfall 016

Outfall 016 is the WWTP #2 discharge during routine operations. It includes mostly all station wastewater which consists principally of demineralizer regenerations, boiler blowdown, coal pile runoff and equipment and floor drains. The treated effluent is pumped to any one of the three operating units and mixed and discharged with the non-contact cooling water (Outfalls 002, 003, or 004). Samples are collected weekly at the discharge from the neutralization tank while flow and pH are recorded continuously. Flow, total suspended solids, oil and grease, copper, iron, and pH are monitored and reported. Based on the historical compliance record, PSNH requests the monitoring frequency for oil and grease, total suspended solids, iron and copper for Outfall 016 be reduced to monthly.

Internal Outfall 017

Outfall 017 is identical to 016. It is only active, however, when boiler chemical cleaning wastes (water side metal cleanings) are being treated and discharged. This happens approximately once every 10 years for each boiler. Under worst case conditions, each boiler will be chemically cleaned once during the 5-year life of the NPDES permit. The same parameters are monitored as for Outfall 016, only on a daily basis. Only one discharge was recorded since 1990 due to the infrequency of chemical cleanings and the ability to evaporate the wastewater in the boilers.

Outfall 018

Effluent consists partially of stormwater and heater condensate drips from the Newington Tank

Farm that drain through a valved oil/water separator. The remainder of the discharge is stormwater runoff from the Schiller Station wood storage yard and other yard drainage areas. The Newington Tank Farm consists of two tanks designated as NT #1 and NT #2. Both NT #1 and NT #2 have a capacity of 278,800 bbls. Both contain #6 oil only. The #6 oil arrives by ship or barge and is pumped directly into the Newington tanks. Outfall 018 effluent samples are collected at the final catch basin before piping drops below ground. Roof drains from the Unit 5 wood boiler and WWTP #2 are piped in downstream from the monitoring location. Flows are estimated based upon the time of discharge from the oil/water separator, drainage area, rainfall and steam used. Rainfall pH is also recorded to compare to effluent readings. Based upon historical compliance, PSNH requests that the monitoring frequency be reduced to quarterly and the pH sampling be reduced to a single grab.

Outfalls 020, 021/022

These outfalls represent river water that is used to backwash the rotating screens in the cooling water intake structures (CWIS). The screens remove river debris and require regular cleaning to ensure unrestricted water passage. This is accomplished by spraying water through the screens and sluicing the leaves, branches, etc. back into the river. The regularity of washing is dependent upon river conditions. Worst case, the wash could occur six hours in a day with a pump rated at 300 gpm. Outfall 020 serves Unit 4, 021 serves Unit 5 and 022 discharges from Unit 6. Since Outfalls 021 and 022 actually discharge from the same location, PSNH requests they be combined into a single outfall. Flows are estimated based upon pump run times.

There are a few other inconsequential discharges associated with the operation of the CWIS. The discharges are relatively minor and present little or no additional loading to the river. Most of the water is discharged down into the screen wells and pumped back into the station condensers. The flows have never been quantified and no samples have been collected. PSNH requests the activities be cited in the permit to allow the operations to continue. This summary of the discharges is provided:

- Floor Sump in #2 CWIS: Includes routine water leakage from pump seals, river water, etc.
- Stormwater: Both CWIS discharge roof drains and the #2 Screenhouse receives a considerable amount of rainwater via a pipe trench that enters the building.
- Screenwell/Inlet Tunnel Drain: On rare occasions the screenwells and tunnels are dewatered to permit routine inspection and maintenance. This activity requires the inlet water to be drained and eventually pumped back into the river.
- Steam Drips: In cold weather station steam is used to heat the screenhouses and is sprayed on the screens to prevent them from freezing.
- Fire Pumps: Located in #2 CWIS, these pumps must be tested annually for approximately one hour and water is sprayed directly into the river. Each pump is rated at 3,000 gpm.

Outfalls 023

This is a new outfall consisting of occasional stormwater runoff from a parking lot used for chemical loading and/or unloading. Although this is a stormwater related discharge, PSNH requested that this outfall be regulated in the draft permit.

Refer to Attachment B for a quantitative summary of the discharge from outfalls 001 through 022 for the period November 1990 through April 2014.

6.3 Derivation of Effluent Limits under the CWA and/or State of New Hampshire Water Quality Standards

6.3.1 Outfall 001

PCB's

40 CFR § 423.12(b)(2) prohibits the discharge of polychlorinated biphenyl (PCB) compounds. Therefore, the draft permit prohibits discharges of PCBs.

Total Residual Oxidants

The National Effluent Limitation Guidelines for the Steam Electric Power Generating Point Source Category ("Steam Electric ELGs"), *see* 40 C.F.R. Part 423, state that for any plant with a total rated electric generating capacity of 25 or more megawatts ("MW"), the quantity of total residual oxidants (TRO) discharged in once-through cooling water from each discharge point may not exceed the quantity determined by multiplying the flow of once-through cooling water from each discharge point by a concentration of 0.2 mg/l (maximum) (*see* 40 C.F.R. § 423.13(b)(1)). This limit is expressed in the draft permit in terms of concentration (0.2 mg/l), pursuant to 40 C.F.R. § 423.13(g), and satisfies antibacksliding requirements in 40 CFR § 122.44(l).

40 C.F.R. § 423.13(b)(2) prohibits the discharge of TRO from any single generating unit for more than two hours per day unless the discharger demonstrates to the permitting authority that more than two hours of discharge is required for macroinvertebrate control. Simultaneous multi-unit chlorination is permitted.

Under the Steam Electric ELGs, the term "maximum concentration" means a limitation not to be exceeded at any time (*i.e.*, "instantaneous maximum"). The TRO limitations in the guidelines are specified as "maximum concentration" limits and not as "daily maximum" limits. After promulgation of the Steam Electric ELGs in 1982, *see* 40 C.F.R. Part 423, EPA was asked to clarify the correct interpretation of the term "maximum concentration". EPA studied this issue and, in 1992, issued guidance in the form of a memorandum to all the Regional Water Management Division Directors. The 1992 guidance explains that the term "maximum concentration", as it applies to TRO, is intended to mean "instantaneous maximum".

Furthermore, for the draft permit, chlorine may be used as a biocide. No other biocide shall be used without written approval from the Regional Administrator and the Director.

Ferrous Sulfate

Ferrous sulfate is no longer used in this waste stream. Hence, monitoring for ferrous sulfate at this outfall has been removed and its discharge is prohibited.

Flow

In the 1990 permit, the flow limit at this outfall was 40 MGD. This limit is carried forward in the draft permit. Based upon infrequent use of this outfall and the request of PSNH, monitoring is only required once per quarter, as specified in the draft permit.

Oil & Grease

This outfall discharges a co-mingled wastewater including non-contact cooling water for miscellaneous plant equipment such as the influent to the oil/water separator and air compressors, as well as occasional stormwater from roof and yard drains. In the 1990 permit, this waste stream was regulated for Oil & Grease (O&G) based on low volume waste requirements found at 40 C.F.R. § 423.12(b)(3). In the current draft permit, based on antibacksliding requirements found at 40 CFR § 122.44(l), O&G limits will remain the same. These limits are shown in the table below.

Pollutant	Maximum For Any 1 Day (mg/L)	Average of Daily Values For 30 Consecutive Days Shall Not Exceed (mg/L)
O&G	20.0	15.0

Temperature

The permit limits on thermal discharges from this and other outfalls are discussed below in Section 6.4 of this Fact Sheet.

6.3.2 Outfalls 002, 003 and 004

PCB's

As stated above, 40 C.F.R. § 423.12(b)(2) prohibits the discharge of polychlorinated biphenyl (PCB) compounds. Therefore, the draft permit prohibits the discharge of PCBs.

Total Residual Oxidants

The Steam Electric ELGs state that for any plant with a total rated electric generating capacity of 25 MW or more, the quantity of TRO discharged in once through cooling water from each discharge point shall not exceed the amount determined by multiplying the flow of once-through cooling water from each discharge point by a concentration of 0.2 mg/l (maximum). This limit is expressed in the draft permit in terms of concentration, pursuant to 40 C.F.R. § 423.13(g), and satisfies antibacksliding requirements found in 40 CFR §122.44(l).

In addition, 40 C.F.R. § 423.13(b)(2) prohibits the discharge of TRO from any single generating unit for more than two hours per day unless the discharger demonstrates to the permitting authority that discharge for more than two hours is required for macroinvertebrate control. Simultaneous multi-unit chlorination is permitted.

As stated above, TRO limits in the Steam Electric ELGs are specified as "maximum concentration" limits (not "daily maximum" limits). As also explained above, under the Steam Electric ELGs, the term “maximum concentration” means a limitation not to be exceeded at any time (*i.e.*, “instantaneous maximum”).

Furthermore, for the draft permit, chlorine may be used as a biocide. No other biocide shall be used without written approval from the Regional Administrator and the Director.

Ferrous Sulfate

Ferrous sulfate is no longer used in this waste stream. Hence, monitoring for ferrous sulfate at this outfall has been removed and its discharge is prohibited.

Flow

In the 1990 permit, flow limits for Outfalls 002, 003 and 004 were as follows:

Outfall	Flow limits (MGD)	
	Monthly Average	Daily Max
002	43.5	52.2
003	50.2	50.2
004	50.2	50.2

These flow limits have been carried forward in the draft permit.

Temperature

The permit limits on thermal discharges from this and other outfalls are discussed below in Section 6.4 of this Fact Sheet.

6.3.3 Outfall 006

Flow

As in the 1990 permit, the permittee is required to report daily maximum flow from this outfall each month.

Total Suspended Solids and Oil & Grease

This outfall discharges effluent from roof drains and brief equipment overflows, usually related to a unit upset. More specifically, the effluent consists of boiler condensate that can be released from events such as steam blowdowns or de-aerator overflow during a unit startup or a boiler trip. Occasionally the outfall must be activated to perform essential maintenance on blowdown tanks or piping that transfers water to waste treatment. EPA has determined that this discharge contains "low volume waste" (boiler blowdown), as defined in 40 CFR § 423.11(b). Hence, Oil and Grease (O&G) and Total Suspended Solids (TSS) limits are being established in the draft permit based on the limits set in the Steam Electric ELGs for low volume wastes ((*see* 40 C.F.R. § Part 423.12(b)(3)). These limits from the Steam Electric ELGs are based on "the best practicable control technology currently available" ("BPT") standard; and benchmark values for stormwater (*see* 65 Fed. Reg. 64767).

The ELGs specified in 40 C.F.R. § 423.12(b)(3) limit the maximum and average concentration of TSS and O&G discharged in low volume waste as shown below. The quantity of pollutant (mass limit) is determined by multiplying the flow of the low volume waste source by the concentration listed in the table. The limits in the draft permit are expressed as concentration-based limits pursuant to Section 423.12(b)(11). Effluent subject to these limits must be monitored prior to mixing with effluent from any other outfall.

Pollutant	Maximum For Any 1 Day (mg/L)	Average of Daily Values For 30 Consecutive Days Shall Not Exceed (mg/L)
TSS	100.0	30.0
O&G	20.0	15.0

pH

The limit for pH is based upon State Certification Requirements and RSA 485-A:8, which states that "The pH range for said (Class B) waters shall be 6.5 to 8.0 except when due to natural causes." These water quality-based limits are more stringent than the limits of 6.0 to 9.0 standard units ("S.U.") provided in the Steam Electric ELGs (*see* 40 C.F.R. § 423.12(b)(1)).

The draft permit includes a provision allowing a relaxation of the pH limits if the permittee performs an in-stream dilution study that demonstrates that the in-stream standards for pH would be protected. If the State approves results from a pH demonstration study, this permit's pH limit range may be relaxed. The notification of the relaxation must be made by certified letter to the permittee from EPA-New England. The pH limit range cannot be less restrictive than 6.0 - 9.0 S.U., however, which are the limitations in the Steam Electric ELGs.

Historic discharges from this outfall, although rare, have not consistently been in compliance with the upper pH limit of 8.0 S.U. Since the 1990 permit issuance, there have been 18 exceedances out of 23 pH measurements. PSNH must take necessary action to prevent future discharges from Outfall 006 exceeding the pH limits. One option may be to route this wastewater to the on-site WWTP for pH neutralization prior to discharge. Subsequent discharge would then be monitored through Outfall 016.

Nitrogen

Great Bay and many of the rivers that feed it are approaching, or have reached, their assimilative capacity for nitrogen and are suffering from the adverse water quality impacts of nutrient overenrichment. The impacts of excessive nutrients are evident throughout the Great Bay Estuary, including the Piscataqua River. A portion of Schiller Station's discharge is transported upstream on the incoming tide into the nitrogen-impaired waters of the Lower Piscataqua and Upper Piscataqua River, Little Bay, and even into Great Bay proper. Therefore, the assessment of the impact of the Facility's discharge on water quality includes all of these waters.

Section 303(d) of the Clean Water Act (CWA) requires states to identify those waterbodies that are not expected to meet surface water quality standards after implementation of technology-based controls. As a result of the documented water quality impairments, portions of the Great Bay Estuary, including its tributaries, have been included on the State of New Hampshire's Section 303(d) list. As mentioned previously, New Hampshire's 2012 Section 303(d) list includes the Lower Piscataqua River - South (Assessment Unit ID: NHEST600031001-02-02). This assessment unit is listed as not supporting aquatic life as a result of estuarine bioassessments. These regulatory findings are consistent with a growing body of technical and scientific literature pointing toward an estuary in environmental decline as a result of nutrient overloading.

Given the nutrient overenrichment throughout the Great Bay estuary, it is clear that significant point source and non-point source reductions are necessary in order to achieve water quality standards. Section 301 of the CWA and its implementation regulations obligate EPA to establish water quality based effluent limits for outfalls that may cause or contribute to a violation of water quality standards. EPA and NHDES's shared preference is to address all sources of nutrient pollution to the Great Bay estuary—both point source loading and the far greater component of non-point source loading—in a coordinated and comprehensive fashion, to the extent possible.

The September 2010 permit reapplication submitted by PSNH indicated that various outfalls contained low concentrations of nitrogen in various species. For example, the discharge sampled from Outfall 006 contained 0.9 mg/l of ammonia nitrogen, Outfall 011 contained 0.33 mg/l of nitrate/nitrite nitrogen, Outfall 016 contained 0.32 mg/l nitrate/nitrite nitrogen and 1.2 mg/l total organic nitrogen and Outfall 018 contained 0.32 mg/l of nitrate/nitrite nitrogen. In this case, EPA has determined that the Best Management Practices (BMPs) required in the Stormwater Pollution Prevention Plan (SWPPP) included in the draft permit are expected to reduce total nitrogen levels to a degree necessary to ensure that Schiller Station does not cause or contribute to a water quality standard violation. In developing these BMPs specifically for this permit, EPA has been informed by the BMPs designed to reduce nitrogen in stormwater discharges found in the 2015 draft New Hampshire small MS4 permit. Additionally, a quarterly monitoring requirement for total nitrogen has been established for this outfall in the draft permit in order to track the effectiveness of the BMPs.

6.3.4 Outfall 011

Flow

In the 1990 permit, the flow limits at this outfall were 115,000 gpd (monthly average) and 230,000 gpd (daily max). Based on the size of the drainage area contributing to this outfall, PSNH requests the flow limits be increased to 300,000/600,000 gpd to accommodate a 10-year, 24-hour storm event of 4.6 inches.

EPA calculated an average discharge flow of 360,000 gpd based on an estimated drainage area of 125,000 square feet and a 4.6 inch rain event. Based upon this calculation, EPA agrees that the flow increase is justified. It was also determined that the increase in flow would neither affect the designated uses of the river nor violate the State's anti-degradation policy. Flow in the Piscataqua River is dominated by tidal exchange. The tidal prism of the Piscataqua River Estuary has been estimated to total approximately 25,000 MGD (see Newington Power Facility NPDES Permit Application, July 1998, p 5-5). A discharge flow of 600,000 gpd represents a fraction (0.0024 %) of the tidal prism volume. Based upon this, EPA has granted the flow increase, as reflected in the draft permit.

Total Suspended Solids and Oil & Grease

This outfall consists of co-mingled discharge of heater condensate drains from the Schiller Station Tank Farm as well as occasional stormwater runoff. Based upon the 1990 permit, this waste stream was regulated for Oil & Grease (O&G). In the draft permit, Total Suspended Solids (TSS) limits are being established based on the BPT limits for low volume waste source(s) established in the Steam Electric ELGs (*see* 40 CFR § 423.12(b)(3)); and benchmark values for stormwater (*see* 65 Fed. Reg. 64767).

The Steam Electric ELGs (*see Section* 423.12(b)(3)) limit the maximum and average concentration of TSS and O&G discharged from low volume waste source(s) as shown below. The quantity of pollutant (mass limit) is determined by multiplying the flow of low volume waste sources times the concentration listed in the table. The limits in the 1990 permit and draft permit are expressed as concentration-based limits pursuant to Section 423.12(b)(11). The permit reflects these limits which must be measured prior to mixing with any other outfall.

Pollutant	Maximum For Any 1 Day (mg/L)	Average of Daily Values For 30 Consecutive Days Shall Not Exceed (mg/L)
TSS	100.0	30.0
O&G	20.0	15.0

pH

The limit for pH is based upon State Certification Requirements and RSA 485-A:8, which states that "[t]he pH range for said (Class B) waters shall be 6.5 to 8.0 except when due to natural causes."

The draft permit includes a provision allowing a relaxation of the pH limits if the permittee performs an in-stream dilution study that demonstrates that the in-stream standards for pH would be protected. If the State approves results from a pH demonstration study, this permit's pH limit range may be relaxed. The notification of the relaxation must be made by certified letter to the permittee from EPA-Region 1. The pH limit range cannot be less restrictive than 6.0 - 9.0 S.U., which are the technology-based limitations included in the applicable Steam Electric ELGs for the facility.

PSNH requested that the pH sampling be reduced to a single grab from any of the three pipes. EPA has granted this request, as reflected in the draft permit.

Rain pH

Rainfall pH must continue to be monitored and reported in order to compare to effluent pH readings.

Based upon historical compliance, PSNH requests the monitoring frequency at this outfall be reduced to quarterly. EPA has granted this request, as reflected in the draft permit.

Polynuclear Aromatic Hydrocarbons (PAHs)

PAHs are a group of organic compounds that form through the incomplete combustion of hydrocarbons. PAHs are also present in crude oil and some heavier petroleum derivatives and residuals such as No. 6 fuel oil. Discharge of these products can introduce PAHs into the environment where they strongly adsorb to suspended particulates and biota. PAHs can also bio-accumulate in fish and shellfish. The ultimate fate of those PAHs which accumulate in the environment is believed to be biodegradation and biotransformation by benthic organisms. Several PAHs are well known animal carcinogens, while others are not carcinogenic alone but can enhance the response of the carcinogenic PAHs.

There are 16 PAH compounds identified as priority pollutants under the CWA (*see* Appendix A to 40 C.F.R. Part 423). In view of evidence of PAH-induced animal carcinogenicity and the type of petroleum products stored at the facility, the draft permit establishes monitoring requirements, without limits, for these Group I and II PAHs, as listed below.

Group 1 PAHs comprise seven known animal carcinogens:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Chrysene
- Dibenzo(a,h)anthracene
- Indeno(1,2,3-cd)pyrene

Quarterly monitoring of the above Group I PAHs, without limits, is required.

Group II PAHs comprise nine priority pollutants which are not considered carcinogenic alone, but which can enhance or inhibit the response of the carcinogenic PAHs:

- Acenaphthene
- Acenaphthylene
- Anthracene
- Benzo(g,h,i)perylene
- Fluoranthene
- Fluorene
- Napthalene
- Phenanthrene
- Pyrene

Quarterly monitoring of the above Group II PAHs, without limits, is required. Of these, naphthalene is considered an important limiting pollutant parameter based upon its prevalence in petroleum products and its toxicity (i.e., naphthalene has been identified as a possible human carcinogen).

For the maximum protection of human health from the potential carcinogenic effects of exposure to PAHs through ingestion of contaminated water and contaminated aquatic organisms, EPA established human health “organism only” *National Recommended Water Quality Criteria* for individual PAH compounds based on the increase of cancer risk over the lifetime and consumption of contaminated fish. The human health criteria for Group I PAHs were established in ng/L, which is many orders of magnitude below the current Practical Quantitation Limits (PQLs) for determining PAH concentrations in aqueous solutions.

The draft permit also requires that the quantitative methodology used for PAH analysis must achieve a minimum level for analysis (“ML”) using approved analytical methods in 40 C.F.R. Part 136. The ML is not the minimum level of detection, but rather the lowest level at which the test equipment produces a recognizable signal and acceptable calibration point for an analyte, representative of the lowest concentration at which an analyte can be measured with a known level of confidence. The ML for each Group I PAH compound must be <0.1 µg/L. The ML for each Group II PAH compound must be <1 µg/L. These MLs are based on those listed in Appendix VI of EPA’s Remediation General Permit. Sample results for an individual compound that is at or below the ML should be reported according to the latest EPA Region 1 *NPDES Permit Program Instructions for the Discharge Monitoring Report Forms (DMRs)*. These values may be reduced by modification pursuant to 40 CFR §122.62 as more sensitive tests become available or are approved by EPA and the State.

EPA believes these requirements are necessary for the protection of human health, to maintain the water quality standards established under Section 303 of the CWA, and to meet New Hampshire’s water quality criteria. Should monitoring data indicate the presence of PAHs in concentrations that may cause or contribute to an excursion above water quality criteria, the permit may be modified, reissued or revoked pursuant to 40 CFR §122.62. Should monitoring indicate PAHs are not detected (using the proper MLs described above) over the first two years of the permit cycle, the permittee may request a reduction in monitoring frequency.

Nitrogen

As described in section 6.3.3 above, many segments of the Great Bay estuary, including the Piscataqua River, are approaching, or have reached, their assimilative capacity for nitrogen and are suffering from the adverse water quality impacts of nutrient overenrichment. Hence, it is clear that significant point source and non-point source reductions are necessary in order to achieve water quality standards.

The September 2010 permit reapplication submitted by PSNH indicated that Outfall 011 contained low concentrations of nitrate/nitrite nitrogen (0.33 mg/l). In this case, EPA has determined that the Best Management Practices (BMPs) required in the Stormwater Pollution Prevention Plan (SWPPP) included in the draft permit are expected to reduce total nitrogen levels to a degree necessary to ensure that Schiller Station does not cause or contribute to a water quality standard violation. In developing these BMPs specifically for this permit, EPA has been informed by the BMPs designed to reduce nitrogen in stormwater discharges found in the 2015 draft New Hampshire small MS4 permit. Additionally, a quarterly monitoring requirement for total nitrogen has been established for this outfall in the draft permit in order to track the effectiveness of the BMPs.

6.3.5 Internal Outfall 013

TSS

As previously stated, Internal Outfall 013 discharges emergency overflow from the coal pile runoff basin into Outfall 018. According to 40 CFR § 423.12(b)(9), any point source discharges of coal pile runoff shall be subject to the BPT effluent limitation for TSS of 50 mg/l as a maximum concentration. However, according to 40 CFR § 423.12(b)(10), any untreated overflow from facilities designed, constructed, and operated to treat the volume of coal pile runoff which is associated with a 10-year, 24-hour rainfall event shall not be subject to the limitations in paragraph (b)(9) of this section. Hence, no TSS limit is included in the draft permit.

Flow, pH and Rainfall pH

Additionally, the permittee is required to annually estimate the flow and monitor both effluent pH and rainfall pH each month. These requirements were included in the 1990 permit.

6.3.6 Outfall 015

Flow

In the 1990 permit, the flow limits at this outfall were 61,800 gpd (monthly average) and 85,300 gpd (daily max). These limits are carried forward in the draft permit.

Total Suspended Solids and Oil & Grease

Discharges from this outfall consist of treated effluent from WWTF #1 which treats various low volume waste streams. This WWTF is rarely operated. Based upon the 1990 permit, this waste stream was regulated for Oil & Grease (O&G). In the draft permit, Total Suspended Solids (TSS) limits are also being established based on BPT limits established in the Steam Electric ELGs (*see* 40 CFR § 423.12(b)(3)) for low volume waste source(s).

The Steam Electric ELGs (*see* 40 C.F.R. § 423.12(b)(3)) limit the maximum and average concentration of TSS and O&G discharged from low volume waste source(s) as shown below. The quantity of pollutant (mass limit) is determined by multiplying the flow of the low volume waste source(s) times the concentration listed in the table. The limits in the 1990 permit and the draft permit are expressed as concentration-based limits pursuant to 40 C.F.R. § Section 423.12(b)(11). The permit reflects these limits and the discharge must be monitored for compliance prior to mixing with the discharge from any other outfall.

Pollutant	Maximum for Any 1 Day (mg/l)	Average of Daily Values for 30 Consecutive Days Shall Not Exceed (mg/l)
TSS	100.0	30.0
O&G	20.0	15.0

pH

The limit for pH is based upon State Certification Requirements and RSA 485-A:8, which states that "The pH range for said (Class B) waters shall be 6.5 to 8.0 except when due to natural causes."

The draft permit includes a provision allowing a relaxation of the pH limits if the permittee performs an in-stream dilution study that demonstrates that the in-stream standards for pH would be protected. If the State approves results from a pH demonstration study, this permit's pH limit range may be relaxed. The notification of the relaxation must be made by certified letter to the permittee from EPA-Region 1. The pH limit range cannot, however, be made less restrictive than the 6.0 - 9.0 S.U. limitations included in the applicable Steam Electric ELGs for the facility.

6.3.7 Internal Outfall 016

Flow

In the 1990 permit, the flow limits at this outfall were 216,000 gpd (monthly average) and 360,000 gpd (daily max). These limits are carried forward in the draft permit.

Segregation of Non-Chemical Metal Cleaning Wastewater Stream

This outfall no longer allows discharge of non-chemical metal cleaning waste. Hence, Outfall 016 no longer contains limits for copper or iron which were only required as technology-based requirements for discharges containing metal cleaning waste. Refer to section 6.3.8 below for a description of internal outfall 017 which now applies to the discharge of all treated chemical and non-chemical metal cleaning waste.

Total Suspended Solids and Oil & Grease

The draft permit limits for Total Suspended Solids (TSS) and Oil and Grease (O&G) are based on the 1990 permit in accordance with the antibacksliding requirements of 40 C.F.R. § 122.44. These limits were originally established based on BPT limits in the Steam Electric ELGs (see 40 C.F.R. § 423.12(b)(3)) for low volume waste source(s).

The Steam Electric ELGs (*see* 40 C.F.R. § 423.12(b)(3)) limit the maximum and average concentration of TSS and O&G discharged by low volume waste source(s) as shown below. The quantity of pollutant (mass limit) is determined by multiplying the flow from low volume waste sources times the concentration listed in the table. The limits in the 1990 permit and draft permit are expressed as concentration-based limits pursuant to 40 C.F.R. § 423.12(b)(11)). The permit reflects these limits which must be measured prior to mixing with any other outfall.

Pollutant	Maximum For Any 1 Day (mg/L)	Average of Daily Values For 30 Consecutive Days Shall Not Exceed (mg/L)
TSS	100.0	30.0
O&G	20.0	15.0

Based upon the historical compliance record and the request of PSNH, monitoring for these pollutants is required monthly.

pH

The limit for pH is 6.0 - 9.0 S.U., which are the limitations included in the applicable Steam Electric ELGs for the facility.

Nitrogen

As described in section 6.3.3 above, many segments of the Great Bay estuary, including the Piscataqua River, are approaching, or have reached, their assimilative capacity for nitrogen and are suffering from the adverse water quality impacts of nutrient overenrichment. Hence, it is clear that significant point source and non-point source reductions are necessary in order to achieve water quality standards.

The September 2010 permit reapplication submitted by PSNH indicated that Outfall 016 contained low concentrations of nitrate/nitrite nitrogen (0.32 mg/l) as well as total organic nitrogen (1.2 mg/l). In this case, EPA has determined that the Best Management Practices (BMPs) required in the Stormwater Pollution Prevention Plan (SWPPP) included in the draft permit are expected to reduce total nitrogen levels to a degree necessary to ensure that Schiller Station does not cause or contribute to a water quality standard violation. In developing these

BMPs specifically for this permit, EPA has been informed by the BMPs designed to reduce nitrogen in stormwater discharges found in the 2015 draft New Hampshire small MS4 permit. Additionally, a quarterly monitoring requirement for total nitrogen has been established for this outfall in the draft permit in order to track the effectiveness of the BMPs.

6.3.8 Internal Outfall 017

Flow

In the 1990 permit, the flow limit at this outfall was 360,000 gpd (daily max). This limit is carried forward in the draft permit.

Additionally, a reporting requirement for monthly average flow has been added since Outfall 017 now includes the discharge of non-chemical metal cleaning waste (see below). Since there is no historical flow data to categorize the average monthly flow of non-chemical metal cleaning waste, EPA has decided that the draft permit should require the monthly average flow to be reported. For the next permit cycle, when sufficient data has been gathered, EPA will determine if a monthly average flow limit is warranted. EPA considers this approach appropriate since, among other reasons, Outfall 017's limits are technology-based and not water quality-based. (The derivation of water quality-based limits would depend on the discharge's flow rate.)

TSS, O&G, Copper and Iron

The draft permit limits for TSS, O&G, copper and iron are based on the 1990 permit in accordance with the antibacksliding requirements of 40 C.F.R. § 122.44. These limits were originally based on BPT limitations established in the Steam Electric ELGs (*see* 40 C.F.R. § 423.12(b)(5) for metal cleaning wastes). Since the discharge at Outfall 017 was specified as "chemical" metal cleaning waste, the same limits for copper and iron were also confirmed by BAT limits established in the Steam Electric ELGs (*see* 40 C.F.R. § 423.13(e)) for chemical metal cleaning wastes. Now that chemical and non-chemical metal cleaning waste are permitted to be discharged from this outfall, the same limits are carried forward as BPJ limits in this permit reissuance. This is because the BPJ limits for non-chemical metal cleaning waste in this case are identical to the BAT limits established for chemical metal cleaning waste. See below for a more thorough discussion.

In the Steam Electric ELGs, 40 C.F.R. §§ 423.12(b)(5) & 423.13(e) limits the maximum and average concentration of TSS, O&G, copper and iron as shown below. The limits in the 1990 permit and draft permit are expressed as concentration-based limits pursuant to Section 423.12(b)(11). The draft permit reflects these limits which must be measured prior to mixing with the discharge from any other outfall.

Pollutant	Maximum For Any 1 Day (mg/L)	Average of Daily Values For 30 Consecutive Days Shall Not Exceed (mg/L)
TSS	100.0	30.0
O&G	20.0	15.0

Pollutant	Maximum For Any 1 Day (mg/L)	Average of Daily Values For 30 Consecutive Days Shall Not Exceed (mg/L)
Copper	1.0	1.0
Iron	1.0	1.0

pH

The limit for pH is 6.0 - 9.0 S.U., which are the limitations included in the applicable Steam Electric ELGs for the facility.

Nitrogen

As described in section 6.3.3 above, many segments of the Great Bay estuary, including the Piscataqua River, are approaching, or have reached, their assimilative capacity for nitrogen and are suffering from the adverse water quality impacts of nutrient overenrichment. Hence, it is clear that significant point source and non-point source reductions are necessary in order to achieve water quality standards.

The September 2010 permit reapplication submitted by PSNH indicated that Outfall 017 contained low concentrations of nitrate/nitrite nitrogen (0.32 mg/l) as well as total organic nitrogen (1.2 mg/l). In this case, EPA has determined that the Best Management Practices (BMPs) required in the Stormwater Pollution Prevention Plan (SWPPP) included in the draft permit are expected to reduce total nitrogen levels to a degree necessary to ensure that Schiller Station does not cause or contribute to a water quality standard violation. In developing these BMPs specifically for this permit, EPA has been informed by the BMPs designed to reduce nitrogen in stormwater discharges found in the 2015 draft New Hampshire small MS4 permit. Additionally, a quarterly monitoring requirement for total nitrogen has been established for this outfall in the draft permit in order to track the effectiveness of the BMPs.

Segregation of Non-Chemical Metal Cleaning Wastewater Stream

According to PSNH, Schiller Station's waste treatment plant #2 treats most station wastewater which consists principally of demineralizer regenerations, boiler blowdown, coal pile runoff and equipment and floor drains. All these different waste streams are comingled and treated prior to being discharged through external outfall 002, 003 or 004. Under the 1990 permit, effluent limits for TSS, O&G, Iron and Copper are applied to the comingled waste stream (Outfall 016) after treatment but prior to being comingled with non-contact cooling water in one of the external outfalls. As described above, the wastewater discharged through internal Outfall 016 is comprised of a variety of dissimilar wastewater streams that have been commingled. Thus, the metals limits applied at Outfall 016 are currently being applied to the commingled waste streams being discharged from the treatment process. EPA has concluded that this approach is inappropriate and must be corrected.

The National Effluent Limit Guidelines (NELGs) for Steam Electric Power Plants, See 40 C.F.R. Part 423, require that when separately regulated waste streams (i.e., "waste streams from different sources") are combined for treatment or discharge, each waste stream must independently satisfy the effluent limitations applicable to it.[4] 40 C.F.R. §§ 423.12(b)(12), 423.13(h). See also 40 C.F.R. § 125.3(f) (technology-based treatment requirements may not be satisfied with "'non-treatment'" techniques such as flow augmentation). Thus, it is not acceptable to determine compliance for different wastewater streams after they have been mixed (or diluted) with each other, unless the effluent limits applicable to them are the same. See 40 C.F.R. § 122.45(h) (internal waste streams).

Hence, the draft permit now requires segregation of these waste streams to be regulated as two internal outfall: Outfall 016 and Outfall 017. At Outfall 016, the applicable effluent limits for all comingled wastes excluding all metal cleaning waste are applied. These various low volume, runoff and drainage waste streams may be comingled prior to treatment and sampling for compliance because the effluent limitations for these waste streams are the same. At Outfall 017, technology-based limits for copper and iron in the chemical and non-chemical metal cleaning wastes are applied based on the NELGs.[5] All metal cleaning waste may not be combined with the low volume, runoff and drainage waste streams prior to compliance monitoring because the metal cleaning wastes are subject to additional effluent limitations for copper and iron. Applying the copper and iron limit of 1.0 mg/l to a comingled waste stream would potentially allow the permittee to (1) comply by diluting the non-chemical metal cleaning waste stream rather than treating it, and (2) discharge total copper and total iron in excess of that authorized by the NELGs. In addition, if non-chemical metal cleaning wastes are greatly diluted, removal of the pollutant metals in the metal cleaning wastes becomes more difficult and less efficient.

Given that the existing permit applies technology-based limits for both copper and iron to the comingled, non-similar waste streams at outfall 016, EPA has concluded that these limitations were incorrectly applied in the current permit. EPA proposes to correct the error in the draft permit.[6] Either the non-chemical metal cleaning wastewater must be separately monitored for compliance with copper and iron limitations (as Outfall 017), or a combined waste stream formula must be developed for the commingled waste stream. EPA does not, however, currently have sufficient information to derive limits based on combined waste stream calculations.[7] Therefore, the draft permit proposes, in effect, to segregate the non-chemical metal cleaning wastewater from the other wastewater streams by applying limits for the metal cleaning wastes at a separate compliance point (Outfall 017) located before mixing with other wastewater flows. The permittee may comply with the requirement by either (1) eliminating or diverting all other waste streams[8] at the time when non-chemical metal cleaning waste is being treated and

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[4] The BPT NELGs set copper and iron limits for both chemical and nonchemical metal cleaning wastes, while the BAT NELGs set limits only for the chemical metal cleaning wastes. As discussed in detail farther below, this leaves EPA to determine BAT limits for the nonchemical metal cleaning wastes on a BPJ basis.

[5] Since Outfall 017 already regulates chemical cleaning waste in the 1990 permit, this discussion focuses on the additional segregation of non-chemical cleaning waste from Outfall 016 to Outfall 017.

[6] The law is clear that when an administrative agency recognizes that it has made an error, it should correct that error. See Southwestern Penn. Growth Alliance v. Browner, 121 F.3d 106, 115 (3d Cir. 1997); Davila-Bardales v. I.N.S., 27 F.3d 1, 5 (1st Cir. 1994); Puerto Rico Cement Co. v. EPA, 889 F.2d 292, 299 (1st Cir. 1989).

[7] In order for EPA to derive iron and copper limits based on combined waste stream calculations, PSNH must supply EPA with a comprehensive list of all non-chemical metal cleaning, low volume and stormwater waste streams that currently comingle at WWTP #2. This list must include the total volume, frequency and concentrations of iron and copper for each wastewater stream.

[8] With the exception of chemical metal cleaning waste. Chemical and non-chemical metal cleaning waste may be comingled prior to treatment and monitoring because they are subject to the same technology-based requirements.

discharged through waste treatment plant #2 (perhaps through schedule changes) and then monitoring compliance of the treated non-chemical metal cleaning waste prior to mixing with any other internal discharge or (2) diverting any non-chemical metal cleaning waste through an alternate treatment process to comply with the technology-based iron and copper limits and monitor compliance at an alternate location before being comingled with any other waste stream.

In other words, EPA's draft permit proposes to require (a) that the non-chemical metal cleaning waste be discharged from Outfall 017 subject to the 1.0 mg/L limits for total copper and total iron, and (b) that compliance monitoring for this type of metal cleaning waste occur after treatment but before discharge being comingled with any other waste streams. Furthermore, the draft permit allows low volume, runoff and drainage waste streams to be combined and discharged through Outfall 016 subject to the relevant effluent limits other than the technology-based copper and iron limits. Copper and iron limits will no longer be in Outfall 016 but will be in Outfall 017.

Development of BAT Effluent Limit for Non-chemical Metal Cleaning Wastes Based On BPJ

As discussed above, Schiller Station discharges many different types of waste streams, including "non-chemical metal cleaning wastes," "chemical metal cleaning wastes," "low volume wastes," and heated cooling water (which carries waste heat).[9] Non-chemical metal cleaning wastes may include wastewater from a variety of sources such as the following non-chemical metal process equipment washing operations: air pre-heater wash, SCR catalyst wash, boiler wash, furnace wash, stack and breeching wash, fan wash, precipitator wash, and combustion air heater wash. As discussed above, the non-chemical metal cleaning wastes are currently combined with several of the Station's low volume wastes prior to being discharged.

EPA has promulgated NELGs for the "Steam Electric Power Generating Point Source Category," the point source category which applies to Schiller Station. See 40 C.F.R. Part 423. These NELGs define "metal cleaning wastes" as:

> any wastewater resulting from cleaning [with or without chemical cleaning compounds] any metal process equipment including, but not limited to, boiler tube cleaning, boiler fireside cleaning, and air preheater cleaning.

40 C.F.R. § 423.11(d). Thus, this regulation defines metal cleaning waste to include any wastewater generated from either the chemical or non-chemical cleaning of metal process equipment. In addition, the regulations define "chemical metal cleaning waste" as "any wastewater resulting from cleaning of any metal process equipment with chemical compounds, including, but not limited to, boiler tube cleaning." EPA also uses, but does not expressly define; the term "non-chemical metal cleaning waste" in the regulations when it states that it has "reserved" the development of BAT NELGs for such wastes. 40 C.F.R. § 423.13(f). While the regulations provide no definition of "non-chemical metal cleaning waste," the definitions of

[9] Cf. 42 Fed. Reg. 15690, 15693 (Mar. 23, 1977) (Interim Regulations, Pretreatment Standards for Existing Sources, Steam Electric Generating Point Source Category) (listing the different types of wastewaters discharged by power plants as follows: metal cleaning wastes (without distinguishing between chemical and nonchemical metal cleaning wastes); cooling system wastes; boiler blowdown; ash transport water; and low volume waste)

metal cleaning waste and chemical metal cleaning waste make clear that non-chemical metal cleaning waste is any wastewater resulting from the cleaning of metal process equipment without using chemical cleaning compounds.

Finally, the regulations define "low volume waste" as follows:

> . . . wastewater from all sources except those for which specific limitations are otherwise established in this part. Low volume wastes sources include, but are not limited to: wastewaters from wet scrubber air pollution control systems, ion exchange water treatment system, water treatment evaporator blowdown, laboratory and sampling streams, boiler blowdown, floor drains, cooling tower basin cleaning wastes, and recirculating house service water systems. Sanitary and air conditioning wastes are not included.

40 C.F.R. § 423.11(b). The waste sources listed as examples of low volume wastes include various process and treatment system wastewaters and do not include wastewater generated from washing metal process equipment. Therefore, low volume wastes are distinct from metal cleaning wastes.

The NELGs establish BPT daily maximum and 30-day average limits of 1.0 mg/l for both total copper and total iron in discharges of "metal cleaning waste." On the face of the regulations, these limits apply to both chemical and non-chemical metal cleaning wastes because, as stated above, both are included within the definition of "metal cleaning waste." 40 C.F.R. § 423.12(b)(5), 423.11(d). Thus, the facility's non-chemical metal cleaning wastes are, at a minimum, subject to NELGs' BPT limits of 1.0 mg/l (maximum and 30-day average limits) for both total copper and total iron. The NELGs also set BAT daily maximum and 30-day average limits of 1.0 mg/L for both total copper and total iron in discharges of chemical metal cleaning waste, 40 C.F.R. § 423.13(e), while indicating that EPA has "reserved" specification of BAT NELGs for non-chemical metal cleaning waste. 40 C.F.R. § 423.13(f). While the regulations do not set categorical BAT limitations for nonchemical metal cleaning waste, by expressly reserving the development of BAT limitations, EPA's regulations confirm that the BAT standard applies to nonchemical metal cleaning wastes. EPA explained in the preamble to the Steam Electric Power Plant NELGs, promulgated in 1982, that it was "reserving" the specification of BAT standards for nonchemical metal cleaning wastes because it felt that it had insufficient information regarding (a) the potential for differences between the inorganic pollutant concentrations found in the non-chemical metal cleaning wastes of oil-burning and coal-burning power plants, and (b) the cost and economic impact that would result from requiring the entire industrial category to ensure that non-chemical metal cleaning wastes satisfy the same limits that had been set for chemical metal cleaning wastes. See 47 Fed. Reg. 52297 (Nov. 19, 1982).

When EPA has promulgated NELGs applying the statute's narrative technology standards to a particular industrial category's pollutant discharges, then those NELGs provide the basis for the discharge limits included in the NPDES permits issued to individual facilities within that industrial category. 33 U.S.C. §§ 1342(a)(1)(A) and (b). See also 40 C.F.R. §§ 122.43(a) and (b), 122.44(a)(1) and 125.3. In the absence of a categorical NELG, however, EPA develops NPDES permit limits by applying the statute's narrative technology standards (such as the BAT standard) on a case-by-case, BPJ basis. See 33 U.S.C. § 1342(a)(1)(B) and (b)(1)(A); 40 C.F.R. §§

122.43(a), 122.44(a)(1), 125.3 and 122.1(b)(1).[10] According to 40 C.F.R. § 125.3(c)(2), in determining BAT requirements, EPA should consider the "appropriate technology for the category of point sources of which the applicant is a member, based on all available information," and "any unique factors relating to the applicant."[11]

CWA § 301(b) sets forth in narrative form the technology standards that pollutant discharges must satisfy and the deadlines by which compliance with them must be achieved. Effluent limitations based on application of the BAT standard were to be achieved no later than March 31, 1989. 33 U.S.C. § 301(b)(2). See also 40 C.F.R. §§ 125.3(a). According to the CWA's legislative history, "best available" technology refers to the "single best performing plant in an industrial field." See 45 Fed. Reg. 68333.[12] EPA also considers the following specific factors in determining the BAT: (i) age of the equipment and facilities involved; (ii) process employed; (iii) engineering aspects of the application of various types of control techniques; (iv) process changes; (v) the cost of achieving such effluent reductions; and (vi) non-water quality environmental impacts (including energy requirements). See CWA § 304(b)(2) and 40 C.F.R. § 125.3(d)(3).

EPA has determined that the BAT-based effluent limits for non-chemical metal cleaning waste discharges at Schiller Station should be at least as stringent as the applicable BPT limitations for such non-chemical metal cleaning wastes. Therefore, for this draft permit, EPA has determined, based on its Best Professional Judgment (BPJ), which non-chemical metal cleaning wastes at Schiller Station should be subject to concentration-based effluent limits of 1.0 mg/L for total copper and total iron. EPA's consideration of the above-listed factors is discussed below.

(i) Age of the equipment and facilities involved

In determining BAT for Schiller Station, EPA accounted for the age of equipment and the facilities involved. Schiller Station began generating electricity in 1952. Schiller Station is equipped to perform treatment of chemical metal cleaning wastes consisting of boiler chemical cleaning wastewater (Outfall 017 in existing permit). There is nothing about the age of the equipment and facilities involved that would preclude the use of the same or similar technology to treat non-chemical metal cleaning wastes at the facility. Schiller Station may, however, need to reroute some existing piping, at some expense, to comply with the new requirements regarding not comingling the non-chemical metal cleaning waste before treatment and monitoring. Based on our knowledge of the flow volumes involved and the nature of the site, EPA would expect

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[10] See Texas Oil & Gas Ass'n v. EPA, 161 F.3d 923, 928-29 (5th Cir. 1998) ("In situations where the EPA has not yet promulgated any [effluent limitation guidelines] for the point source category or subcategory, NPDES permits must incorporate 'such conditions as the Administrator determines are necessary to carry out the provisions of the Act.' 33 U.S.C. 1342(a)(1). …. In practice, this means that the EPA must determine on a case-by-case basis what effluent limitations represent the BAT level, using its 'best professional judgment.' 40 C.F.R. § 125.3(c)-(d). Individual judgments thus take the place of uniform national guidelines, but the technology-based standard remains the same."); Trustees for Alaska v. EPA, 749 F.2d 549, 553 (9th Cir. 1984) (same for BCT).

[11] EPA is not aware, and PSNH has not identified, any unique factors applicable to the facility that would impact the selection of the BAT in this case. EPA has taken into account site-specific factors in the course of discussing the six BAT considerations below.

[12] See also Texas Oil & Gas Ass'n, 161 F.3d at 928 (quoting CMA v. EPA, 870 F.2d at 226); CMA v. EPA, 870 F.2d at 239; Kennecott v. EPA, 780 F.2d 445, 448 (4th Cir. 1985); Ass'n of Pacific Fisheries, 615 F.2d at 816-17; American Meat Inst. v. EPA, 526 F.2d 442, 463 (7th Cir. 1975).

any re-piping expenses to be modest.

(ii) Process employed

In determining the BAT for Schiller Station, EPA considered the process employed at the facility. Schiller Station steam-electric power plant is rated to generate 48 MW of electrical energy in each of its three generating units (two coal-burning and one wood-burning). Treating non-chemical metal cleaning wastes to the same level as chemical metal cleaning wastes will not prevent the permittee from maintaining its primary production processes. The facility already treats chemical metal cleaning waste generated as a result of operations at the facility. Chemical metal cleaning wastewater (specifically boiler cleaning) is treated prior to discharge using neutralization tanks for pH adjustment and settling basins for solids removal. This treatment process can also be applied to non-chemical metal cleaning wastes.

(iii) Engineering aspects of the application of various types of control techniques

Technologies to treat metal cleaning wastes for copper and iron are in wide use at large steam electric power plants around the country. Typically, this treatment process entails pH adjustment, metal coagulation and solids removal. This is fairly straightforward, standard technology applied to treat many types of wastewaters containing metals.[13] The NPDES permit for the Mystic Station power plant in Everett, Massachusetts, for instance, requires non-chemical metal cleaning wastes to receive the same level of treatment as chemical metal cleaning wastes and both must meet mass-based limits equivalent to concentration-based limits of 1.0 mg/L for total copper and total iron. See Mystic Station NPDES Permit No. MA0004740. As mentioned above, technology to treat chemical metal cleaning wastewater already exists at Schiller Station. Specifically, this wastewater is treated prior to discharge using pH adjustment and solids removal within neutralization and waste tanks/basins. The Station can utilize the same treatment technologies at the facility to meet the proposed BAT standards for copper and iron for non-chemical metal cleaning wastewater. In order to employ this existing treatment capability, some wastewater streams may need to be redirected before and during metal cleaning treatment. Because this effluent stream is currently comingled with low volume wastes, it must be segregated before treatment or a combined waste stream formula could potentially be applied. From an engineering standpoint, the waste segregation proposed for the draft permit could be accomplished with scheduling changes and the facility's existing treatment technology. In other words, Schiller Station could change the timing of non-chemical cleaning operations to coincide with either chemical cleaning operations or outages.

(iv) Process changes

EPA has also evaluated the process changes associated with treatment of non-chemical metal cleaning wastes. As discussed, non-chemical metal cleaning wastes can be treated using existing technology currently in use at the plant. Since metal cleaning wastewater treatment is a separate process from power generation, the treatment of non-chemical metal cleaning wastewater does not impact power generating operations at the Station.

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[13] See pages 441-455 of the Final Development Document for Effluent Limitations Guidelines and Standards and Pretreatment Standards for the Steam Electric Point Source Category, November, 1982, for treatment technologies for metal cleaning wastes.

(v) Cost of achieving effluent reductions

EPA acknowledges that waste stream segregation and additional treatment of the non-chemical metal cleaning wastes could be accomplished, but that it may require some engineering modifications and associated expenditures. However, EPA believes that these costs would be modest. In addition, should PSNH choose to pursue either the "scheduling changes" or the "combined waste stream formula" options, the costs required to comply with the permit limits could be still less. EPA recognizes that more substantial costs may result from steps needed to comply with the new CWA § 316(b) requirements, and the cost to segregate non-chemical metal cleaning waste should be relatively insignificant.

(vi) Non-water quality environmental impacts (including energy requirements)

Finally, EPA considers the non-water quality environmental impacts associated with the treatment of non-chemical metal cleaning wastes, including energy consumption, air emission, noise, and visual impacts at Schiller Station. In particular, EPA believes that the permittee should be able to treat the non-chemical metal cleaning wastes with a similar amount of energy usage, air emissions and noise as presently occurs at the facility. As previously stated, the metal cleaning waste segregation proposed for the draft permit could be accomplished with scheduling changes and the facility's existing treatment technology. In addition, EPA does not expect any change in the visual impacts of the plant from the redirection of waste streams. EPA has determined that the non-water environmental impacts from the steps needed to comply with the BAT effluent limits would be negligible.

As previously discussed in this section, the low volume, runoff and drainage waste streams may be combined prior to sampling for compliance because the O&G and TSS effluent limitations for these waste streams are the same. The non-chemical metal cleaning waste may not, however, be combined with these other waste streams prior to compliance monitoring because the metal cleaning wastes are subject to additional effluent limitations for copper and iron. All metal cleaning wastewater must be treated prior to mixing with any other waste streams. Dilution of metal cleaning wastes is prohibited prior to treatment. All chemical and non-chemical metal cleaning wastes must be sampled prior to mixing with any other waste stream and are subject to effluent limitations for TSS, O&G, copper and iron shown in the table below.

Pollutant	**Maximum For Any 1 Day (mg/L)**	**Average of Daily Values For 30 Consecutive Days Shall Not Exceed (mg/L)**
TSS	100.0	30.0
O&G	20.0	15.0
Copper	1.0	1.0
Iron	1.0	1.0

6.3.9 Outfall 018

Flow

In the 1990 permit, the flow limit at this outfall was 300,000 gpd (monthly average) and 600,000 gpd (daily max). These limits are carried forward in the draft permit.

Total Suspended Solids and Oil & Grease

This outfall consists of a co-mingled discharge of heater condensate drips from the Newington Tank Farm that drain through a valved oil/water separator, as well as occasional stormwater runoff from the Schiller Station wood storage yard and other drainage areas. In the 1990 permit, this waste stream was regulated for Oil & Grease (O&G). Using best professional judgment (BPJ), EPA has made the determination that this co-mingled discharge which passes through a valved oil/water separator is similar to a low volume waste and has similar treatment technology (oil/water separator). Therefore, EPA will apply the same limitations as for a low volume waste source. Hence, the draft permit contains Total Suspended Solids (TSS) and O&G limitations based on the Best Conventional Treatment standard established in the Steam Electric ELGs (*see* 40 C.F.R. § 423.12(b)(3)) for low volume waste source(s).

The maximum and average concentration of TSS and O&G discharged in low volume waste source(s) are limited in 40 C.F.R. § 423.12(b)(3) as shown below. The limits in the 1990 permit and draft permit are expressed as concentration-based limits pursuant to 40 C.F.R. §423.12(b)(11). The permit reflects these limits which must be measured prior to mixing with any other outfall.

Pollutant	Maximum For Any 1 Day (mg/L)	Average of Daily Values For 30 Consecutive Days Shall Not Exceed (mg/L)
TSS	100.0	30.0
O&G	20.0	15.0

Since the O&G limits are the same as those in the 1990 permit, they comply with antibacksliding regulations in 40 C.F.R. § 122.44.

pH

The limit for pH is based upon State Certification Requirements and RSA 485-A:8, which states that "[t]he pH range for said (Class B) waters shall be 6.5 to 8.0 except when due to natural causes."

The draft permit includes a provision allowing a relaxation of the pH limits if the permittee performs an in-stream dilution study that demonstrates that the in-stream standards for pH would be protected. If the State approves results from a pH demonstration study, this permit's pH limit range may be relaxed. The notification of the relaxation must be made by certified letter to the permittee from EPA-New England. The pH limit range cannot be less restrictive than 6.0 - 9.0

S.U., which are the limitations included in the applicable Steam Electric ELGs for the facility (*see* 40 C.F.R. § 423.12(b)(1).

PSNH requested that the pH sampling be reduced to a single grab from any of the three pipes. EPA has granted this request, as reflected in the draft permit.

Rain pH

Rainfall pH must continue to be monitored and reported in order to compare to effluent pH readings.

Based upon historical compliance, PSNH requests the monitoring frequency at this outfall be reduced to quarterly. EPA has granted this request, as reflected in the draft permit.

Polynuclear Aromatic Hydrocarbons (PAHs)

PAHs are a group of organic compounds that form through the incomplete combustion of hydrocarbons. PAHs are also present in crude oil and some heavier petroleum derivatives and residuals such as No. 6 fuel oil. Discharge of these products can introduce PAHs into the environment where they strongly adsorb to suspended particulates and biota. PAHs can also bio-accumulate in fish and shellfish. The ultimate fate of those PAHs which accumulate in the environment is believed to be biodegradation and biotransformation by benthic organisms. Several PAHs are well known animal carcinogens, while others are not carcinogenic alone but can enhance the response of the carcinogenic PAHs.

There are 16 PAH compounds identified as priority pollutants under the CWA (*see* Appendix A to 40 C.F.R. Part 423). In view of evidence of PAH-induced animal carcinogenicity and the type of petroleum products stored at the facility, the draft permit establishes monitoring requirements, without limits, for these Group I and II PAHs, as listed below.

Group 1 PAHs comprise seven known animal carcinogens:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Chrysene
- Dibenzo(a,h)anthracene
- Indeno(1,2,3-cd)pyrene

Quarterly monitoring of the above Group I PAHs, without limits, is required.

Group II PAHs comprise nine priority pollutants which are not considered carcinogenic alone, but which can enhance or inhibit the response of the carcinogenic PAHs:

- Acenaphthene
- Acenaphthylene

- Anthracene
- Benzo(g,h,i)perylene
- Fluoranthene
- Fluorene
- Napthalene
- Phenanthrene
- Pyrene

Quarterly monitoring of the above Group II PAHs, without limits, is required. Of these, naphthalene is considered an important limiting pollutant parameter based upon its prevalence in petroleum products and its toxicity (i.e., naphthalene has been identified as a possible human carcinogen).

For the maximum protection of human health from the potential carcinogenic effects of exposure to PAHs through ingestion of contaminated water and contaminated aquatic organisms, EPA established human health "organism only" *National Recommended Water Quality Criteria* for individual PAH compounds based on the increase of cancer risk over the lifetime and consumption of contaminated fish. The human health criteria for Group I PAHs were established in ng/L, which is many orders of magnitude below the current Practical Quantitation Limits (PQLs) for determining PAH concentrations in aqueous solutions.

The draft permit also requires that the quantitative methodology used for PAH analysis must achieve a minimum level for analysis ("ML") using approved analytical methods in 40 C.F.R. Part 136. The ML is not the minimum level of detection, but rather the lowest level at which the test equipment produces a recognizable signal and acceptable calibration point for an analyte, representative of the lowest concentration at which an analyte can be measured with a known level of confidence. The ML for each Group I PAH compound must be <0.1 µg/L. The ML for each Group II PAH compound must be <1 µg/L. These MLs are based on those listed in Appendix VI of EPA's Remediation General Permit. Sample results for an individual compound that is at or below the ML should be reported according to the latest EPA Region 1 *NPDES Permit Program Instructions for the Discharge Monitoring Report Forms (DMRs)*. These values may be reduced by modification pursuant to 40 CFR §122.62 as more sensitive tests become available or are approved by EPA and the State.

EPA believes these requirements are necessary for the protection of human health, to maintain the water quality standards established under Section 303 of the CWA, and to meet New Hampshire's water quality criteria. Should monitoring data indicate the presence of PAHs in concentrations that may cause or contribute to an excursion above water quality criteria, the permit may be modified, reissued or revoked pursuant to 40 CFR §122.62. Should monitoring indicate PAHs are not detected (using the proper MLs described above) over the first two years of the permit cycle, the permittee may request a reduction in monitoring frequency.

Nitrogen

As described in section 6.3.3 above, many segments of the Great Bay estuary, including the Piscataqua River, are approaching, or have reached, their assimilative capacity for nitrogen and are suffering from the adverse water quality impacts of nutrient overenrichment. Hence, it is clear that significant point source and non-point source reductions are necessary in order to achieve water quality standards.

The September 2010 permit reapplication submitted by PSNH indicated that Outfall 018 contained low concentrations of nitrate/nitrite nitrogen (0.32 mg/l). In this case, EPA has determined that the Best Management Practices (BMPs) required in the Stormwater Pollution Prevention Plan (SWPPP) included in the draft permit are expected to reduce total nitrogen levels to a degree necessary to ensure that Schiller Station does not cause or contribute to a water quality standard violation. In developing these BMPs specifically for this permit, EPA has been informed by the BMPs designed to reduce nitrogen in stormwater discharges found in the 2015 draft New Hampshire small MS4 permit. Additionally, a quarterly monitoring requirement for total nitrogen has been established for this outfall in the draft permit in order to track the effectiveness of the BMPs.

6.3.10 Outfalls 020 and 021/022

Based upon the request of PSNH, Outfalls 021 and 022 have been combined into a single outfall since they discharge from the same location. The combined Outfall 021/022 will henceforth be referred to as Outfall 021, as in the draft permit.

Flow

The total flow must be estimated each month and may not exceed 108,000 gpd as a daily maximum.

Temperature

The temperature of the discharge shall at no time exceed the temperature of the intake water used for this discharge.

6.3.11 New Outfall 023

This outfall consists of occasional stormwater runoff from a parking lot used for chemical loading and/or unloading. The Multi-Sector General Permit Part 8 Subpart O addresses requirements for industrial activities at Steam Electric Generating Facilities. Based on Section 8.O.4.4, which discusses Chemical Loading and Unloading, the following requirements apply to this site:

> *Minimize contamination of precipitation or surface runoff from chemical loading and unloading areas. Consider using containment curbs at chemical loading and unloading areas to contain spills, having personnel familiar with spill prevention and response procedures present during deliveries to ensure that any leaks or spills are immediately contained and cleaned up, and loading and unloading in covered areas and storing chemicals indoors.*

Flow

The permittee must estimate and report flow from this outfall on a monthly basis as described in the draft permit.

pH

The pH shall not be less than 6.0 standard units (S.U.) nor greater than 9.0 S.U., unless due to naturally occurring conditions. The pH shall be within 0.5 S.U. of the rainfall pH when the rainfall pH is outside of the above range.

Rain pH

Rainfall pH shall be monitored and reported during the month in which the discharge occurs in order to compare to effluent pH readings.

6.4 NPDES Permitting Requirements for Thermal Discharges

6.4.1 Existing Permit Thermal Limits

Schiller Station's existing NPDES permit, issued in 1990, includes a number of limits and conditions on the Facility's thermal discharges from Outfalls 001, 002, 003 and 004 (which service Schiller Station generating Units 4, 5 and 6, respectively). Specifically, the existing permit imposes the following restrictions on thermal discharges from these outfalls:

- A daily maximum discharge temperature limit (Max-T) of 95ºF;
- A daily maximum temperature differential between the intake and discharge temperatures (Delta-T) of 25ºF (this limit is increased to 30ºF for a two-hour period during condenser maintenance); and
- A prohibition of discharges that cause the receiving water to exceed a maximum temperature of 84°F at any point beyond a distance of 200 feet in any direction from the point of discharge.

See Parts I.A.3, I.A.5, I.A.6 and I.A.7 of the 1990 permit (note (*) and note (b)). The permit also, in effect, limits the maximum waste heat load discharged by the Facility per day. This effective, though not expressly stated, limit follows from the permit's limits on Delta-T and the maximum volume of non-contact cooling water permitted to be discharged from Outfalls 002, 003 and 004 (servicing generating units 4, 5 and 6, respectively). The permit sets a flow limit of approximately 150 million gallons per day (MGD) on the combined discharges from the three outfalls. *See id.* (EPA has not included the 40 MGD volumetric limit on cooling water discharges from Outfall 001 in this calculation because Unit 3 currently operates on a very limited basis.) With a delta T (ΔT) of 25ºF and a maximum flow of 150 MGD, the resulting heat load is calculated as follows:

$$Q = C_p m(\Delta T)/24 \text{ hours}$$

Where:

C_p = Heat capacity (specific heat) of water = 1.0 BTU/pound °F
m = mass of water = cooling water flow rate (MGD) x 8.34 pounds/gallon =150 x 8.34 = 1251 lb
ΔT = discharge temperature – intake temperature (°F) = 25°F and
Q = Heat load, million British Thermal Units (mBTU)/hour = 1,303 mBTU/hour

However, for a maximum of two hours each day, as stated above, the ΔT may be 30ºF, which results in the following heat load 1,564 mBTU/hour (150 MGD x 30ºF x 8.34/24 hours). Therefore, the maximum allowable waste heat load discharged each day is 31,796 mBTU/day (1,303 mBTU x 22 hours + 1,564 mBTU x 2 hours).

Furthermore, the 1990 permit includes narrative requirements that effectively limit thermal discharges, among other things. Part I.A.1.b of the 1990 permit states, "[t]he discharges shall not jeopardize any Class B use of the Piscataqua River and shall not violate applicable water quality standards …." Moreover, Part I.A.1.h of the 1990 permit provides that:

> [t]he combined thermal plumes for the station shall (a) not block zone of fish passage, (b) not change the balanced indigenous population of the receiving water, and (c) have minimal contact with the surrounding shorelines.

As per the discussion in the Fact Sheet for the 1990 permit, *see* pp. 5 - 7, EPA applied the permit's thermal discharge limits pursuant to a variance under CWA § 316(a).

In addition, in a letter dated August 17, 1990, NHDES certified that these requirements also satisfied the NHWQS. The permit's prohibition against discharges causing in-stream temperatures above 84°F at any point beyond a distance of 200 feet in any direction from the point of discharge is consistent in concept with the identification of a mixing zone (*see* Section 5.3 above). Yet, as discussed above in Section 5.4, a mixing zone that satisfies State water quality standards could also be used to determine thermal discharge limits that satisfy CWA § 316(a).

6.4.2 Collection of Thermal Data

In order to characterize the thermal discharge under the present design and operational profile of Schiller Station, EPA requested that the permittee collect additional thermal information (EPA Letter from Stephen S. Perkins, Director, Office of Ecosystem Protection, EPA, to William H. Smagula, P.E., Director, PSNH Generation, dated May 4, 2010). This thermal data, along with field data collected by EPA, allowed EPA to perform an updated analysis of the potential impact of the Facility's thermal discharges on the Piscataqua River.

Thermal Plume Mapping

Field measurements were collected by EPA on August 31, 2010, to delineate the horizontal, vertical, and downstream extent of the thermal plume discharged from Schiller Station, as well as its temperature and relative increase above ambient temperature. This one-day monitoring effort was designed to be a "snap shot" of thermal plume conditions over a brief time period. Late

August was selected for the monitoring effort to capture seasonally high ambient river temperatures along with expected high electric generation by the facility, which would result in near maximum permitted discharge flows and temperatures. This would constitute approximate "worst-case" conditions for the receiving water.

An EPA field crew recorded river temperatures by conducting multiple transects through the Station's plume while towing a boat mounted temperature sonde. A pressure transducer on the temperature sonde recorded its exact depth as it recorded the temperature measurements. Temperature, depth and GPS positioning data were recorded and stored every 10 seconds during a transect run. Multiple bank-to-bank transects, perpendicular to the flow of the river, as well as down river and up river, were conducted within and outside of the Station's thermal plume.

Fixed Thermistor Data Collection

In addition to the one day "snap shot" of summer thermal plume conditions in the river, continuous, long-term temperature data was collected. EPA sent PSNH a CWA § 308 Information Request Letter, dated May 4, 2010 (clarified and amended by a follow-up letter from EPA, dated June 1, 2010). As part of the request, PSNH was directed to characterize Schiller Station's thermal plume. From August 15, 2010, through November 14, 2010, the permittee was required to collect continuous temperature data using a series of thermistors placed in eleven locations in the Piscataqua River, in the vicinity of the Station's discharge.

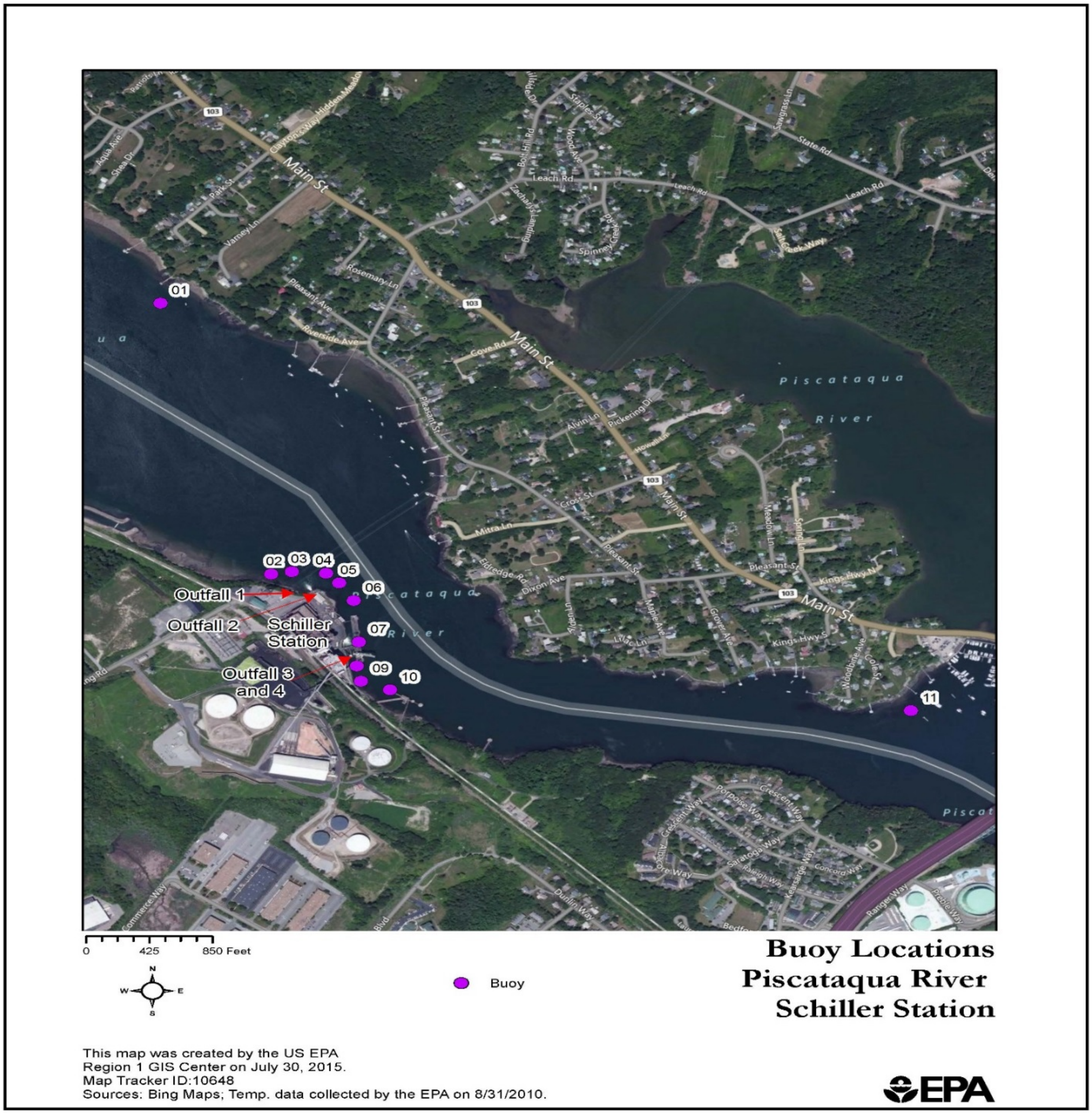
Thermistors were deployed at approximate locations designated by EPA. The thermistors were given number designations and their positions are depicted in Figure 6-1. Thermistor Station 1 (upstream) and Thermistor Station 11 (downstream) were deployed in locations to collect temperatures representative of ambient conditions in the Piscataqua River (*i.e.*, unaffected by the Facility's thermal discharges). The ambient monitoring locations were outside of the effects of the thermal plume(s) and were used to determine background river temperature at locations upstream and downstream of Schiller's discharge. The other thermistor stations were arranged in locations that had the potential to encounter the thermal plume.

For water depths greater than 20 feet, three thermistors per station were used (one approximately six inches below the water surface, one approximately one foot above the river floor, and one approximately midway between the other two thermistors). For water depths less than 20 feet, two thermistors per station were used (one approximately six inches below the water surface, and one approximately one foot above the river floor).

The thermistors collected continuous temperature data, with a minimum of 12 temperature measurements recorded each hour. For each thermistor, the hourly average, hourly maximum, and hourly minimum temperatures were recorded for each hour (clocktime). The average, maximum, and minimum hourly values were calculated from a minimum of 12 temperature measurements recorded during that hour. Facility operating conditions during the thermistor deployment were also recorded.

In addition, three monthly data reports were provided to EPA by PSNH, beginning on September 24, 2010, and continuing monthly thereafter until November 29, 2010. The reports summarized the river temperature data collected from August 15 through November 14, 2010, along with corresponding facility operation data (Reports dated September 20 and 24, 2010 [AR-21, AR-23]; October 22 and 25, 2010 [AR-38 and AR-39]; and November 24 and 29, 2010 [AR-42 and AR-43]).

Figure 6-1 The location of a series of thermistors placed in eleven locations in the Piscataqua River. The thermistors were used to collect continuous temperature data in the vicinity of the Schiller Station thermal discharges (August 15, 2010, through November 14, 2010).



6.4.3 Analysis of Thermal Data

Analysis of Thermal Plume Mapping Data

The colored temperature contours generated from the field data collected on August 31, 2010, are depicted in Figure 6-2. This thermal plume map was generated by EPA by plotting the temperature and position data collected during the multiple transect boat mounted temperature sonde runs. An initial inspection of the figure shows a concentrated thermal discharge not associated with the Schiller Station outfalls. This is a permitted thermal discharge from Eversource Energy's Newington Station.

According to facility intake temperature data provided by Schiller Station, the ambient river temperatures recorded on August 31, 2010, were among the highest from the time period of August 15 through September 14 (approximately 23°C; 73.4°F). Units 4, 5 and 6 were all operating during the transect runs, with an average capacity generation of approximately 80% for the day. Both EPA and NHDES were satisfied that the data collected on August 31, 2010, and depicted in Figure 6-2, represent reasonable worst-case conditions.

An examination of the temperature representation in Figure 6-2 shows a maximum surface temperature of approximately 28.0°C (82.4°F) at a small point within the 200-foot boundary of the mixing zone. This point likely represents the station outfall where the thermal discharge first enters the receiving water, just as it mixes with the Piscataqua River. The majority of the 200 foot boundary area maintained a surface temperature of 24.0°C (75.2°F) to 25.0°C (77.0°F) or below. EPA temperature monitoring information on August 31, 2010, conducted under reasonable worst-case conditions, confirmed that the receiving water did not exceed a maximum temperature of 84°F at a distance of 200 feet or greater in any direction from the points of thermal discharge. Indeed, water temperatures did not reach 84°F even within 200 feet of the point of discharge. These values are within the thermal limit requirements included in the 1990 permit.

Analysis of Fixed Thermistor Data

Facility operating conditions during the thermistor deployment were recorded and included with the data reports submitted to EPA by PSNH. The rate of non-contact cooling water, the daily facility generation and the water temperature of both the intake and discharge for Generation Units 4, 5 and 6 were submitted for the time period of August 15 through November 14, 2010. During this three-month period, the maximum difference in temperature between the intake and the discharge (delta T) was 23.0°F, recorded at Unit 5 on November 10, 2010. The absolute maximum discharge temperature recorded for the entire three month period was 92.7°F, recorded on September 4, 2010, at Unit 5. These values are within the thermal limit requirements included in the 1990 permit.

As observed on Figure 6-2, the thermal discharge from Eversource Energy's Newington Station is discharged just upstream of Schiller Station. Based on the monitoring conducted on August 31, 2010, the thermal contours suggest the possibility that under certain river and facility operating conditions, a well-mixed remnant of the thermal plume from Newington Station could have been recorded by the Schiller Station surface thermistors at monitoring Stations 2, 3, and 4 during their deployment (August 15 - November 14, 2010). A review of the surface thermistors, as well as the operational data for Newington Station for that time period revealed that the thermal discharge from Newington Station likely was not recorded at Surface Stations 2, 3 and 4.

As discussed previously, both Station 1 (upstream of the facility) and Station 11 (downstream of the facility) were located in areas that represent ambient river temperature conditions. A review of the Schiller Station thermal plume data confirmed that the thermal discharge from the Station was not recorded at either background station. These stations are approximately 1.3 miles apart, and while they did represent ambient thermal conditions in the river, natural tidal impacts related to their distance from each other caused the two background stations to record temperatures that sometimes differed from one another by over 1.5°C (2.7°F), especially in early September 2010. Rather than average the temperature data from these two background stations, EPA selected Station 1, upstream from the facility, as the background station that best represented ambient river conditions in the Piscataqua River. Station 11 was not used in the data analysis.

Summary statistics for the August 15 through the November 14, 2010, fixed position continuous temperature monitors for Stations 1 through 10 are presented in Table 6-B. An examination of the continuous three months of thermal data from the Stations 2 through 10 thermistors indicates that the thermistor located approximately six inches below the surface at Station 7 consistently recorded the highest temperatures [ARs 21, 23, 38, 39, 42 and 43]. Station 7 was located approximately 95 feet from shore, and approximately 200 feet from thermal discharge Outfalls 003 and 004 (Figure 6-1). Figure 6-3 depicts temperature data from August 15 through November 14, 2010, from the Station 7 continuous recording thermistor. The figure includes graphs showing the Station 7 near surface (A7) temperatures, the depth of the thermistor and the difference between the temperature of the near surface Station 7 readings and the ambient temperature of the Piscataqua River as recorded at Station 1. Also included in Figure 6-3 are graphs showing the Station 7 near bottom (C7) temperatures, the depth of the thermistor and the difference between the temperature of the near bottom Station 7 readings and the ambient temperature of the Piscataqua River. The relatively higher temperatures recorded at the near surface thermistor shows that the thermal plume from Schiller Station is primarily a surface feature. The absolute maximum instantaneous temperatures from all thermistors at Stations 2 through 10 were recorded as follows. The near surface maximum temperature was 26.0°C (78.8°F), recorded at Station 7. The mid-depth maximum temperature was 23.6°C (74.4°F), recorded at Station 3. The near-bottom maximum temperature was 23.5°C (74.3°F), recorded at Station 2. Temperatures recorded at monitoring Stations 2 through 10, which approximated a 200 foot distance from the thermal discharge outfalls, were observed to be well below the 84°F limit included in the 1990 permit.

Figure 6-2. Colored temperature contours depicted by plotting the temperature and position data collected during multiple transect runs on August 31, 2010.

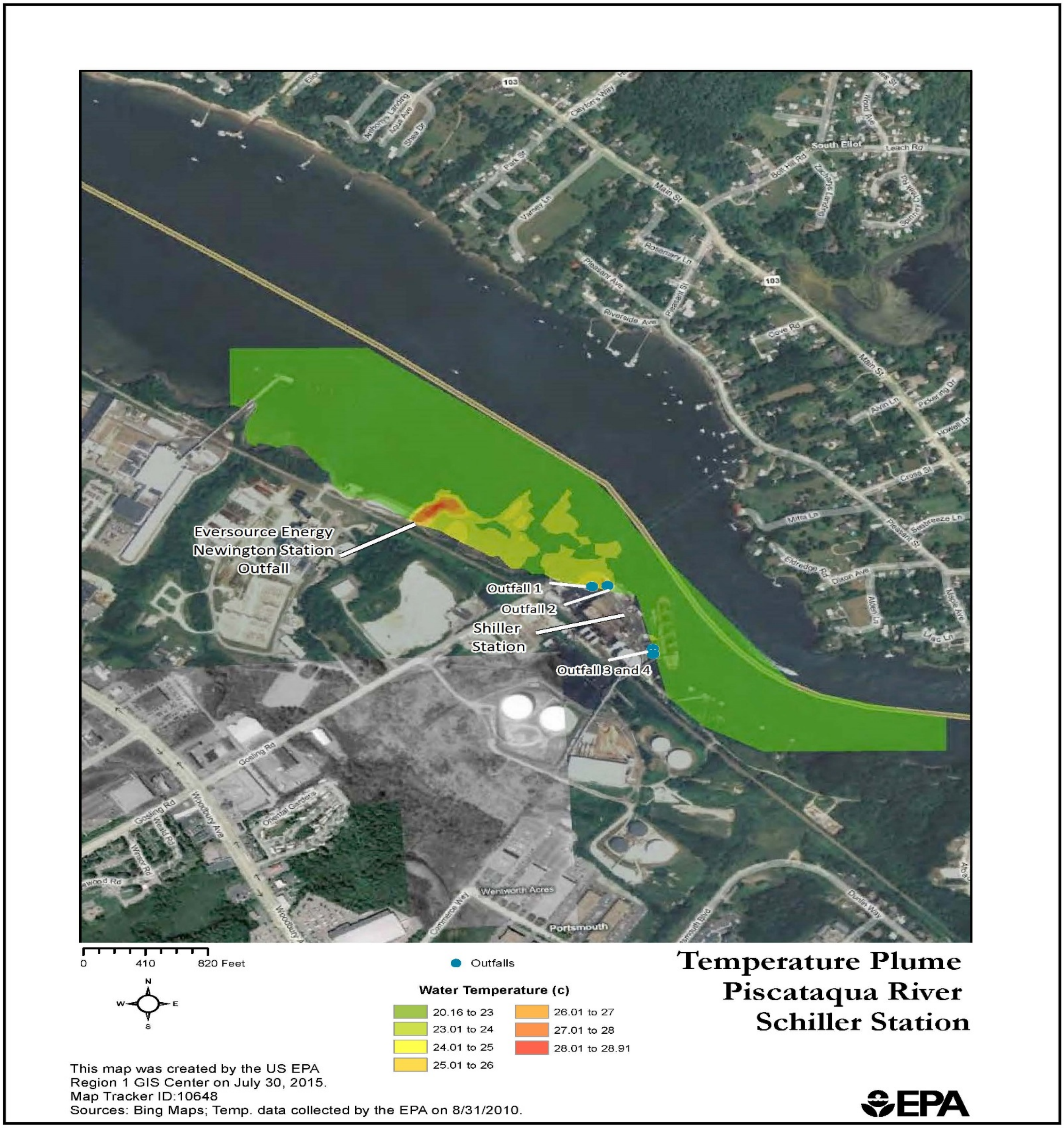
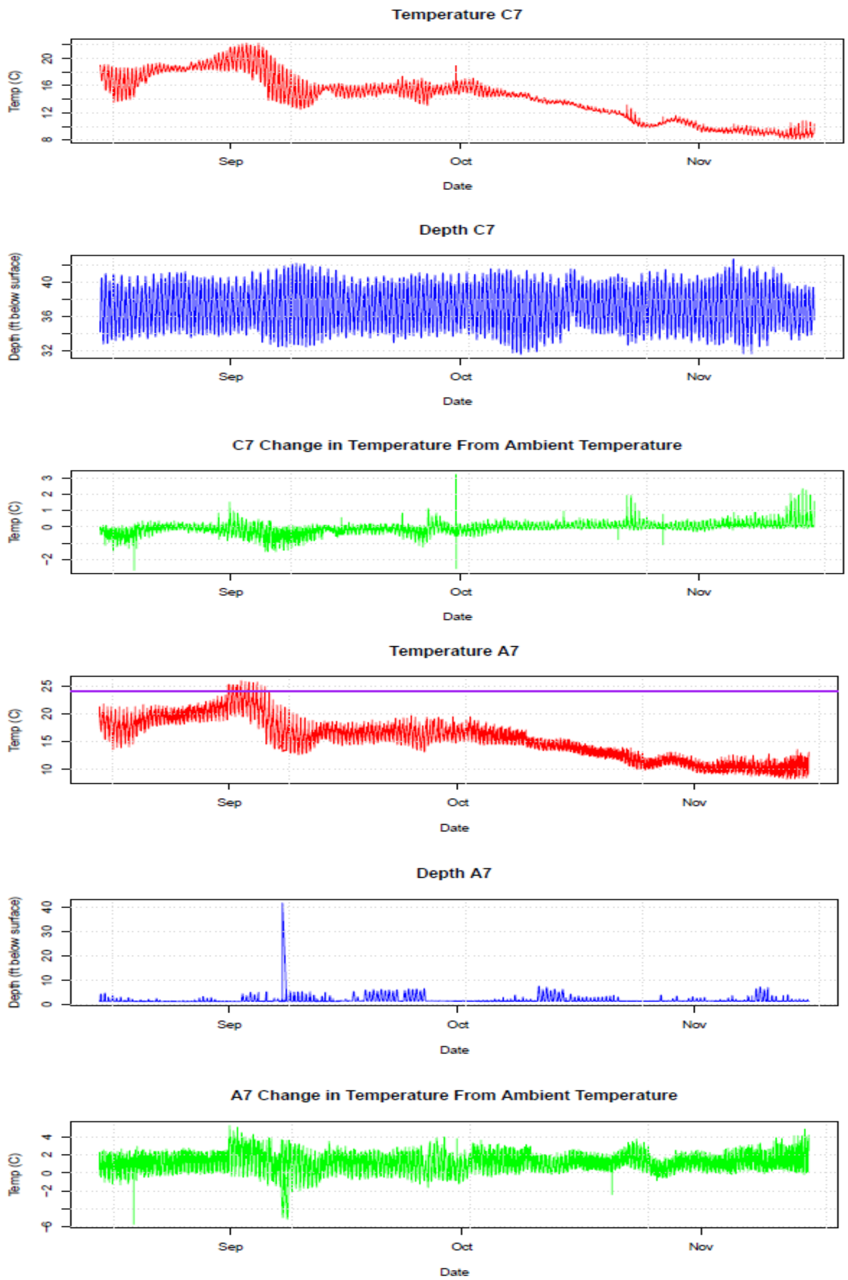


Table 6-B Summary Statistics for the Three Month Temperature Data Set for Stations 1 through 10

Station 2 had no mid-depth temperature sensor so no data is presented for that station location. The raw temperature data was recorded every five minutes at all stations and at all depths (PSNH, August 15- November 14, 2010).

Water Temperature at Data Logger Stations 1- 10 PSNH Schiller Station Thermal Study August 15 –November 14, 2010											
Sensor Depth		**Station Number**									
	Parameter	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Surface	Average Temp (Deg C)	14.3	14.8	15.0	14.8	14.3	14.4	15.4	14.7	14.7.	14.4
	Average Temp Deg F	57.8	58.6	58.9	58.6	57.7	58.0	59.7	58.5	58.5	57.9
	Max Temp (Deg C)	22.2	24.5	24.9	24.1	23.3	23.3	26.0	25.8	25.9	24.6
	Max Temp (Deg F)	72.0	76.0	76.9	75.3	73.9	73.9	78.8	78.5	78.6	76.2
	Standard Deviation (Deg C)	3.6	3.7	3.8	3.7	3.6	3.5	3.7	3.5	3.4	3.5
	Standard Deviation (Deg F)	6.4	6.6	6.9	6.6	6.4	6.3	6.7	6.3	6.2	6.2
Mid	Average Temp (Deg C)	14.3	NA	14.6	14.5	14.1	14.2	14.4	14.3	14.5	14.2
	Average Temp Deg F	57.8	NA	58.2	58.1	57.4	57.6	58.0	57.7	58.1	57.6
	Max Temp (Deg C)	22.2	NA	23.6	22.9	22.4	22.8	22.7	22.5	22.3	22.1
	Max Temp (Deg F)	72.0	NA	74.4	73.2	72.4	73.1	72.9	72.6	72.2	71.9
	Standard Deviation (Deg C)	3.6	NA	3.6	3.5	3.6	3.4	3.4	3.4	3.3	3.4
	Standard Deviation (Deg F)	6.4	NA	6.5	6.4	6.4	6.2	6.1	6.1	5.9	6.2
Deep	Average Temp (Deg C)	14.3	14.6	14.6	14.4	14.2	14.2	14.2	14.2	14.5	14.2
	Average Temp Deg F	57.8	58.3	58.2	58.0	57.5	57.5	57.6	57.6	58.1	57.6
	Max Temp (Deg C)	22.2	23.5	23.0	22.6	22.4	22.5	22.2	22.1	22.2	22.1
	Max Temp (Deg F)	72.0	74.3	73.4	72.7	72.4	72.6	72.0	71.9	72.0	71.7
	Standard Deviation (Deg C)	3.6	3.6	3.6	3.5	3.6	3.4	3.4	3.4	3.3	3.4
	Standard Deviation (Deg F)	6.4	6.4	6.4	6.3	6.4	6.1	6.1	6.1	6.0	6.1

Figure 6-3. Temperature data from the Station 7 continuous recording thermistor near Schiller Station (August 15 through November 14, 2010).



6.4.4 Thermal Discharge Requirements under CWA § 316(a)

As explained in Section 5.4, above, CWA § 316(a), 33 U.S.C. § 1326(a), authorizes the permitting authority to set thermal discharge limits less stringent than technology-based and/or water quality-based requirements based on a "variance" if CWA § 316(a)'s biological criteria are satisfied. A permit applicant may qualify for a variance under CWA § 316(a) if it can demonstrate to the permitting agency's satisfaction that thermal discharge limits based on technology and water quality standards would be more stringent than necessary to assure the protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife in and on the body of water into which the discharge is made (BIP). *See* 33 U.S.C. § 1326(a); 40 C.F.R. §§ 125.70, 125.73(a). The applicant must also demonstrate that any alternative, variance-based thermal discharge limits that it requests will assure the protection and propagation of the BIP, considering the cumulative impact of its thermal discharge together with all other significant impacts on the species affected. *See* 33 U.S.C. § 1326(a); 40 C.F.R. § 125.73(a). If satisfied that the applicant has made such a demonstration, then the permitting authority may impose thermal discharge limits that, taking into account the interaction of the thermal discharge with other pollutants, will assure the protection and propagation of the BIP. *See* 33 U.S.C. § 1326(a); 40 C.F.R. §§ 125.70, 125.73(a) and (c)(1)(i).

As also explained above, dischargers operating under an existing CWA § 316(a) variance "may base their [renewal] demonstration upon the absence of prior appreciable harm in lieu of predictive studies." 40 C.F.R. § 125.73 (c)(1). The existing discharger must demonstrate the absence of prior appreciable harm "taking into account the interaction of such thermal component [of the discharge] with other pollutants and the additive effect of other thermal sources to a [BIP]..." 40 C.F.R. § 125.73(c)(1).

As discussed above, Schiller Station's existing permit's thermal discharge requirements are based on a CWA § 316(a) variance. *See* Fact Sheet for the 1990 Permit, pp. 5-7. The Facility initially requested that its new permit retain the same thermal discharge limits based on a renewal of its CWA § 316(a) variance. *See* September 13, 2010, Letter from John M. MacDonald, PSNH, to Shelley Puleo, EPA, Attachment 3, p. 1 (response to EPA request for information to supplement NPDES permit application). PSNH's request maintains, in essence, that the Facility's existing thermal discharge has not caused appreciable harm to the BIP and, indeed, could not have caused such harm given how small it is relative to the large volume and cold temperatures of the waters of the Piscataqua River estuary. PSNH subsequently requested that the new permit increase the maximum discharge temperature limit from 95ºF to 100ºF.

After considering PSNH's request in light of the available information, and after consulting with the NH-DES, EPA is proposing to (a) grant PSNH's request for renewal of its CWA § 316(a) variance with the permit's current thermal discharge restrictions, and (b) reject its request to increase the maximum discharge temperature limit to 100ºF. EPA's analyses underlying these proposed decisions are presented below.

As discussed previously, instream and discharge thermal data indicate that Schiller Station has been able to comply with the existing permit's limits, although the discharge has reached the permitted delta T and maximum discharge temperature limits during a number of summer months (DMR Data 1991 – 2013). Under CWA § 316(a), however, the key question is not whether the permittee has complied with the existing permit limits. The key questions are whether the record demonstrates that the Facility's thermal discharges have not caused prior appreciable harm to the BIP, and whether the record provides reasonable assurance of the protection and propagation of the BIP going forward with the proposed thermal discharge limits.

EPA's regulations define the term "balanced indigenous population" (or BIP) as follows:

> (c) The term *balanced, indigenous community* is synonymous with the term *balanced, indigenous population* in the Act and means a biotic community typically characterized by diversity, the capacity to sustain itself through cyclic seasonal changes, presence of necessary food chain species and by a lack of domination by pollution tolerant species. Such a community may include historically non-native species introduced in connection with a program of wildlife management and species whose presence or abundance results from substantial, irreversible environmental modifications. Normally, however, such a community will not include species whose presence or abundance is attributable to the introduction of pollutants that will be eliminated by compliance by all sources with section 301(b)(2) of the Act; and may not include species whose presence or abundance is attributable to alternative effluent limitations imposed pursuant to section 316(a).

40 C.F.R. § 125.71(c). EPA has determined that it would be unreasonable to try to evaluate the potential thermal impacts to *every* marine, riverine and diadromous species that may potentially be present at one time or another in the Piscataqua River in the vicinity of Schiller Station's discharge. In such cases, EPA regulations, *see* 40 C.F.R. §§ 125.71(b) and 125.72(b), and guidance (1977) direct the permitting agency to focus analysis on a subset of the potentially affected species. The species in this subset are referred to as "Representative Important Species" (RIS). EPA regulations define RIS as follows:

> *Representative important species* means species which are representative, in terms of their biological needs, of a balanced, indigenous community of shellfish, fish and wildlife in the body of water into which a discharge of heat is made.

40 C.F.R. §§ 125.71(b). The RIS may include, without limitation, species commonly associated with power plant impacts, economically important species, particularly thermally sensitive or vulnerable species, and federally listed threatened or endangered species.

EPA assembled a list of RIS for the area of the Piscataqua River into which Schiller Station discharges its waste heat. The list is included in Table 6-C. More detailed information regarding Schiller Station impingement and entrainment impacts on the RIS species discussed below is found in Section 8.2.3 of this Fact Sheet.

Table 6-C. Representative Important Species in the Piscataqua River near Schiller Station

Species	Common Name
Tautogolabrus adspersus	cunner
Osmerus mordax	rainbow smelt
Scomber scombrus	Atlantic mackerel*
Clupea harengus	Atlantic herring *
Pleuronectes americanus	winter flounder *
Alosa pseudoharengus	alewife
Alosa aestivalis	blueback herring
Morone saxatilis	striped bass
Lepomis macrochirus	bluegill
Gadus morhua	Atlantic cod *
Homarus americanus	American lobster
Acipenser oxyrinchus	Atlantic sturgeon**

*Essential Fish Habitat species designation (Department of Commerce, 1999)

** On January 31, 2012, NOAA's Fisheries Service listed five distinct population segments (DPSs) of Atlantic sturgeon under the Endangered Species Act. The Chesapeake Bay, New York Bight, Carolina, and South Atlantic populations of Atlantic sturgeon are listed as endangered, while the Gulf of Maine population is listed as threatened.

Cunner

This species, a close relative of the tautog, lives near the coastline and is usually found inhabiting eelgrass beds and other benthic structures. They are observed swimming near piers, docks, and among rocks. Cunner are not a sought after commercial fish or popular recreational fish. One noteworthy characteristic of cunner is that they do not migrate long distances. Therefore, the reduced presence of this species within an area of its expected range may be an indicator of local stress to the biological community in that specific area (US Fish and Wildlife Service). Cunner have been documented in the Piscataqua River and in the vicinity of Schiller Station. This species makes up a large relative percentage of the annual entrained ichthyoplankton and annual impingement numbers recorded at Schiller Station.

Rainbow Smelt

This small anadromous fish is found in estuaries, harbors, and offshore waters during summer, autumn and winter. Smelt migrate into rivers and streams to spawn, beginning in late winter (Massachusetts) to late spring (eastern Maine). It is an important prey species as well as a sought after recreational fish. Rainbow smelt populations are in decline. Spawning runs that once teamed with smelt are greatly diminished. Since 2004, rainbow smelt have been designated as a federal Species of Concern under the Endangered Species Act (ESA) (National Oceanic and Atmospheric Administration – National Marine Fisheries Service; NOAA Fisheries). Rainbow smelt ichthyoplankton have been entrained at Schiller Station. Rainbow smelt make up a large relative proportion of fish impinged at the station as well

Atlantic Mackerel

In the western Atlantic, mackerel are found from Labrador to North Carolina. Atlantic mackerel are common in cold and temperate waters over the continental shelf. They swim in schools near the surface, and travel to and from spawning and summering grounds. Depending on their size, females can hatch between 285,000 and almost 2 million eggs. Eggs generally float in the surface water and hatch in 4 to 7½ days, depending on water temperature. An important part of the food web, Atlantic mackerel feed heavily on crustaceans such as copepods, krill, and shrimp, while they serve as prey items for several species of fish and marine mammals. Atlantic mackerel are sensitive to changes in water temperature and migrate long distances on a seasonal basis to feed and spawn. An important commercial fish, overfishing eventually depleted the Atlantic mackerel stock in the 1970's. Fishery managers have implemented annual catch quotas to limit harvests and rebuild the stock (NOAA Fisheries). Atlantic mackerel are designated as Essential Fish Habitat species (Department of Commerce). Atlantic mackerel ichthyoplankton were recorded in entrainment samples collected from October 2006 to September 2007 at Schiller Station. However, adult mackerel were not found in impingement records from the same time period. While impingement and entrainment monitoring data from a power plant may not be a representative indicator of the presence or abundance of a fish species in the associated waterbody, the absence of adult mackerel in impingement sampling may be an indication that this important representative species spawns in near-by coastal waters adjacent to the Piscataqua River, but juvenile and adult life stages of the species are not routinely found in large numbers in the river itself.

Atlantic Herring

A small schooling fish, herring are found in coastal and continental shelf waters from Labrador to Cape Hatteras, North Carolina. When herring spawn, they deposit their eggs on the rock, gravel, or sand bottoms. Schools of herring can produce so many eggs that they can cover an area of ocean bottom in a dense carpet of eggs several centimeters thick. A variety of bottom-dwelling species including winter flounder, cod, haddock, and red hake feed on herring eggs. Juvenile herring are heavily preyed upon due to their abundance and small size (NOAA Fisheries). An important commercial fish, like Atlantic mackerel, the stock was greatly depleted in the 1970's. Atlantic herring has recovered substantially from those very low levels and is now harvested sustainably. This fish has been designated as an Essential Fish Habitat species (Department of Commerce, 1999). Early life stages as well as juvenile and adult herring are present in the Piscataqua River, as reflected in entrainment and impingement records at Schiller Station.

Winter Flounder

This species is found in estuaries and on the continental shelf of the Northwest Atlantic, from the Gulf of St. Lawrence, Canada, to North Carolina. In the winter, adults migrate from offshore areas where they feed to inshore bays and estuaries where they spawn. Females usually produce between 500,000 and 1.5 million eggs. They deposit their eggs on sandy bottoms and algal mats at night, usually about 40 times every spawning season. They are benthic feeders. Fish (mainly striped bass, bluefish, toadfish, and summer flounder), birds, invertebrates, winter skate, and marine mammals prey on larval and juvenile winter flounder. Atlantic cod, spiny dogfish, and monkfish prey on adults (NOAA Fisheries). Winter flounder are an important commercial and recreational fish throughout New England and the Mid-Atlantic, although current harvests are a fraction of their historic levels. Heavy fishing pressure, habitat destruction and other stressors caused winter flounder stocks to drastically decline. Strict fishing regulations are now in place. Winter flounder life stages are present in the Piscataqua River. They made up approximately ten percent of the fish impinged from October 2006 to September of 2007 at Schiller Station. Early life stages of this species were also identified in entrainment samples at Schiller Station.

Alewife and Blueback Herring

These species, together known as "river herring" are important anadromous fish in the Piscataqua River. When in the marine environment, they form large schools. Alewife are more sensitive to temperature and they ordinarily spawn in early spring at temperatures of about 55° to 60°. Herring begin spawning at slightly higher temperatures. River herring eggs are about 0.05 inches in diameter and stick to brush, stones, or anything else they may settle upon. Incubation occupies about 6 days at 60°. Young alewives are about 5 mm long when hatched, grow to 15 mm long when a month old, and soon after begin to work their way downstream. They have been seen descending as early as June 15 in more southerly Gulf of Maine streams. Successive companies of fry may move out of the spawning area and down with the current throughout the summer; and by autumn the young alewives have all found their way down to salt water when 2 to 4 inches long. River herring are chiefly plankton feeders; copepods, amphipods and shrimp are common prey items (Bigelow and Schroeder, 1953). Numbers have declined and the range of the two species has been restricted from overfishing, pollution, and restricted fish passage. River herring are harvested for food and bait. In New Hampshire, these species are managed by the NH Fish and Game Department. Relatively small numbers of river herring have been impinged at Schiller Station. River herring larvae have not been identified in the entrainment samples.

Striped Bass

The striped bass is a highly migratory fish that moves north from the mid-Atlantic during the spring and autumn, spending May through October feeding on Great Bay's river herring, pollock, and silversides. It is a relatively large fish, a rapid swimmer and a carnivorous feeder that grows rapidly. The striped bass can move from fresh water to salt water and return with ease. It produces a great many eggs and larvae, of which only a few per female survive to maturity. Females produce eggs in direct proportion to their weight. A three-pound female produces 14,000 eggs and a 50-pound female produces about five million eggs. Larvae feed on zooplankton and the young-of-year feed on small fish and worms. When they are about six inches long, they begin to feed on small schooling forage fish, soft-shelled clams, peeler crabs, and clamworms. Adults feed on menhaden, river herring, anchovies, white perch, blue crabs, and other invertebrates. (NOAA Fisheries). The population of striped bass is robust and it is the most sought after coastal sportfish in New Hampshire. (NH Fish and Game). Striped bass are an important predator species in the Piscataqua River. The species early life stages were not identified in entrainment samples at Schiller Station, but a relatively small number of these fish were collected during impingement sampling.

Bluegill

The bluegill is a species of freshwater sunfish introduced into most New Hampshire water bodies. Its original range included the St. Lawrence and Mississippi River basins and Atlantic slope drainages as far north as Virginia. Bluegills thrive among thick aquatic vegetation, feeding on invertebrates and small fish. Females lay eggs in shallow circular depressions along the shoreline, excavated by males who aggressively defend their nests. Females may lay up to 27,000 eggs and remain reproductively active as long as water temperatures are suitable; in some years this may extend into late fall. They can survive in very warm water temperatures and are considered tolerant of pollution and habitat alteration. There are no specific conservation or management targets for bluegill in New Hampshire (NH Fish and Game). Since bluegill are nest builders and spawn in a low energy, fresh water environment, it is not surprising that no early life stages were present in Schiller Station entrainment samples. Adult bluegill, along with pumpkinseeds, a related sunfish family member (centrarchids), were collected in small numbers as part of Schiller Station impingement sampling.

Atlantic Cod

Atlantic cod are distributed throughout the North Atlantic, with well-known stocks in the Grand Banks and Georges Banks. Smaller stocks exist closer to shore in Southern New England and in the Gulf of Maine. In coastal New Hampshire, codfish of various ages are near the Isles of Shoals and both juveniles and adults are caught along Jeffrey's Ledge. They can occur from surface waters to depths of 1,200 feet, depending on life stage and season. Adapted for bottom feeding, they inhabit rocky bottoms but may occasional feel on herring in the water column. Codfish in the Gulf of Maine spawn during February or March and all females are mature by the time they are 23 inches long (NH Fish and Game). They feed on copepods, amphipods, and barnacle larvae as juveniles. Adults feed on shrimp, small lobsters, spider and hermit crabs, and fish such as capelin, herring, and sand lance. They are prey to larger fish, marine mammals and humans. Adult cod form spawning aggregations from late winter to spring and the fertilized eggs drift with the currents as they develop into larvae. Several stocks of Atlantic Cod went through a population crash in the 1990's and have failed to recover. The primary threat the species face is from overfishing (NOAA Fisheries). It is also under a fishery management plan by the New England Fishery Management Council, which is designed to reduce fishing mortality and promote rebuilding of the stocks. At Schiller, early life stages of Atlantic cod were recorded in entrainment samples and juvenile cod were noted in impingement samples, both in relatively small numbers.

American Lobster

The American lobster is found only on the eastern coast of North American where its range includes 1,300 miles of coastline no more than 30 to 50 miles wide, then widening at Cape Cod, Massachusetts to nearly 200 miles on Georges Bank. They live on rocky bottoms and are scavengers rather than hunters, feeding on carrion, clams, snails, mussels, worms, sea urchins, and even other lobsters (NH Fish and Game). To grow, they must molt, which occurs primarily during June to October, although this varies in different locales. After a complicated mating process a female can carry sperm for as long as a year before fertilizing her eggs. The number of eggs produced by a female depends on her size: a 1 ½-pound lobster can produce about 10,000 eggs, while a 20-pound lobster can produce nearly 100,000. She carries the eggs for 9 to 12 months. When hatched, larvae spend four to five weeks near the surface of the ocean, transported by wind and currents as they pass through four distinct growth phases. The lobster is more abundant in the northern part of its range included Maine, New Hampshire, and parts of Canada. (NOAA Fisheries). Lobsters are a finite resource, and they are carefully managed so that the population can sustain itself at a healthy and harvestable level. Techniques include size restrictions for harvested lobsters, V-notching fertile females and returning them to the water, as well as limiting numbers of traps (NH Fish and Game). Schiller Station has impinged adults and juvenile lobsters and has entrained a relatively small number of their larvae.

Atlantic Sturgeon

The Atlantic sturgeon is a long-lived, estuarine dependent, anadromous fish. Atlantic sturgeon can grow to approximately 14 feet long and can weigh up to 800 pounds. The more southern populations mature chronologically earlier than the northern. Spawning adults migrate upriver in spring, as early as February in more southern areas and as late as June the farthest north. Spawning occurs in flowing water between the salt front and fall line of large rivers. Atlantic sturgeon spawning intervals range from 1 to 5 years for males and 2 to 5 years for females. Females produce eggs based on their age and body size, ranging from 400,000 to 8 million eggs. Sturgeon eggs are highly adhesive and are deposited on bottom substrate, usually on hard surfaces (e.g., cobble). It is likely that cold, clean water is important for proper larval development. Atlantic sturgeon are benthic feeders and typically forage on benthic invertebrates such as crustaceans, worms, and mollusks.

On February 6, 2012, NOAA's National Marine Fisheries Service (NMFS) listed five distinct population segments of Atlantic sturgeon under the Endangered Species Act. The Chesapeake Bay, New York Bight, Carolina, and South Atlantic populations of Atlantic sturgeon were listed as endangered, while the Gulf of Maine population was listed as threatened. The decision became effective on April 6, 2012. Atlantic sturgeon found in the Piscataqua River are part of the Gulf of Maine population and therefore listed as threatened. As part of ongoing communication with NMFS for other federal actions in the Piscataqua River, NMFS reported that Atlantic sturgeon use the portion of the Piscataqua River in the vicinity of Schiller Station (E-mail from C. Vaccaro, NMFS to D. Arsenault, EPA, September 12, 2011).

Based on this information and the expected distribution of the species, EPA has initiated an Endangered Species Act informal Section 7 consultation with NMFS Protected Resources Division as part of this permit action (see Section 13 and Attachment E of this document). No Atlantic sturgeon were collected in impingement and entrainment sampling from October 2006 to September of 2007 at Schiller Station.

Summary

The RIS described in Table 6-C, represent a fish assemblage that includes all expected levels of a stable biological community for this type of environment. These levels include forage species (blueback herring and alewife), higher trophic level predator species (cod and striped bass), pelagic feeders (Atlantic mackerel), benthic feeders (winter flounder, American lobster), anadromous species (rainbow smelt, striped bass, river herring), and riverine freshwater species (bluegill and other sunfish).

A central challenge of this particular CWA § 316(a) variance analysis is the lack of a strong, long-term data set on the health of the species that make up or represent the BIP in the area of Schiller Station. Long-term data on the overall abundance of fish, or on the abundance of particular species of fish, in the area of the discharge does not exist as far as EPA knows. Moreover, there is no "before-and-after" fish abundance data that might be able to indicate whether or not the onset, or any increase, of thermal discharges by the Facility might appear to correlate with any declines of local fish populations.

Nevertheless, EPA reviewed the best available information to support its CWA § 316(a) analysis. This assessment utilized a variety of information, including the thermal monitoring data discussed above and the scientific literature concerning thermal effects on aquatic organisms. EPA also considered impingement and entrainment monitoring data from Schiller Station, while recognizing that there are important limitations on using this data in the CWA § 316(a) context, as this data was not generated from a sampling program scientifically designed to monitor fish abundance in the river. EPA also considered information from the records for the Newington Station NPDES permit renewal and the Dover Wastewater Treatment Facility NPDES permit renewal. Both of these facilities are located along the Piscataqua River in the vicinity of Schiller Station.

Scope of Schiller Station's Current Thermal Discharge Plume

For the purposes of this discussion, the Schiller Station "mixing zone" is identified as a subset of the overall area affected by the facility's thermal discharge plume and it constitutes the area that extends in the water in any direction 200 feet from the thermal discharge outfalls. The highest surface temperatures have been documented in the mixing zone. The mixing zone is part of the larger area affected by the facility's thermal plume. As discussed earlier, temperatures at the edge of this mixing zone may not exceed 84°F, according to the existing permit, but instream temperatures were shown to be much lower, with a representative high surface temperature of 24.0°C (75.2°F) to 25.0°C (77.0°F) or below (Figure 6-2). Recorded on a reasonably "worst case day" of thermal contribution by the facility (August 31, 2010), this represents a maximum delta T of from 1°C (1.8°F) to 2°C (3.6°F) above the ambient temperature.

Because of the configuration of the discharge, the high energy currents in the Piscataqua River, and the assumption that more mixing takes place as the thermal discharge moves into the receiving water from the outfall, the thermal influence of the discharge is expected to dissipate past the 200-foot mixing zone boundary. This is confirmed in Figure 6-2. Although elevated temperatures above ambient may still be detected greater than 200 feet away from the discharge, the extent of the temperature increases is expected to be much less. Since temperatures within the mixing zone are not expected to adversely affect the biological community, the more diluted areas of this extended area affected by the thermal plume is also not expected to adversely affect the biological community.

EPA assessed the scope of Schiller Station's thermal plume based on the thermal monitoring data discussed above. The scope of the plume refers to the area and depth of the river which experiences temperature changes as a result of the Facility's discharges, as well as the intensity of those temperature changes. As explained above, the thermal monitoring data was collected during the summer and fall. The one day "snap-shot" characterization of the thermal plume, conducted on August 31, 2010, is representative of reasonably worst case conditions.

This thermal monitoring data reveals that Schiller Station's thermal discharge plume is relatively modest in scope, even under worst case summer conditions (Figure 6-2). This is not surprising in light of the volume, velocity and cold temperature of Piscataqua River flows in the area of Schiller Station relative to the moderate nature of the Facility's thermal discharge. Schiller Station's DMR data shows a maximum discharge temperature of 95ºF and a maximum reported discharge flow rate of approximately 120 MGD for Outfalls 002, 003 and 004 combined. Furthermore, outside of the peak summer operations represented in the monitoring data, Schiller Station in recent years has typically operated at a much lower capacity factor and, accordingly, would commonly produce a far lesser thermal plume. As indicated in the Zone of Passage discussion to follow, along with Figure 6-2 and the discussion of thermal data, the thermal plume neither reaches very far, nor is very hot, and it does not penetrate deeply into the water column.

Zone of Passage with the Current Thermal Discharge

From reviewing the available information, EPA concludes that under the existing permit conditions, Schiller Station's thermal discharge plume will not create a significant impediment to fish or other organisms migrating, or otherwise seeking to swim, past the Facility. This is because the thermal plume extends neither far nor deep enough into the river at high enough temperatures to significantly interfere with fish passage.

The total bank-to-bank width of the Piscataqua River, measured at the narrowest point of the river, perpendicular to the flow in the vicinity of the Schiller Station outfalls, is approximately 850 feet. Water temperature data shows, however, that the highest temperature "hot spot" recorded within the 200-foot mixing zone designated by the existing permit is only 82.4ºF, and this peak temperature occurs at a small point within the mixing zone. The area outside this mixing zone, while required to meet a temperature limit below 84ºF, is only minimally affected by the thermal discharge and maintains ambient river temperatures for the majority of the remaining width of the river. An examination of Figure 6-2 indicates that a rise in surface temperature of up to a degree Celsius, from 23.1ºC to 24ºC (approximately a 1.7ºF rise; 73.6ºF to 75.2ºF) over ambient river temperature is evident in a localized area upstream from the discharge. This is a minimal, localized surface temperature increase, likely of short duration. The high energy tidal flow of the Piscataqua River is moving water past the discharge, fostering vigorous mixing. A transitory temperature increase of this magnitude is expected to have an insignificant impact on fish passage in the river and the aquatic community in the vicinity of the discharge. A more detailed discussion of the potential impacts of various absolute water temperature as well as delta T's will be included later in this section.

It must be noted that the requirements of the mixing zone specified by the existing permit do not stipulate that ambient temperatures must be achieved at the edge of the mixing zone, but rather a maximum temperature of 84ºF must not be exceeded. Under the reasonably worst case conditions observed on August 31, 2010, the maximum mixing zone temperature allowed would have resulted in a delta T of approximately 10.6ºF at the edge of the mixing zone. An inspection of the thermal map confirms that the majority of the surface area associated with the New Hampshire side of the river, in addition to all of the Maine side of the river (it is reasonable to assume), maintained ambient river temperatures.

In addition, as detailed above, the thermal plume is discharged from surface outfalls and is buoyant. As a result, the plume's effect on water temperature decreases with greater depth in the river. Indeed, the thermal plume is primarily a near-surface feature expected to occupy only a small portion of the water column and not to contact sediment or benthic species. This is confirmed by a three-month data set of temperatures collected from temperature monitors placed near the surface, at mid-depth and near the bottom of the river. Monitors at mid-depth and near bottom recorded cooler temperatures than the surface monitors (Table 6-B).

The width and depth of the river unaffected by the Facility's thermal plume allows sufficient zone of passage for both swimming and drifting organisms. Swimming organisms have a large section of the river available in the event an avoidance response is triggered by the thermal plume. Such avoidance behavior due to elevated temperatures would only occur, if at all, in a very small area within the mixing zone. In EPA's judgment, the thermal discharge represents little or no impediment to fish migration up or down the Piscataqua River. Moreover, EPA concludes that the thermal plume will not degrade fishing opportunities in the vicinity of Schiller Station.

With regard to drifting organisms, the majority of early life stages of fish in the Piscataqua River will pass by Schiller Station without coming in contact with the plume. Although a percentage of drifting organisms moving along the southern bank (New Hampshire side) of the river at the surface may encounter the thermal discharge, the high energy tidal currents of the Piscataqua move water quickly past the Schiller outfalls under most tidal conditions. For example, assuming the entire 200-foot wide mixing zone contained a delta T of 2°C (3.6°F) above ambient conditions (projected worst case conditions). At the maximum tidally induced river current of 4.9 feet per second, a drifting organism would move through the mixing zone in 41 seconds. Over 80% of the tidal cycle is expected to move a drifting organism through the mixing zone in from under one minute to 13 minutes. The maximum expected exposure of a drifting organism to the mixing zone is projected to be approximately 33 minutes, during slack tides. This quick transport past the mixing zone, under most conditions within a matter of minutes, will limit the exposure time of the organisms to any elevated water temperatures.

In broad terms, sudden changes in temperature are believed to be deleterious to fish life, with abrupt changes of 5°C (9°F) or greater likely to be harmful (Snyder 2011). Tolerance of fish to changes in temperature is species specific, based on acclimation temperature, the life stage, the condition of the individual fish and the time of exposure to the elevated temperature, among other factors. As discussed above, a delta T of 2°C (3.6°F), was the highest delta T observed under reasonably worst case conditions on August 31, 2010.

While specific temperature tolerance information was not assembled for every RIS species, a general review of the literature supports EPA's judgment that drifting organisms that encounter the thermal plume will not experience an adverse effect.

For example, winter flounder larvae were exposed for 13 minutes to a delta T from 8°C (14.4°F) to 14°C (25.2°F) and the larvae were then observed for 96 hours. Only larvae exposed to the delta T of 14°C yielded mortality different from the control organisms (Valenti, 1974).

In another experiment, three species of flounder larvae were exposed to a delta T of 12°C (21.6°F) under a range of exposure times and did not show significant decreased survival (Hoss et al. 1973).

Two week old striped bass larvae were exposed to a delta T of 7°C (12.6° F) for 30 minutes (acclimation temperature of 22°C; 71.6°F) without mortality. However, delta T's of 9°C (16.2°F) and 11°C (19.8°F) caused approximately 50% mortality with an exposure of 5 to 6 minutes (Coutant and Kedl, 1975).

Blueback herring eggs were exposed to a delta T of 10°C (18°F) for exposure times of 5, 30 and 180 minutes (Koo and Johnson, 1978) without mortality of the hatched larvae.

The literature did indicate that at least for some species, an absolute temperature above 30°C (86°F) was likely to result in mortality, even under limited exposure times. For example, an exposure of striped bass larvae to temperatures of 31C° (87.8°F) and 31.9°C (89.4°F) for as little as 5 to 6 minutes resulted in increased mortality.

This general review reinforces the expectation that drifting organisms in the Piscataqua River exposed to an increase in temperature for several minutes will experience no detrimental effects.

Furthermore, comparing the peak temperatures within the mixing zone of the thermal plume to the critical temperatures indicated in the literature for the RIS, EPA concludes that the thermal plume is unlikely to have caused appreciable harm to the BIP in the past and is unlikely to do so in the future. When comparing thermal plume temperatures with the temperature sensitivity of species found in the area of the facility, two important factors must be considered.

First, the modest size of the mixing zone and thermal plume as a whole, along with the high energy currents of the river, only allows exposure of organisms to elevated temperatures for a short period of time (see the drifting organism discussion above). Controlled experiments published in the scientific literature to obtain thermal tolerance information for specific species of fish are generally based on a 24-hour, 48-hour or 96-hour exposure of the organism to the elevated temperature, with no opportunity for avoidance of the temperature. As discussed above, this is not directly applicable to the brief thermal exposure (possibly a few minutes) an organism is likely to experience in the mixing zone or overall thermal plume of Schiller Station. Therefore, the thermal tolerance data obtained from the literature may be of limited value.

Second, once again, the modest size of the mixing zone and thermal plume as a whole compared with the unaffected area of the Piscataqua River is a factor. For many fish species, avoidance temperatures are triggered well before the fish is exposed to potentially lethal temperature values. Because the Piscataqua River in the area of the station retains a large portion of the river that is unaffected by the thermal plume, adult and juvenile fish species have the opportunity to easily avoid the elevated water temperature long before potential lethality is a consideration, if at all. This avoidance behavior is not judged to adversely affect the fish species.

A general review of thermal tolerance information for the Schiller Station RIS life stages expected to be present in the Piscataqua River in late summer noted that young-of-year alewife acclimated to 75.2°F showed a no effects level (100% survival) at a test temperature of 84.2°F

(Otto, 1976). Cunner showed an upper sublethal temperature in the range of 78.8°F to as high as 89.6°F (Auster, 1989). Adult striped bass and adult bluegill acclimated to 73.4°F demonstrated a loss of equilibrium at approximately 97°F. Adult striped bass have been found to tolerate temperatures as high as 84ºF without visible signs of stress.

To evaluate potential impacts to adult species or early life stages of fish expected to be present in the vicinity of Schiller Station outside of the summer months, EPA used the in-stream delta T ranges documented for the summer season (2°F to 4°F delta T in most of the mixing zone, with a localized hot spot as high as 9°F above ambient) combined with documented ambient river temperatures for the months where the appropriate species or life stages are expected to be present. It would have been inappropriate to use the maximum summer mixing zone temperatures observed in August to assess cooler ambient water temperature conditions.

EPA has taken a conservative approach to the thermal evaluation during other seasons. It is likely the facility will not run at high summer capacity and will therefore experience a lower delta T across the condensers in the fall, winter and spring, when the once through cooling is more efficient. However, EPA is using the summer season delta T and facility operation for this discussion. Although Figure 6-2 represents summer conditions, EPA assumes that when the facility is operating at a high capacity during other times of the year, the general pattern and delta T configuration of the temperature contours of the mixing zone will be generally similar. Therefore, Figure 6-2 is a reasonable reference point as to the delta T contours likely to be seen in the mixing zone during other times of the year.

For example, adult rainbow smelt inhabit the lower Piscataqua River in the spring. Smelt have been tested at temperatures as high as 68°F without mortality. (Woytanowski and Coughlin, 2013), but under an acclimation temperature of 52°F, the upper incipient lethal temperature is reported to be 64°F (Evans and Loftus 1987). The acclimation temperature of 52°F generally corresponds to Piscataqua River ambient temperatures during the month of April. (Schiller Station DMR data, 2000 - 2012). Assuming the thermal mixing zone would contain delta T ranges similar to levels documented for the summer season (2°F to 4°F delta T in most of the mixing zone, with a localized hot spot as high as 9°F above ambient), mixing zone temperatures would range from 54°F to as high as 61°F during the month of April. These temperatures are still below the smelt upper incipient lethal temperature of 64°F.

EPA also reviewed potential impacts, if any, to Atlantic sturgeon, a federally protected species that may be in the action area of the facility. Although sturgeon are a benthic species and will not likely come in contact with a surface thermal plume, this review is designed to provide a discussion of temperatures expected in the overall action area of the facility. The preferred temperature ranges and upper and lower lethal temperatures for Atlantic sturgeon are not well established. Atlantic sturgeon juveniles in the Hudson River have been documented to move downstream as the river warms in the spring, seeking temperatures of approximately 75°F to 76°F. Once again, assuming the thermal mixing zone during any season would contain delta T ranges similar to levels documented for the summer season (2°F to 4°F delta T in most of the mixing zone, with a localized hot spot as high as 9°F above ambient), mixing zone temperatures would likely be from 60°F to as high as 67°F during the month of May. This is based on an average Piscataqua River ambient temperature in May of approximately 58°F (Schiller Station DMR data, 2000 - 2012). Thus, elevated near-surface water temperatures are unlikely to thermally stress Atlantic sturgeon found in the vicinity of Schiller Station.

As discussed below, EPA also considered the potential impact of the thermal mixing zone on early life stages of organisms that may drift into the thermal plume. The presence of eggs and larvae in the Piscataqua River peaks in the month of June, according to entrainment sampling at Schiller Station. Using the Facility's DMR data from 2000 to 2012, the monthly average ambient river temperature in the Piscataqua River in June ranged from 63°F to 69°F, with an overall average for the thirteen years of approximately 66°F. A representative ambient temperature of 66°F was selected for June for the purposes of this discussion. Also, as discussed previously, EPA conservatively assumed the thermal mixing zone would contain delta T ranges similar to levels documented for the summer season (2°F to 4°F delta T in most of the mixing zone, with a localized point as high as 9°F above ambient). This approach results in projected near surface mixing zone temperatures in the range of 68°F to 70°F for most of the mixing zone, with a localized point of 75°F during the month of June. A general literature review of temperature sensitivity of the early life stages of relevant fish species noted a 50% habitat suitability of blueback eggs and larvae at approximately 78ºF. (Pardue *et al*., 1983). For tautog, a close relative of the cunner, Olla and Samet (1978) reported that eggs incubated above 68°F resulted in embryos with anatomical deformities. Atlantic mackerel larvae have been collected at temperatures only as high as approximately 72°F (NOAA September 1999). These temperature thresholds do not exceed the range of near surface temperatures expected in the majority of the mixing zone. As discussed previously, the experiments conducted in the case of tautog eggs use an incubation time of over 24 hours. Any exposure of the small number of tautog eggs to the hottest point of the mixing zone will likely last minutes and result in a minimal chance of an adverse impact. For the same reasons of limited opportunity of exposure and the short duration exposure, no adverse impacts to mackerel species are expected to occur as well.

There does also seem to be an absolute temperature range, in addition to a delta T range, beyond which even a minimal time exposure can cause harm to fish species. For example, an exposure of striped bass larvae to temperatures of 31C° (87.8°F) and 31.9°C (89.4°F) for as little as 5 to 6 minutes resulted in increased mortality. As a general guideline to maintain survival in temperate areas, one approach to consider is to manage thermal discharges so that large areas are not heated above 30°C (86°F) for long periods (Cairns, 1956).

Phytoplankton similar to the tiny, free floating plant life found in the lower Piscataqua River have been shown to be influenced by an increase in water temperature. Ilus and Keskitalo (2008) observed that phytoplankton exposed to water with a temperature elevated by approximately 3.6°F for an extended period demonstrated increased primary productivity and overall biomass. A shift in the relative abundance of the phytoplankton community was also noted. Research on short duration exposure of phytoplankton to elevated temperatures was not available. In the case of phytoplankton, EPA has judged that the anticipated brief exposures to the range of delta T's in the mixing zone (2°F to 9°F) will not result in detectable mortality or otherwise meaningful levels of mortality. In addition, since the thermal plume is a surface feature and does not directly contact the benthic habitat that might contain anchored plant life, no mortality is anticipated in this area. At the same time, EPA also does not regard Schiller Station's thermal discharge to the Piscataqua River to pose a threat to the BIP as a result of fueling phytoplankton growth because of the limited scope of the thermal plume.

It must be noted, however, that there is a degree of unavoidable uncertainty over the extent to which the thermal sensitivity temperatures referenced in this section will reliably predict potential thermal effects on the various life stages of fish in the Schiller Station mixing zone. These temperatures are primarily derived from laboratory experiments designed to evaluate the biological impacts of elevated water temperatures on various life stages of fish by maintaining the subject organisms in the warmer test water for hours, or even days, in order to determine a stress response. Free floating eggs and larvae in the vicinity of Schiller Station, however, would likely only be exposed to elevated near-surface temperatures in the mixing zone for a matter of minutes at most because of the active tidal currents of the Piscataqua River. Furthermore, under actual river conditions, motile organisms can swim away from any encounter with a small area of disfavored water temperatures. Therefore, the effects of the Schiller Station thermal discharge would be expected to be less than would be predicted by the literature.

Other Potential Effects on the BIP from the Current Thermal Discharge

The reach of the lower Piscataqua River receiving Schiller Station's thermal discharge is not considered a high value spawning or nursery area. The industrialized shoreline and high energy tidal currents in the area of Schiller Station do not provide high quality spawning or nursery habitat for indigenous aquatic species. Anadromous nursery areas are usually found in low flow aquatic habitats with structure sufficient to afford shelter for young-of-year and juvenile fish species. This segment of the Piscataqua River does not have these features. Furthermore, to the extent that any benthic (at a depth of approximately 30 feet) nursery habitat did exist in the vicinity of Schiller Station's discharge, the buoyant thermal plume would be unlikely to affect the benthic habitat. While EPA expects that some spawning likely takes place in the area of the Schiller Station discharges – for example, based on entrainment data presented in Table 8-A, cunner may spawn in these waters – the relatively limited scope of the thermal plume is likely to have limited, if any, effect on such spawning. In addition, early life stages (ELS; eggs and larvae) of many species are represented in entrainment sampling at Schiller Station and monitoring data from the EP Newington Energy facility, indicating successful spawning in the larger habitat of the Piscataqua River and Great Bay.

EPA is not aware of evidence suggesting that Schiller Station's existing thermal discharge has undermined the protection and propagation of the BIP, either in terms of the overall community of organisms or the populations of specific species that are part of the BIP. EPA is also not aware of any data suggesting that the local community of aquatic organisms, or populations of individual indigenous species, is less healthy in the relevant area of the Piscataqua River than in other similar waters in the region. Moreover, as discussed above, the temperatures in the Schiller Station thermal plume are not high enough – relative to the delta T, short exposure time information and critical temperatures for the RIS – to cause adverse impacts to species in the receiving water.

EPA is also unaware of any evidence suggesting that Schiller Station's thermal discharge has resulted in the dominance of nuisance species in the receiving water. Such an effect is not expected given the relatively small scope of the Facility's thermal discharge plume. Impingement and entrainment records from Schiller Station and monitoring data from the EP Newington Energy facility indicate that marine, riverine and anadromous RIS, at all life stages, are present in the river, and the fish assemblage is not dominated by nuisance species. Taking all of this into account, EPA finds that Schiller Station's thermal discharge has not harmed the BIP in the relevant area of the Piscataqua River and would not be expected to do so in the future.

EPA has reached this conclusion taking into account the length of time that Schiller Station has maintained its thermal discharges and the nature of those discharges, as discussed above. *See* 40 C.F.R. § 125.73(c)(2). Furthermore, EPA also has taken into account whether appreciable harm might have been caused by the Facility's thermal discharge interacting with other types of pollutant discharges or other thermal discharges. With regard to the former, EPA does not see any pollutants being discharged by Schiller Station or other dischargers that would combine with the Facility's thermal discharge in a way that would have appreciably harmed the BIP or that would undermine assurance of the protection and propagation of the BIP going forward. With regard to the latter, EPA considered the thermal discharges from PNSH's Newington Station power plant and the EP Newington Energy, LLC, power plant, both of which lie along the Piscataqua River upstream of Schiller Station. Neither of these discharges, however, presents a significant adverse cumulative thermal effect in conjunction with Schiller Station's discharge. Newington Station currently operates only infrequently and, therefore, contributes little heat to the river (*see* Newington Station Capacity Factor Information (AR-253)). The EP Newington Energy facility operates with a closed-cycle cooling system using wet cooling towers and has only a relatively small thermal discharge (specifically 4.0 MGD of cooling tower blow down, *see* NPDES Permit No. NH0023361 (available on EPA's website at http://www.epa.gov/region1/npdes/permits/2012/finalnh0023361permit.pdf)

PSNH Request to Increase Effluent Temperature Limit to 100ºF

PSNH has requested that EPA raise the permit's temperature limit to 100ºF for its cooling water discharges. EPA proposes to reject this request as part of the draft permit. The primary reason for this rejection is that PSNH has not made an adequate demonstration, or really any demonstration at all, that the protection and propagation of the BIP will be assured with discharges at that level. All the data and analysis regarding conditions under the existing permit involve discharges of 95ºF or less and do not establish that the BIP will be adequately protected with discharges up to 100ºF. Raising the discharge temperature would increase the amount of heat discharged to the river and would change the scope of the thermal discharge plume to some unknown extent. As a result, Schiller Station has not carried its burden to demonstrate to EPA that the protection and propagation of the BIP would be assured with a temperature limit of 100ºF applied pursuant to a CWA § 316(a) variance. Furthermore, EPA would expect to see higher temperatures within a larger area than exists with the current temperature limit of 95ºF. As a result, there would be a greater chance of adverse effects to any swimming or drifting organisms that contact unfavorable temperatures from the thermal discharge plume.

The permittee has also requested that temperature limits be removed at outfall 001. EPA proposes to reject this request because detailed supporting information and a justification was not included with the request.

Conclusion

Based on the above analysis, EPA concludes that Schiller Station's existing thermal discharge has not caused appreciable harm to the BIP. Moreover, EPA concludes that the record provides reasonable assurance that with the same thermal discharge limits in place, the Facility's thermal discharge will not cause such harm to the BIP in the future – in other words, will allow for the protection and propagation of the BIP. Indeed, the Facility's declining capacity factors indicate that, if anything, Schiller Station's thermal discharges will decrease overall in the future, though EPA cannot be sure of whether or when such reductions may occur.

Thus, EPA's new draft permit for Schiller Station proposes to retain the thermal discharge limits from the existing permit. Consistent with the Facility's request, EPA is proposing to issue these permit limits pursuant to a variance under CWA § 316(a).

EPA could lawfully end its analysis in support of the permit's thermal discharge limits here based on granting Schiller Station's request for a renewal of its CWA § 316(a) variance. These variance-based limits would supplant any more stringent technology-based and/or water quality-based limits that would otherwise be prescribed under CWA § 301. EPA decided, however, to present an assessment of technology-based and water quality-based requirements in this Fact Sheet because of public interest in this permit. Not only does PSNH obviously have strong interest in this permit but wider public interest has been evidenced by the Sierra Club's law suit against EPA filed in 2011 seeking to accelerate the Agency's development and issuance of this permit. EPA anticipates that if it only addresses thermal discharge requirements under CWA § 316(a), then comments and questions might be raised about what the technology-based and water quality-based permit requirements would have been in the absence of a CWA § 316(a) variance. Therefore, EPA decided to anticipate such questions by providing this additional analysis in the Fact Sheet.

6.4.5 Technology-Based Thermal Discharge Limits

Turning to technology standards, the statute classifies heat as a "nonconventional" pollutant subject to Best Available Technology economically achievable (BAT) standards. *See* 33 U.S.C. §§ 1311(b)(2)(A) and (F). *See also* 33 U.S.C. §§ 1311(g)(4), 1314(a)(4) and 1362(6). As noted previously in this Fact Sheet, the ELGs for the Steam Electric Power Generating Point Source Category, which are found at 40 C.F.R. Part 423, apply to Schiller Station because this facility meets the ELG's definition of a steam electric power plant. This definition covers facilities that, among other things, burn a fossil fuel (coal, oil, gas) as its fuel source. Since the Steam Electric ELGs do not include categorical standards for thermal discharge, the permit writer is authorized under Section 402(a)(1)(B) of the CWA and 40 C.F.R § 125.3 to establish technology-based thermal discharge limits by applying the BAT standard on a case-by-case, BPJ basis.

With regard to technologies for reducing thermal discharges, EPA is aware that closed-cycle cooling towers, if available for use at the site, would substantially reduce (*i.e.*, by approximately 95%) thermal discharges from a facility like Schiller Station. While the Temperature and Temperature Rise limits might remain the same (or close to the same), closed-cycle cooling would allow for an approximately 95% reduction in the volume of the thermal discharge, which, in turn, would result in an approximately 95% reduction in the amount of heat (in BTUs) discharge to the river. Therefore, thermal discharge limits based on this technology would be substantially more stringent than the current limits, which are compatible with Schiller Station's existing open-cycle cooling system. EPA's evaluation of the closed-cycle cooling option is set forth below.

In setting BAT effluent limits on a BPJ basis, EPA considers the relative capability of available technological alternatives and seeks to identify the best performing technology for reducing pollutant discharges (*i.e.*, for approaching or achieving the national goal of eliminating the discharge of pollutants). In addition, before determining the BAT, EPA also considers the following factors: (1) the age of the equipment and facilities involved; (2) the process employed; (3) the engineering aspects of the application of various control techniques; (4) process changes; (5) the cost of achieving such effluent reduction; and (6) non-water quality environmental impacts (including energy requirements). Finally, based upon all available information, EPA also considers the appropriate technology for the category or class of point sources of which the applicant is a member and any unique factors relating to the applicant. *See* 33 U.S.C. § 1314(b)(2)(B); 40 C.F.R. §§125.3(c)(2)(i) and (ii), and 125.3(d)(3). EPA has considered each of these factors in this BPJ determination of the BAT for controlling thermal discharges at Schiller Station.

For the same power plant, an "open-cycle" (or "once-through") cooling system would produce much higher levels of thermal discharge (and water withdrawal) than a closed-cycle or partially closed-cycle cooling system. Schiller Station currently operates with an open-cycle cooling system. As a result, essentially the entire volume of the facility's cooling water (and thus the entire amount of waste heat) is discharged to the receiving water. "Closed-cycle" cooling systems reduce thermal discharges (and cooling water withdrawals) by using cooling water to condense the steam but then, instead of discharging the heated water directly to a receiving water body, they have a cooling system that removes most of the waste heat from the cooling water so that it can be reused for additional cooling.[14] Typically, the waste heat is dissipated to the atmosphere through a cooling tower or cooling pond of some type.

Given that Schiller Station is an existing facility that would require retrofitting to achieve technologically-driven improvements, EPA has investigated the existing steam electric facilities that have achieved the greatest reductions in thermal discharges through technological retrofits. As a general matter, the best performing facilities in terms of reducing thermal discharges at existing open-cycle cooling power plants are facilities that have converted from open-cycle cooling to closed-cycle cooling using some type of "wet" cooling tower technology. Converting to closed-cycle cooling can reduce heat load to the receiving water by 95% or more.[15] EPA's research has identified a number of facilities that have made this type of technological improvement. *See Draft Permit Determinations Document for Brayton Point Station NPDES Permit*, at pp. 7-37 to 7-38; *Responses to Comments for Brayton Point Station NPDES Permit*, at p. IV-115.

Consistent with the retrofit application of closed-cycle cooling at these other facilities, EPA has

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[14] Cooling towers can also be used in a "helper tower" configuration, which involves using cooling towers to "chill" the heated water prior to discharge, but does not involve reusing the cooling water. Therefore, this approach does not reduce cooling water withdrawals.

[15] For example, retrofitting all four generating units at Brayton Point Station in Massachusetts reduced the heat load to Mount Hope Bay (the receiving water) by approximately 96%.

determined that converting Schiller Station's cooling system to a closed-cycle system using wet, mechanical draft cooling towers would be the BAT for the reduction of thermal discharges at the Facility. As part of its determination of the BTA for Schiller Station's CWISs under CWA § 316(b), EPA evaluated alternative cooling system technologies in light of their feasibility and the various factors listed above (*e.g.*, cost, engineering considerations). (*See* Section 9.5.4 below). EPA relies upon and incorporates by reference that technological analysis here.[16] With a wet cooling tower system, Schiller Station's remaining and much reduced thermal discharge (consisting of cooling tower blowdown) would be discharged to the Piscataqua River, subject to specific effluent limits consistent with the technology. With this new cooling technology, Schiller Station's highest volume of thermal discharge would be approximately 1.5 MGD in the summer months, at a temperature of 98°F, assuming an intake temperature of 82°F. This would represent a greater than 97% reduction in flow volume and 95% reduction in heat load from the current two pump operation at a delta T of 20°F.[17]

Although EPA has found that thermal discharge limits based on retrofitting closed-cycle cooling would satisfy the BAT standard at Schiller Station, the draft permit's limits are not based on this technology. This is because, as discussed above, EPA has also concluded that a less stringent set of limits –namely, the thermal discharge limits in the existing permit—would satisfy CWA § 316(a) and support renewal of Schiller Station's existing § 316(a) variance. In other words, technology-based temperature limits based on the installation and operation of a closed-cycle cooling system at Schiller Station would be more stringent than necessary to assure the protection and propagation of the BIP, and the alternative thermal discharge limits will satisfy CWA § 316(a)'s standard for the protection of aquatic life. The thermal discharge limits proposed in the draft permit under CWA § 316(a) are not technology-based, but, as it turns out, they would allow Schiller Station to continue to use its open-cycle cooling system. PSNH would be free, however, to convert to closed-cycle cooling as a method of meeting its permit limits if it wanted to.

6.4.6 Water Quality-Based Thermal Discharge Limits

As explained above, a CWA § 316(a) variance can authorize alternative thermal discharge limits less stringent than what otherwise would be required based on federal technology standards and state water quality standards under CWA § 301. Because EPA is proposing the draft permit's thermal discharge requirements based upon renewal of an existing CWA § 316(a) variance, determining technology-based and water quality-based requirements is not strictly necessary for this draft permit. Nevertheless, as with the technology-based requirements discussed above, EPA decided to determine the water quality-based requirements that would apply to Schiller Station's thermal discharges in the absence of a variance in order to enable the Agency to consider the requirements that the state's water quality standards would call for and to address

[16] *See also* BAT determinations by Region 1 for Brayton Point Station (discussed in *In re Dominion Brayton* Point, 12 E.A.D. at 538-548); for Merrimack Station (Fact Sheet, Attachment D, Section 7.5, http://www.epa.gov/region1/npdes/merrimackstation/pdfs/MerrimackStationAttachD.pdf); General Electric Aviation (Lynn, MA) (Fact Sheet, Section V.C.8.a, http://www.epa.gov/region1/npdes/permits/draft/2011/draftma0003905fs.pdf); and Mt. Tom Station (Fact Sheet, Section 7.1, http://www.epa.gov/region1/npdes/permits/draft/2014/draftma0005339permit.pdf).

[17] Ultimately, the waste heat load discharged by the Facility in BTUs is a function of the volume of thermal effluent discharge and the Delta-T.

possible public interest in the application of state water quality standards.

6.4.6.1 *Determination by NHDES*

EPA generally defers to a state's application of its own water quality standards as reflected in a state certification under CWA § 401(a)(1). *See In the Matter of General Electric Company, Hookset, New Hampshire*, 4 E.A.D. 468, 470 (1993) ("Challenges to permit limitations and conditions attributable to State certification will not be considered by the Agency . . . [and instead] must be made through applicable State procedures."); *In the matter of Lone Star Steel Company,* 3 E.A.D. 713, 715 (1991). Yet, although EPA generally does not "look behind" State certification conditions, if EPA believes that a State has committed "clear error" by failing to include more stringent conditions required by the State's own standards, then EPA *must* include the more stringent conditions in order to comply with CWA § 301(b)(1)(C). *In re Ina Road Water Pollution Control Facility, Pima County, Arizona*, NPDES Appeal 84-12 (Nov. 6, 1985), at 3. *See also In re American Cyanamid Col., Santa Rosa Plant*, NPDES Appeal No. 92-18 (EAB Sept. 27, 1993), at 14; *In re City of Jacksonville, District II Wastewater Treatment Plant*, NPDES Appeal No. 91-19 (EAB Aug. 4, 1992) at 16.

In a letter dated August 7, 2013, EPA asked NHDES whether a renewal of the existing permit's thermal discharge requirements would satisfy the state's water quality standards. More specifically, EPA wrote:

> EPA is seeking concurrence from NHDES and NHFGD that these 1990 thermal limits attain New Hampshire Surface Water Quality Standards and that the decision to use these thermal limits is supported by New Hampshire state policy and is protective of the existing uses of the receiving water.

In response, NHDES reviewed both the "snap-shot" data collected by EPA and the continuous temperature data collected by Schiller Station's in-stream thermistors and then sent EPA a letter dated September 4, 2013, stating that:

> [w]e have reviewed the thermal study, which appears to have been conducted under reasonable worst-case conditions, and have considered changes at the facility since the 1990 permit was issued, including the decommissioning of Unit 3. Based on that review, as well as discussions with the NH Department of Fish and Game, we agree that the thermal limits contained in the 1990 permit can be continued in the reissued permit.

Based on EPA's analysis of the application of the NHWQS, as detailed below, EPA sees no reason to question the state's conclusion that renewing the existing permit limits will satisfy the State's standards. At this point in this permit proceeding, NHDES has yet to provide a CWA § 401 certification for the proposed NPDES permit for Schiller Station, but based on the State's conclusion in the letter quoted above, and EPA's analysis below, EPA expects that the State will certify the permit at the appropriate time.

6.4.6.2 *Relevant Provisions of New Hampshire's Water Quality Standards*

Aspects of New Hampshire's surface water quality standards (NHWQS) relevant for thermal discharges are discussed in detail above in Section 5.3 of this document. As this discussion explains, the NHWQS require that:

> [a]ll surface waters shall be restored to meet the water quality criteria for their designated classification including existing and designated uses, and to maintain the chemical, physical, and biological integrity of surface waters.

N.H. Code R. Env-Wq 1703.01(b). "Biological integrity" is defined to mean:

> . . . the ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

Env-Wq 1702.07. Consistent with these provisions, the NHWQS also mandate that all the State's waters meet a water quality criterion for "Biological and Aquatic Community Integrity," which requires that:

> (a) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.
> (b) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

Id. 1703.19(a) & (b). The definition of biological integrity in the NHWQS is generally consistent with EPA's definition of the terms "balanced, indigenous population" and "balanced, indigenous community" in its regulations promulgated under CWA § 316(a). *See* 40 C.F.R. § 125.71(c).

Furthermore, with specific regard to thermal discharges, New Hampshire's environmental statutes and WQS regulations combine to dictate that for Class B waters:

> [a]ny stream temperature increase associated with the discharge of … cooling water … shall not be such as to appreciably interfere with the uses assigned to this class. The waters of this classification shall be considered as being acceptable for fishing, swimming and other recreational purposes and, after adequate treatment, for use as water supplies.

RSA 485-A:8, II. S*ee also* Env-Wq 1703.13(b). The statute also provides that:

> [t]here shall be no disposal of … waste into said waters except those which have received adequate treatment to prevent the lowering of the biological, physical, chemical or bacteriological characteristics below those given above [for dissolved oxygen, bacteria and the absence of objectionable physical characteristics], nor shall such disposal of … waste be inimical to aquatic life or to the maintenance of

> aquatic life in said receiving waters.

RSA 485-A:8, II. In addition, the NHWQS also provide that:

> [i]n prescribing minimum treatment provisions for thermal wastes discharged to interstate waters, the department shall adhere to the water quality requirements and recommendations of the New Hampshire fish and game department, the New England Interstate Water Pollution Control Commission, or the United States Environmental Protection Agency, whichever requirements and recommendations provide the most effective level of thermal pollution control.

N.H. Rev. Stat. Ann. § 485-A:8(VIII). *See also* Env-Wq 1703.13(b). This provision applies to Schiller Station because the Piscataqua River is an interstate waterway.

As also explained in Section 5.3 above, the NHWQS allow water quality-based NPDES permit limits to be set based on site-specific "mixing zones," if the state's mixing zone criteria would be satisfied. *See* 40 C.F.R. § 131.13; Env-Wq 1707.02. The NHWQS define "mixing zones" as follows:

> Env-Wq 1702.27 "Mixing zone" means a defined area or volume of the surface water surrounding or adjacent to a wastewater discharge where the surface water, as a result of the discharge, might not meet all applicable water quality standards.

Env-Wq 1702.27. Thus, with a mixing zone, discharges are allowed to cause exceedances of applicable state water quality criteria within the delineated zone as long as all water quality criteria will be met at the boundary of the mixing zone and certain specific criteria are satisfied within the zone. Env-Wq 1702.27 and 1707.02. New Hampshire's WQS regulations state that:

> … [f]or Class B waters, the department shall designate a limited area or volume of the surface water as a mixing zone if the applicant provides sufficient scientifically valid documentation to allow the department to independently determine that all criteria in Env-Wq 1707.02 have been met.

Env-Wq 1707.01(b). The state regulations further specify the following mixing zone criteria:

> Env-Wq 1707.02 Minimum Criteria. Mixing zones shall be subject to site specific criteria that, as a minimum:
>
> (a) Meet the criteria in Env-Wq 1703.03(c)(1);[18]
> (b) Do not interfere with biological communities or populations of indigenous species;
> (c) Do not result in the accumulation of pollutants in the sediments or biota;
> (d) Allow a zone of passage for swimming and drifting organisms;
> (e) Do not interfere with existing and designated uses of the surface water;
> (f) Do not impinge upon spawning grounds and/or nursery areas of any

18 Env-WQ 1703.03(c)(1)(d) prohibit the discharge of substances that would result in the dominance of nuisance species.

> indigenous aquatic species;
> (g) Do not result in the mortality of any plants, animals, humans, or aquatic life within the mixing zone;
> (h) Do not exceed the chronic toxicity value of 1.0 TUc* at the mixing zone boundary
> *Env-Wq 1702.50 “Toxic unit chronic (TUc)” means the reciprocal of the effluent dilution that causes no unacceptable effect to the test organisms by the end of the chronic exposure period. The TUc can be calculated by dividing 100 by the chronic NOEC value.
> ;and
> (i) Do not result in an overlap with another mixing zone.

Env-Wq 1707.02.

EPA has considered the NHWQS, including the state’s mixing zone criteria, as well as pertinent thermal data, thermal model projections and biological information concerning the health of the relevant community of aquatic organisms and the manner in which they may be affected by changes in in-stream water temperatures and other cumulative stressors. From this evaluation, as discussed below, the agencies conclude that it would be appropriate to retain the existing permit’s thermal discharge limits under the NHWQS. Of course, as explained farther above, EPA is proposing to base the permit’s thermal discharge limits on a variance under CWA § 316(a).

6.4.6.3 *The Proposed Thermal Discharge Limits Will Satisfy NHWQS Even Without Formally Delineating a Mixing Zone*

EPA is proposing to retain the existing permit’s thermal discharge limits pursuant to the renewal of the Facility’s existing CWA § 316(a) variance, but these limits will also satisfy NHWQS. The NHWQS do not specify an in-stream numeric temperature criterion for Class B waters, such as the segment of the Piscataqua River receiving Schiller Station’s discharge, but they do provide that:

> [i]n prescribing minimum treatment provisions for thermal wastes discharged to interstate waters, the department shall adhere to the water quality requirements and recommendations of the New Hampshire fish and game department, the New England Interstate Water Pollution Control Commission, or the United States Environmental Protection Agency, whichever requirements and recommendations provide the most effective level of thermal pollution control.

N.H. Rev. Stat. Ann. § 485-A:8(VIII). This provision applies to Schiller Station’s thermal discharges because the Pisquataqua River is an interstate waterway. The most effective limits for thermal discharge control recommended by any of the listed agencies are the CWA § 316(a) variance-based limits proposed by EPA. Therefore, these limits satisfy this provision of the NHWQS. Moreover, as quoted above, NHDES sent EPA a September 4, 2013, letter indicating that it had consulted with NH Fish & Game and that the two State agencies agreed that the existing thermal discharge limits could also be retained under the State’s water quality standards.

In addition, EPA has determined under CWA § 316(a) that the proposed thermal discharge limits will be adequate to assure the protection and propagation of the BIP in the Piscataqua River estuary. EPA concludes that this same analysis establishes that New Hampshire's biologically-focused narrative water quality criteria will also be satisfied by the proposed permit conditions. For example, EPA's analysis indicates that these limits will satisfy the NHWQS's mandate that "[a]ll surface waters shall provide, wherever attainable, for the protection and propagation of fish, shellfish and wildlife, and for recreation in and on the surface waters." N.H. Code R. Env-Wq 1703.01(c). This requirement closely tracks the standard applied under CWA § 316(a). Furthermore, these permit limits will also satisfy the state's water quality criterion for "Biological and Aquatic Community Integrity," which requires that the state's waters "support and maintain a balanced, integrated, and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region," and that any "[d]ifferences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function." *See* N.H. Code R. Env-Wq 1703.19(a) & (b), 1703.01(b), and 1702.07. In addition, EPA's analysis under CWA § 316(a) indicates that the proposed thermal discharge will neither "…appreciably interfere with the uses assigned to this class…, [including] being acceptable for fishing …" nor "be inimical to aquatic life or to the maintenance of aquatic life …" in the river. RSA 485-A:8, II.

As indicated above, the NHWQS define "mixing zones" to be "… a defined area or volume of the surface water surrounding or adjacent to a wastewater discharge where the surface water, as a result of the discharge, might not meet all applicable water quality standards." Env-Wq 1702.27. As explained above, however, the proposed thermal discharge limits *will* satisfy applicable NHWQS without the application of a mixing zone.

6.4.7 Requested Increase in Thermal Limits by Permittee

PSNH has requested that the temperature criteria for Outfalls 002, 003 and 004 be increased from 95°F/25°C to 100°F/30°C. As previously discussed, however, EPA proposes to reject this request under CWA § 316(a) for the draft permit. For the same reasons provided under CWA § 316(a), EPA finds that it is unable to conclude that the NHWQS would be satisfied with the requested increase in the Max-T limit. Moreover, EPA does not believe a mixing zone could be designated to allow the discharge temperature increase because, as discussed above, Schiller Station has not provided "sufficient scientifically valid documentation to allow the department [or EPA] to independently determine that all criteria in Env-Wq 1707.02 have been met." Env-Wq 1707.01(b). In addition, the permittee has provided no justification that an increase in their permitted thermal limits is necessary for continued facility operation.

The permittee has also requested that temperature limits be removed at Outfall 001. EPA proposes to reject this request because detailed supporting information and justification was not included with the request.

6.4.8 Draft Permit Thermal Limits

Based upon this analysis of the thermal plume and a review of the applicable State Surface Water Quality Standards, EPA is proposing that the 1990 thermal limits be carried forward in the 2013 draft permit. Specifically, the proposed limitations are

- a maximum 25°F difference between intake and discharge, except during a two hour period during condenser maintenance when the maximum difference is 30°F;
- a maximum discharge water temperature of 95°F; and
- at no time shall the discharge cause the receiving water to exceed a maximum temperature of 84°F at a distance of 200 feet in any direction from the point of discharge.

7. Cooling Water Intake Structure (CWIS) Requirements

7.1 Introduction

With any NPDES permit issuance or reissuance, EPA is required to evaluate or re-evaluate compliance with applicable standards, including those specified in Section 316(b) of the CWA, 33 U.S.C. § 1326(b), cooling water intake structures (CWISs). CWA §316(b) applies to point source dischargers that need an NPDES permit and also seek to withdraw water from a "waters of the United States" through a CWIS to use for cooling purposes (*see, e.g.,* 40 C.F.R. § 125.91). To satisfy §316(b), the location, design, construction, and capacity of the facility's CWIS(s) must reflect "the best technology available for minimizing adverse environmental impacts" ("BTA"). Such impacts include death or injury to aquatic organisms by "impingement" (the process by which fish and other organisms are killed or injured when they are pulled against the CWIS's screens when water is being withdrawn from a water body) and "entrainment" (the process by which fish larvae and eggs and other very small organisms are killed or injured when they are pulled into the CWIS and sent through a facility's cooling system along with the water taken from the source water body for cooling) (*see, e.g.,* 40 C.F.R. § 125.92(h) and(n)). Entrained organisms are subjected to thermal, physical and, in some cases, chemical stresses in the facility's cooling system.

As explained and presented below, Region 1's BTA determination for the Schiller Station permit has been developed on a site-specific basis, consistent with EPA's New CWA § 316(b) Regulations. In addition, because the NHWQS apply to the effects of CWISs on the State's waters, EPA has also considered what they require for Schiller Station's CWISs.

The following Sections 7.2-10 of this document present EPA's determination of the CWIS requirements for the renewed NPDES permit for Schiller Station. To lay the foundation for this determination, this section explains the legal requirements applicable to CWISs.

7.2 Legal Requirements Governing Cooling Water Intake Structures

7.2.1 CWA § 316(b) – Statutory Language

Section 316(b) is the CWA's only provision that directly requires regulation of the *withdrawal* of water from a water body, as opposed to the discharge of pollutants into water bodies. Rather than address all types of water withdrawal, however, this provision only governs the withdrawal of water for cooling purposes through a CWIS by a point source discharger. Specifically, CWA § 316(b) provides that:

> *[a]ny standard established pursuant to [CWA sections 301 or 306] and applicable to a point source shall require that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact.*

33 U.S.C. § 1326(b). The plain meaning of this language is that Congress wanted EPA to ensure that the best technology available for minimizing adverse environmental impacts from CWISs would be utilized by plants withdrawing water from the Nation's water bodies for their cooling processes.

The legislative history related to CWA § 316(b) is relatively sparse, but what exists reinforces the plain meaning of the statutory language. In the House Consideration of the Report of the Conference Committee (Oct. 4, 1972) on the final version of the 1972 CWA Amendments, Representative Clausen stated that "[s]ection 316(b) requires the location, design, construction and capacity of cooling water intake structures of steam-electric generating plants to reflect the best technology available for minimizing any adverse environmental impact." 1972 Legislative History at 264. The impetus for enacting CWA § 316(b) seems to have been Congressional awareness of the problem of fish being harmed by power plant CWISs, as evidenced by the Senate Consideration of the Report of the Conference Committee (Oct. 4, 1972) for the final 1972 CWA Amendments. *Id*. at 196–99, 202.[19]

7.2.2 Regulations under CWA § 316(b)

As a general matter, in determining the BTA for CWISs, EPA evaluates and compares technological alternatives for reducing the adverse environmental impacts associated with cooling water withdrawals. The adverse impacts at issue in this context are primarily the entrainment and impingement of aquatic organisms. The Agency determines which technologies are feasible and the extent to which each would reduce adverse environmental impacts. EPA also typically considers a variety of additional factors in evaluating and comparing the alternatives, such as engineering considerations, cost, non-water environmental effects, energy effects and a comparison of the costs and benefits of the alternatives.

EPA's New CWA § 316(b) Regulations became effective on October 14, 2014. These regulations set national requirements under CWA § 316(b) for CWISs at existing facilities. Before discussing these requirements, this section discusses the complicated history of EPA efforts to promulgate regulations setting national, categorical requirements for CWISs under CWA § 316(b). This section describes important aspects of that history to provide the reader with background information helpful for understanding the Agency's regulatory approach.

EPA attempted over many years to promulgate regulations setting national categorical requirements under CWA § 316(b). Its efforts were plagued, however, by delays, setbacks and alterations arising out of litigation over the regulations proposed by the Agency. *See* 79 Fed. Reg. 48313-48318. In the absence of categorical regulatory requirements, EPA for decades

[19] *Accord Seabrook*, 1977 EPA App. LEXIS 16, *19–*20; *In re Brunswick Steam Elec. Plant*, Decision of the Gen. Counsel No. 41, at 200–01 (1976) [hereinafter "*Brunswick*"].

applied the BTA standard to both new and existing facilities with regulated CWISs on a site-specific, Best Professional Judgment ("BPJ") basis. *See, e.g.*, 79 Fed. Reg. 48314, 48317; *Entergy Corp. v. Riverkeeper, Inc.*, 129 S.Ct. 1498, 1503 (2009). This approach was consistent with CWA §§ 402(a)(1)(B) and 402(a)(2), 40 C.F.R. §§ 122.43(a), 122.44(b)(3), 401.12(h) and 401.14, and longstanding EPA practice upheld by the courts. It was later expressly required by 40 C.F.R. § 125.90(b), promulgated in 2004.

EPA first promulgated § 316(b) regulations governing CWISs in 1976, *see* Best Technology Available for the Location, Design, Construction, and Capacity of Cooling Water Intake Structures for Minimizing Adverse Environmental Impact, 41 Fed. Reg. 17387 (Apr. 26, 1976), but then withdrew the regulations three years later, after a federal court remanded them to the Agency due to procedural error. *See Appalachian Power Co. v. Train*, 566 F. 2d 451 (4th Cir. 1977) (regulations remanded on procedural grounds without reaching their substantive merits); 44 Fed. Reg. at 32956 (withdrawal of regulations). *See also* 66 Fed. Reg. at 65261 (discussion of regulatory history).

In 1995, EPA was sued for failing to promulgate regulations applying the BTA standard under CWA § 316(b). The parties to the case settled the litigation by entering into a consent decree in which EPA committed to develop new § 316(b) regulations in three phases. In general, Phase I was to set BTA requirements for *new facilities* with CWISs, while Phase II was to set BTA standards for *large, existing power plants* with CWISs (defined as those with intake flows of 50 MGD or more). Given Schiller Station's intake flow of 125 MGD, the facility was expected to be covered by the Phase II Rule. Phase III was to address all remaining existing facilities with CWISs, such as manufacturing facilities and smaller power plants.

The "Phase I Rule" was promulgated in 2001. *See generally* 66 Fed. Reg. 65255. The regulations were challenged in federal court but were upheld with the exception of certain provisions that authorized compliance with the BTA standard by implementing environmental "restoration" measures. *See Riverkeeper, Inc. v. U.S. Environmental Protection Agency*, 358 F.3d 174, 189–91 (2d Cir. 2004) (hereinafter "*Riverkeeper I*"). The Phase I regulations for new facilities are currently in effect and are codified at 40 C.F.R. Part 125, Subpart I. They do not, however, apply to *existing* facilities such as Schiller Station.

EPA next promulgated the "Phase II Rule" for large, existing power plants in September 2004. *See Final Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities*, 69 Fed. Reg. 41576 (Jul. 9, 2004). The Phase II regulations were codified at 40 C.F.R. Part 125, Subpart J, and would have applied to Schiller Station had they remained in effect. They were also challenged in federal court, however, and the reviewing court struck down or remanded to the Agency numerous provisions of the Phase II regulations. *Riverkeeper, Inc. v. U.S. Envtl. Prot. Agency*, 475 F.3d 83, 89, 130–31 (2d Cir. 2007) (hereinafter "*Riverkeeper II*"), *rev'd in part Entergy*, 129 S.Ct. at 1507 (reversing Second Circuit's holding that EPA did not have authority to consider a comparative cost/benefit analysis in determining the BTA). In response to *Riverkeeper II*, EPA formally suspended the Phase II Rule on July 9, 2007, with the exception of 40 C.F.R. § 125.90(b), which remained in effect. *See National Pollutant Discharge Elimination System–Suspension of Regulations Establishing Requirements for Cooling Water Intake Structures at Phase II Existing Facilities*, 72 Fed. Reg. 37107 (Jul. 9, 2007). According to 40 C.F.R. § 125.90(b) (2004), "[e]xisting facilities that are not subject to requirements under this [subpart J] or another subpart of this part [125] must meet requirements under section 316(b) of the CWA determined by the Director on a case-by-case, best professional judgment (BPJ) basis."

In 2006, EPA promulgated the "Phase III Rule." *See Final Regulations To Establish Requirements for Cooling Water Intake Structures at Phase III Facilities*, 71 Fed. Reg. 35,006 (Jun. 16, 2006). The Phase III Rule was codified at 40 C.F.R. Part 125, Subpart N, and it addressed all existing facilities not addressed by the Phase II Rule (*i.e.*, smaller power plants and manufacturing facilities). It also addressed new offshore oil and gas extraction facilities because the Phase I Rule had not covered them. As with the Phase I and II Rules, the Phase III Rule was challenged in federal court. EPA defended the Phase III Rule's provisions regarding new offshore oil and gas facilities but, following the Supreme Court's 2009 decision in *Entergy*, the Agency sought a voluntary remand of the parts of the Phase III Rule that addressed existing facilities. EPA explained that it planned to reconsider the Phase III Rule decision with regard to existing facilities in conjunction with its reconsideration of the Phase II Rule. In other words, EPA planned to reconsider requirements for all existing facilities together. The Fifth Circuit granted EPA's motion, while at the same time affirming the Phase III Rule's provisions pertaining to new offshore oil and gas extraction facilities. *See ConocoPhillips Co. v. U.S. Envtl. Prot. Agency*, 612 F.3d 822, 842 (5th Cir. 2010).

After the suspension of the Phase II and III Rules, and under the then-effective terms of 40 C.F.R. § 125.90(b), EPA made BTA determinations on a site-specific, BPJ basis. Neither the CWA nor EPA regulations dictate specific, detailed methodologies for determining a site-specific BTA under § 316(b). Therefore, EPA developed reasonable, appropriate approaches for its BPJ determinations of site-specific BTAs. EPA looked by analogy to the factors considered in the development of effluent limitations under the CWA and EPA regulations for guidance concerning additional factors that might be relevant to consider in determining the BTA under CWA § 316(b). In setting effluent limitations on either a national categorical basis or a site-specific BPJ basis, EPA considers a set of factors specified in the statute and regulations. *See, e.g.*, 33 U.S.C. §§ 1311(b)(2)(A) and 1314(b)(2); 40 C.F.R. § 125.3(d)(3).[20] These factors include: (1) the age of the equipment and facilities involved, (2) the process employed, (3) the engineering aspects of applying various control techniques, (4) process changes, (5) cost, and (6) non-water quality environmental impacts (including energy issues). EPA also considered the appropriate technology for the category or class of point sources of which the applicant is a member and any unique factors relating to the applicant. 40 C.F.R. § 125.3(c)(2)(i)–(ii). Thus, EPA considered these factors in making its BPJ determinations of the BTA for a facility's CWISs. In addition, as discussed above, and as is considered when setting BPT and BCT effluent limitations, EPA also considered the relationship of an option's costs and benefits in determining the BTA.

The New CWA § 316(b) Regulations

On April 20, 2011, EPA proposed new regulations setting categorical standards applying CWA § 316(b) to CWISs at existing power plants and manufacturers, and new units at existing facilities.

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[20] *See also NRDC v. EPA*, 863 F.2d at 1425 ("in issuing permits on a case-by-case basis using its 'Best Professional Judgment,' EPA does not have unlimited discretion in establishing permit limitations. EPA's own regulations implementing [CWA § 402(a)(1)] enumerate the statutory factors that must be considered in writing permits.").

76 Fed. Reg. 22174-22288 (April 20, 2011). On August 15, 2014, EPA promulgated new final regulations at 40 C.F.R. Part 125, Subpart J, setting categorical BTA standards for existing facilities with CWISs with design intake flows greater than 2 MGD and which use 25% or more of the intake water for cooling purposes. Schiller Station satisfies these criteria and the new regulations apply to the Facility. *See* 79 Fed. Reg. 48300 - 48439 (Aug. 15, 2014) ("Final Regulations to Establish Requirements for Cooling Water Intake Structures at Existing Facilities and Amend Requirements at Phase I Facilities; Final Rule") (the "New CWA § 316(b) Regulations"). The new regulations became effective on October 14, 2014. *See* 79 Fed. Reg. 48300, 48358. (EPA notes that multiple petitions challenging the New CWA § 316(b) Regulations have been filed in federal court.)

As explained above, in the decades prior to promulgation of the New CWA § 316(b) Regulations, EPA determined the BTA for individual permits on a site-specific, BPJ basis. In many ways, the new process for determining the BTA created by the New CWA § 316(b) Regulations builds upon that prior site-specific, BPJ determination process. The new regulations continue to call for the BTA for each individual facility to be determined on a site-specific, case-by-case basis. Unlike the case-by-case nature of "pure BPJ permitting," however, the new regulations make specific provision for many aspects of that site-specific analysis.

For impingement mortality control, the new regulations specify a number of "pre-approved" technologies that a facility can choose to implement to satisfy the BTA standard. The regulations also allow a facility to use other technologies to satisfy the BTA standard if it can demonstrate that they will perform adequately. *See* 40 C.F.R. §§ 125.94(c)(6) and (7). Thus, approval of such an alternative technology would involve a site-specific decision. The regulations also have a number of additional provisions that pertain to specific issues concerning impingement, such as fragile species, *de minimis* effects and more. *See, e.g.,* New CWA § 316(b) Regulations, 40 C.F.R. §§ 125.95(c)(5), (6), (9) and (11).

For entrainment control, the regulations expressly call for the permitting agency to make a site-specific determination of which technologies and/or practices satisfy the BTA standard for each individual facility. *See* 40 C.F.R. § 125.94(d). The BTA "must reflect the Director's determination of the maximum reduction in entrainment warranted after consideration of the relevant factors as specified in § 125.98." *See also* 40 C.F.R. § 125.98(f). The regulations also give permitting authorities the discretion to "reject an otherwise available technology" as the BTA for entrainment if the social costs are "not justified" by the social benefits or if there are other unacceptable adverse factors that cannot be mitigated. *Id.* § 125.98(f)(4); 79 Fed. Reg. at 48,351-52.

The factors to be considered in determining the BTA for entrainment under various permitting circumstances are spelled out in 40 C.F.R. § 125.98(f). First, 40 C.F.R. § 125.98(f)(2) specifies the following factors that *must* be considered:

> (i) numbers and types of organisms entrained, including, specifically, the numbers and species (or lowest taxonomic classification possible) of Federally-listed, threatened and endangered species, and designated critical habitat (e.g., prey base);
>
> (ii) impact of changes in particulate emissions or other pollutants associated with

entrainment technologies;

(iii) land availability inasmuch as it relates to the feasibility of entrainment technology;

(iv) remaining useful plant life; and

(v) quantified and qualitative social benefits and costs of available entrainment technologies when such information on both benefits and costs is of sufficient rigor to make a decision.

The regulations specify that, "[t]he weight given to each factor is within the Director's discretion based upon the circumstances of each facility." 40 C.F.R. § 125.95(f)(3). In addition, 40 C.F.R. § 125.95(f)(3) provides that the following factors *may* be considered in determining a site-specific BTA:

(i) entrainment impacts on the waterbody;

(ii) thermal discharge impacts;

(iii) credit for reductions in flow associated with the retirement of units occurring within the ten years preceding October 14, 2014;

(iv) impacts on the reliability of energy delivery within the immediate area;

(v) impacts on water consumption; and

(vi) availability of process water, gray water, waste water, reclaimed water, or other waters of appropriate quantity and quality for reuse as cooling water.

Again, the regulations leave the permitting authority with discretion to decide on precisely *how* to consider all these factors.

Consistent with the *Entergy* decision and the reasoning described above, EPA's New CWA § 316(b) Regulations call for consideration of relative costs and benefits in determining the BTA for entrainment reduction. (This is not made an element for evaluation with regard to impingement mortality reduction, for which a variety of compliance options are specified in 40 C.F.R. § 125.94(c).) The New CWA § 316(b) Regulations specify that in determining the site-specific BTA for entrainment reduction by a facility, one of the factors that must be considered is the "[q]uantified and qualitative social benefits and costs of available entrainment technologies when such information on both benefits and costs is of sufficient rigor to make a decision." 40 C.F.R. § 125.98(f)(2)(v). *See also* 40 C.F.R. §§ 125.92(x) and (y) (definitions of social benefits and social costs); 79 Fed. Reg. 48368, 48371. Thus, this sort of information does not have to be considered if the permitting authority decides the available information is "not of sufficient rigor."

Also consistent with *Entergy*, the New CWA § 316(b) Regulations do not propose a specific comparative cost/benefit test. The regulations call, instead, for "the maximum reduction in entrainment *warranted* after consideration of the relevant factors as specified in § 125.98." 40

C.F.R. § 125.94(d)(emphasis added).[21] *See also* 40 C.F.R. § 125.98(f). Similarly, the regulations also provide that "[t]he Director may reject an otherwise available technology as a BTA standard for entrainment if the social costs are not justified by the social benefits." 40 C.F.R. § 125.98(f)(4).

The New CWA § 316(b) Regulations also include specific "transition" provisions that specify procedures for permits that were in various stages of the permit development process at the time the new regulations were promulgated. Relevant to the Schiller Station permit proceeding, 40 C.F.R. § 125.98(g), provides as follows:

> (g) *Ongoing permitting proceedings.* In the case of permit proceedings begun prior to October 14, 2014, whenever the Director has determined that the information already submitted by the owner or operator of the facility is sufficient, the Director may proceed with a determination of BTA standards for impingement mortality and entrainment without requiring the owner or operator of the facility to submit the information required in 40 C.F.R. 122.21(r). The Director's BTA determination may be based on some or all of the factors in paragraphs (f)(2) and (3) of this section and the BTA standards for impingement mortality at § 125.95(c). In making the decision on whether to require additional information from the applicant, and what BTA requirements to include in the applicant's permit for impingement mortality and site-specific entrainment, the Director should consider whether any of the information at 40 C.F.R. 122.21(r) is necessary.

The new regulations make clear that for an ongoing proceeding, when sufficient information has already been collected, the permitting authority may proceed to determine a site-specific BTA for entrainment and impingement mortality reduction and EPA does not intend that the ongoing permit proceeding must backtrack and go through the full information gathering and submission process set out by the new regulations for new permit proceedings. *See also* 79 Fed. Reg. 48358 ("… in the case of permit proceedings begun prior to the effective date of today's rule, and issued prior to July 14, 2018, the Director should proceed. See §§ 125.95(a)(2) and 125.98(g)."). Furthermore, the regulation also states that the permitting authority may base its site-specific BTA determination for entrainment on some or all of the factors specified in 40 C.F.R. §§ 125.98(f)(2) and (3).

The permit proceeding for Schiller Station is an "ongoing permit proceeding" under 40 C.F.R. § 125.98(g). The Facility's existing NPDES permit expired in 1995 and PSNH timely applied for permit renewal prior to its expiration. (Schiller Station's existing permit has been administratively extended pursuant to 40 C.F.R. § 122.6(a).) Region 1 was working on the permit prior to promulgation of the New CWA § 316(b) Regulations and had gathered substantial additional information from the Facility through the use of information request letters (sent under CWA § 308(a)) and site visits. In this case, the Region has considered whether any of the permit application information specified at 40 C.F.R. § 122.21(r) is necessary to support this permit decision, but has determined that the information already submitted by the Facility is sufficient. Therefore, Region 1 will proceed to determine the site-specific BTA for controlling impingement mortality and entrainment at Schiller Station. This BTA determination is presented

[21] Of course, as explained below in the main body of the text, for ongoing permit proceedings under 40 C.F.R. § 125.98(g), the permitting authority has the discretion to decide *whether or not* to consider some or all of the factors under 40 C.F.R. §§ 125.98(f)(2) and (3).

in detail farther below.

7.2.3 State Water Quality Standards

a. Application to Cooling Water Intake Structures

CWA § 316(b) requires CWISs to satisfy the BTA standard. This federal technology standard establishes the minimum requirements that all CWISs must meet. CWISs must also satisfy any more stringent state law requirements that may apply. *See* CWA §§ 301(b)(1)(C), 401(a)(1) & (d), & 510; 40 C.F.R. §§ 122.4(d), 122.44(d), & 125.84(e). *See also In re Dominion Energy Brayton Point, LLC (Formerly USGen New England, Inc.) Brayton Point Station*, 12 E.A.D. 490, 626 (EAB 2006). CWA § 510 expressly authorizes states to impose more stringent water pollution control standards than those dictated by the minimum federal requirements. *See* 40 C.F.R. § 131.4(a); *PUD No. 1 of Jefferson County v. Wash. Dep't of Ecology*, 511 U.S. 700, 705 (1994). States have this authority with regard to pollutant discharges and cooling water withdrawals through CWISs. *See* 40 C.F.R. § 125.90(c). For example, a state could adopt technology-based requirements for CWISs more stringent than the federal requirements under CWA § 316(b), or its water quality standards could apply to the effects of CWISs and require more stringent permit conditions than those called for by CWA § 316(b). Accordingly, EPA's New CWA § 316(b) Regulations provide:

> (i) *More stringent standards.* The Director must establish more stringent requirements as best technology available for minimizing adverse environmental impact if the Director determines that compliance with the applicable requirements of this section would not meet the requirements of applicable State or Tribal law, including compliance with applicable water quality standards (including designated uses, criteria, and antidegradation requirements).

40 C.F.R. § 125.94(i). *See also* 40 C.F.R. § 125.90(c) and 40 C.F.R. §§ 125.80(d) and 125.84(e) (provisions in regulations mandating that CWIS requirements in permits for new facilities must satisfy any more stringent state requirements).

NPDES permits issued by EPA are also subject to the State certification process under CWA § 401. CWA § 401(a)(1) provides, in pertinent part, that:

> [a]ny applicant for a Federal license or permit to conduct any activity…which may result in any discharge into the navigable waters, shall provide the licensing or permitting agency a certification from the State in which the discharge originates…that any such discharge will comply with the applicable provisions of sections 1311, 1312, 1313, 1316, and 1317 of this title…No license or permit shall be granted until the certification required by this section has been obtained or has been waived…No license or permit shall be granted if certification has been denied by the State…

33 U.S.C. § 1341(a)(1). The plain language of § 401(a)(1) dictates that unless State certification has been waived, no NPDES permit may be issued by EPA without that certification. *See PUD No. 1*, 511 U.S. at 707. This language also indicates that a denial of certification by the State bars issuance of the Federal permit or license. EPA regulations reiterate these commands. *See* 40 C.F.R. §§ 122.4(b), 124.53(a), & 124.55(a). Neither the statute nor the regulations identify any

exceptions to the certification requirement. Denial of certification by a state could, of course, be challenged by the permittee through State legal proceedings. *See, e.g.*, 40 C.F.R. § 124.55(e); *Dubois v. U.S.D.A.*, 102 F.3d 1273 (1st Cir. 1996).

With regard to State certifications, CWA § 401(d) provides, in pertinent part, that:

> [a]ny certification provided under this section shall set forth any effluent limitations and other limitations, and monitoring requirements necessary to assure that any applicant for a Federal license or permit will comply with any applicable effluent limitations and other limitations, under section 1311 or 1312 of this title . . . and with any other appropriate requirement of State law set forth in such certification, and shall become a condition on any Federal license or permit subject to the provisions of this section.

33 U.S.C. § 1341(d). The plain language of § 401(d) makes clear that the State's § 401 certification must contain any conditions needed to ensure compliance with CWA § 301, including § 301(b)(1)(C), and any appropriate requirement of State law, and that such limitations imposed in a certification must be included as conditions in the federal permit. *See also PUD No. 1*, 511 U.S. at 707–08. EPA regulations repeat these commands from the statute. 40 C.F.R. §§ 121.2, 122.44(d)(3), 124.53(e)(1), & 124.55(a)(2). *See also* 40 C.F.R. § 122.4(d). Limits included in a federal permit based on State certification requirements can be challenged in State legal proceedings. 40 C.F.R. § 124.55(e). *See also Roosevelt Campobello Int'l Park Comm'n v. U.S. Envtl. Prot. Agency*, 684 F.2d 1041, 1055–56 (1st Cir. 1982).

The U.S. Supreme Court has held that once the CWA § 401 State certification process has been triggered by the existence of a discharge, then the certification may impose conditions and limitations on *the activity as a whole* – not merely on the discharge – to the extent needed to ensure compliance with State water quality standards or other applicable requirements of State law. The Court explained that:

> [t]he text [of CWA § 401d)] refers to the compliance of the applicant, not the discharge. Section 401(d) thus allows the State to impose "other limitations" on the project in general to assure compliance with various provisions of the Clean Water Act and with "any other appropriate requirement of State law."…Section 401(a)(1) identifies the category of activities subject to certification – namely, those with discharges. And § 401(d) is most reasonably read as authorizing additional conditions and limitations on the activity as a whole once the threshold condition, the existence of a discharge, is satisfied.

PUD No. 1, 511 U.S. at 711–12. Thus, for example, a State could impose certification conditions related to CWISs on a permit for a facility with a discharge if those conditions were necessary to assure compliance with a requirement of State law, such as State water quality standards. *See id.* at 713. This also helps to confirm that in setting *discharge* conditions to achieve water quality standards, a State can and should take account of the effects of *other aspects of the activity* that may influence the discharge conditions that will be needed to attain water quality standards.

b. New Hampshire Water Quality Standards

New Hampshire's water quality standards apply to regulate the effects of cooling water withdrawals. That is, permit conditions on cooling water withdrawals must comply with (or not cause or contribute to a failure to attain) relevant water quality criteria, designated uses, and antidegradation requirements. New Hampshire's standards state as follows:

> [t]hese rules shall apply to any person who causes point or nonpoint source discharge(s) of pollutants to surface waters, or who undertakes hydrologic modifications, such as dam construction or water withdrawals, or who undertakes any other activity that affects the beneficial uses or the level of water quality of surface waters.

N.H. Code R. Env-Wq 1701.02(b) (Applicability). *See also id.* 1708.03 (Submittal of Data). This language clearly indicates the applicability of New Hampshire's WQS to cooling water withdrawals from the State's waters.

Given that withdrawals of water for cooling can harm aquatic life, such withdrawals must comply with the designated uses and water quality criteria included in the State's WQS for the purpose of protecting aquatic organisms and their habitat. For example, as discussed farther above, the state's standards dictate, in pertinent part, that:

> (b) All surface waters shall be restored to meet the water quality criteria for their designated classification including existing and designated uses, and to maintain the chemical, physical, and biological integrity of surface waters.
> (c) All surface waters shall provide, wherever attainable, for the protection and propagation of fish, shellfish and wildlife, and for recreation in and on the surface waters.

Id. 1703.01(b) and (c) (Water Use Classifications). The State's standards also prescribe the following water quality criterion for "biological and aquatic community integrity":

> (a) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.
> (b) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

Id. 1703.19. *See also id.* 1702.07 (definition of "biological integrity").

In sum, the limits in EPA-issued NPDES permits that address cooling water intake structures must satisfy both CWA § 316(b) and any more stringent requirements necessary to satisfy applicable state water quality standards. The NPDES permit that EPA expects to issue to Schiller Station will be subject to state certification under CWA § 401(a)(1) and, therefore, will also need to satisfy any conditions of such a certification. The New Hampshire Department of Environmental Services (NHDES) administers the certification process for the state. EPA expects that NHDES will provide its certification sometime after it has reviewed the Draft Permit, but before EPA issues the Final Permit, or that the certification is determined to be waived.

7.3 Conclusion

The permit requirements in Schiller Station's new NPDES permit must satisfy the federal technology-based BTA standard of CWA § 316(b) as well as any more stringent requirements necessary to achieve compliance with New Hampshire's water quality standards. While this permit proceeding is covered by EPA's New CWA § 316(b) Regulations, these regulations call for the BTA for Schiller Station, and the permit requirements associated with the BTA, to be determined on a site-specific basis. Permit requirements needed to satisfy New Hampshire water quality standards must also be determined on a site-specific basis. EPA's determination of permit requirements for CWISs is set forth in the following sections and, as stated above, these requirements will be subject to the CWA § 401(a)(1) water quality certification process.

8. Biological Impacts Associated with Schiller Station's CWIS's

The principal adverse environmental impacts typically associated with CWISs evaluated by EPA are the *entrainment* of fish eggs, larvae, and other small forms of aquatic life through the plant's cooling system, and the *impingement* of fish and other larger forms of aquatic life on the intake screens. *See, e.g.,* 79 Fed. Reg. at 48318. Entrainment and impingement can kill or injure large numbers of the aforementioned aquatic organisms. In some cases, these losses may contribute to diminished populations of local species of commercial and/or recreational importance, locally important forage species, and/or local threatened or endangered species. As a result, CWISs can have effects across the food web. In effect, CWISs can substantially degrade the quality of aquatic habitat by placing within the ecosystem a significant anthropogenic source of mortality to resident organisms. In addition to considering the direct adverse impacts of CWISs, their effects as cumulative impacts or stressors in conjunction with other existing stressors, including CWISs at multiple facilities, on the affected species should also be considered. Furthermore, losses of particular species could contribute to a decrease in the balance and diversity of the ecosystem's overall assemblage of organisms. *See* 66 Fed. Reg. 65256, 65262-65 (Dec. 18, 2001) (preamble to Final Phase I rule under CWA § 316(b)).

As indicated above, entrainment of organisms occurs when a facility withdraws water into the CWIS from an adjacent water body. Fish eggs and larvae in the water are typically small enough to pass through intake screens and become entrained along with the cooling water within the facility. As a result, the eggs and larvae are exposed to shear forces from mechanical pumps, physical stress or injury from contact with pipe surfaces, elevated temperatures from waste heat removal, and, in some cases, high concentrations of chlorine or other biocides. 66 Fed. Reg. at 65263. These organisms are typically killed or otherwise harmed as a result of entrainment. The number of organisms entrained is dependent upon the volume and velocity of cooling water flow through the plant and the concentration of organisms in the source water body that are small enough to pass through the screens of CWIS. The extent of entrainment can be affected by the intake structure's location, the character of the biological community in the water body, the characteristics of any intake screening system or other entrainment reduction equipment used by the facility, and by the season during which the water is being taken from the water body. 66 Fed. Reg. at 65263.

Impingement of organisms occurs when a facility draws water through its CWIS and organisms too large to pass through the screens, and unable to swim away, become trapped against the screens and other parts of the intake structure. Facilities also have various methods for removing organisms from the screens and returning them to the water body (or disposing of the material).

In some cases, fragile species may be killed either as a result of being impinged against the screens or as a result of injury from the facility's process for removing the organisms from the screens. Even if not killed directly, contact with the screens or other equipment may cause an organism to lose its protective slime and/or scales or suffer other injuries which can result in eventual, albeit delayed, mortality.

The quantity of organisms impinged is a function of the intake structure's location and depth, the velocity of water drawn to the entrance of the intake structure (approach velocity) and through the screens (through-screen velocity), the seasonal abundance of various species of fish, and the size of various fish relative to the size of the mesh in any intake barrier system (e.g., screens). 66 Fed. Reg. at 65263. For resident fish in the Piscataqua River, CWISs pose multiple threats to single populations in that organisms are exposed to entrainment mortality as eggs and larvae and impingement mortality as juveniles and adults. In addition, CWISs can also potentially harm other types of organisms (*e.g.*, shellfish or macrocrustaceans).

8.1 Local Biology

As previously mentioned, Schiller Station withdraws water from (and discharges to) the lower Piscataqua River. The Piscataqua River is a high value habitat for a variety of marine and estuarine species, and serves as the only conduit between the Gulf of Maine and Great Bay. In fact, the Great Bay Estuary, which includes the Piscataqua River is one of the most extensive and biologically significant eelgrass and salt marsh systems in New England. Part of the Great Bay Estuary is studied, managed and protected as part of the National Estuarine Research Reserve System (NERRS).[22]

While some fish species permanently reside in the river, most use it to either access spawning or nursery habitats in Great Bay and its associated influent rivers, or to migrate from these areas to marine habitats in the Gulf of Maine and beyond. Still others are seasonally present, preying on the concentrated but temporal influx of migrating forage species. The location of Schiller Station's CWIS's in highly productive tidal waters raises concern for the organisms that use this habitat. Tidal rivers and estuaries are among the most productive aquatic ecosystems and provide spawning and nursery habitat for many species, as well as permanent habitat for adult organisms.

Short (1992) published a comprehensive ecological profile of the Great Bay Estuary. Drawing from historical reports and sampling by New Hampshire Fish and Game Department, Short determined that a mix of 52 marine, estuarine and freshwater fish species occurred in at least some part of the Great Bay Estuarine system. *See* Short, F.T., The Ecology of the Great Bay Estuary, New Hampshire and Maine: An Estuarine Profile and Bibliography, NOAA – Coastal Ocean Program Publ., 1992.

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[22] The New Hampshire Fish and Game Department manages the Great Bay National Estuarine Research Reserve (NERR), which was designated in 1989. The Reserve is also supported by the Great Bay Stewards, a non-profit friends group. The Great Bay NERR is part of the National Estuarine Research Reserve System (NERRS). Established by the Coastal Zone Management Act of 1972, the NERRS operates as a partnership between the National Oceanic and Atmospheric Administration (NOAA) and the coastal states. *See* 2009 Great Bay 20th Report (AR-186).

Several impingement and entrainment studies that were conducted in this reach of the Piscataqua River are available for characterization of local and anadromous fish and shellfish communities. Marine Research Inc. issued a report in 2004 entitled Newington Power Facility Post-operational Impingement Sampling Final Report (hereinafter TRC, 2004). Newington Station is geographically very close to Schiller Station. TRC (2004) collected 324 fish of 13 different species off the screens at Newington Station between October 2002 and January 2004. Fish species collected included American eel, Atlantic menhaden, Atlantic tomcod, hake, mummichog, Atlantic silverside, threespine stickleback, grubby, white perch, tautog, cunner, winter flounder and smooth flounder.

In addition, from 2006 to 2007, Normandeau Associates, Inc., conducted the most recent entrainment and impingement studies at Schiller Station. *See* Normandeau Associates, Inc., Entrainment and Impingement Studies Performed at Schiller Generating Station from September 2006 through September 2007, April 2008 (hereinafter "Normandeau, 2008 studies"). Data from these studies provide insight as to what species are present in the Piscataqua River in and around Schiller Station. These studies should not, of course, be interpreted as the definitive list of all species that occur in the Great Bay estuary.

Schiller Station impinged 33 species of fish and, typical of estuaries, they included a mix of marine (cod, sea raven, hakes), estuarine (striped bass, tomcod, sticklebacks) and freshwater species (pumpkinseed, bluegill). Several species of anadromous fish (rainbow smelt, alewife, and blueback herring) were collected as well. Many of these estuarine species are broadcast spawners that disperse their eggs to the water column. The eggs and larvae of these species drift with the currents throughout the water column until they reach their juvenile life stage. Juvenile fishes school in the shallow, protected waters until they mature, at which point they move to deeper offshore water.

Several of the fishes noted in the studies are desirable species for recreational and commercial fishermen (*e.g.*, winter flounder, Atlantic herring, skate species, pollock, Atlantic cod, tautog, hake species and striped bass). Eight of the species sampled during the Normandeau 2008 studies have fishery management plans or restrictions managed by the New England Fishery Management Council (white hake, silver hake, red hake, Atlantic herring, Atlantic cod, winter flounder, skate species and pollock). Generally, these fishery management plans are designed to reduce fishing mortality and promote rebuilding of stocks to sustainable biomass levels in response to population declines resulting from overfishing. Three of the species (Atlantic cod, tautog and skate species, which is most likely winter skate) subject to impingement and entrainment are considered "overfished" (meaning that stock biomass remains low compared to maximum sustainable yield biomass) and/or overfishing is currently occurring (meaning fishing mortality remains high compared to maximum sustainable yield). In addition, several fish species observed in Schiller Station impingement samples from 2006 through 2007 – namely, rainbow smelt, Atlantic menhaden, Atlantic herring, blueback herring and alewife – are considered "fragile species" under 40 C.F.R. § 125.92(m) of the New CWA § 316(b) Regulations. *See also* 40 C.F.R. §§ 125.94(c)(5), (6) and (9).

In addition to fishes, several species of invertebrates, including commercially and/or recreationally important species such as the Jonah crab, cancer crab, horseshoe crab and American lobster, are present in the Piscataqua River. Schiller Station has impinged adults and juveniles of these species, and also has entrained their eggs and larvae.

8.2 Impingement and Entrainment Impacts

The quantity of organisms entrained and impinged at a CWIS is generally a function of the intake structure's location, design, flow capacity (and resulting intake velocity), frequency of operation (i.e., capacity utilization), and the abundance of organisms within the influence of the cooling water intake current. The productive biological community of the Piscataqua River near Schiller Station's CWISs provides for conditions such as high egg and larval densities, numerous juvenile and adult fish and macrocrustaceans, and anadromous fish migrating to spawning habitat, all of which could potentially lead to high rates of entrainment and impingement. This section discusses the results of the Normandeau 2008 studies biological monitoring conducted at Schiller Station during 2006-2007 and the potential for adverse environmental impacts to aquatic organisms as a result of the operation of Schiller Station's CWISs.

8.2.1 Entrainment Studies

Entrainment samples were collected through a 0.300 mm mesh plankton net suspended outside of Screen House #2 (intake for Units 5 and 6). Entrainment monitoring was not conducted for Unit 4's intake. Normandeau estimated ichthyoplankton entrainment for Schiller Station from October 2006 to September 2007.

Entrainment samples consisted of compositing four separate 100 m^3 samples collected every 6 hours over a 24-hour period. Entrainment samples were processed in Normandeau's laboratory facility in Bedford, New Hampshire. Sorting, species and life stage identification and enumeration were all completed by Normandeau to generate entrainment rates (number of eggs or larvae per volume of water). Entrainment losses were calculated by multiplying the entrainment rate by the weekly plant cooling water flow.

Schiller Station also conducted monthly entrainment survival studies. Samples were collected in Screen House #2 prior to the water passing through the facility. At least 200 fish eggs, fish larvae and macrocrustacean larvae were collected for initial (Time 0) assessment and at least 100 were available for latent (24-hour) survival observations. Samples were sorted into six categories (initial alive, initial stunned, initial dead, latent alive, latent stunned, and latent dead)[23].

8.2.2 Impingement Studies

Fish for impingement sampling were collected in the fish and debris return sluice coming off of the traveling screens for each unit. Normandeau reported impingement losses from October 2006 to September of 2007. Impingement samples were collected over a continuous 24-hour period, once a week. Each individual sample represented a six-hour collection period. Impingement sampling was only conducted when the plant was operational (defined as having at least one

[23] For sorting, larvae that are actively moving are sorted as alive, larvae that move in response to physical prompting are stunned, and larvae that show no response to physical prompting are sorted as dead.

circulating pump running at the time of sampling).

Schiller Station conducted an impingement collection efficiency study to determine what percentage of impinged fish on the screens they were able to collect within the fish return sluice. Once a month, they marked 100 dead fish and introduced the marked fish via a small pipe to a point within the screenhouse directly in front of the traveling screens. The number of marked fish collected at the end of the sampling period divided by the number of marked fish released represented the collection efficiency. The collection efficiency was then applied to their fish impingement abundance estimates.

Schiller also conducted impingement survival studies. Wild caught fish and macrocrustaceans were collected during routine impingement monitoring sampling. Their initial condition at the time of collection (Time 0) was assessed and they were classified as alive, stunned or dead. All live animals were then held for at least an additional 12 hours to determine latent survival rates.[24] Animal status was again classified as alive, stunned, or dead. Latent survival rate was determined by the number of fish alive after 12 hours divided by the total number of fish impinged at Time 0. Impingement losses were adjusted by these measured survival rates. Impingement losses were calculated using design flow, because this represents a worst-case impact analysis.

8.2.3 Summary of Impingement and Entrainment Impacts

EPA's analyses of the entrainment and impingement losses from Schiller Station are presented in this section.

One key question to address in an analysis of entrainment effects is whether or not to assume 100% mortality for entrained organisms. For the national analyses supporting the New CWA § 316(b) Regulations, and consistent with prior analyses supporting the development of regulations, EPA adopted a presumption of 100% mortality for entrained organisms. This is a reasonable presumption to apply in general given the fragility of the entrained organisms (*i.e.*, very small eggs and larvae) and the nature of the stresses they are subjected to when entrained through a cooling system (*e.g.*, extreme water temperatures, sheer stress, physical impacts, and potential exposure to biocides). *See* 79 Fed. Reg. 48318. At the same time, EPA's New CWA § 316(b) Regulations allow a permittee to try to make a site-specific demonstration that entrainment mortality is actually less than 100% for its cooling system. *See* 40 C.F.R. § 125.96(d)(3); 79 Fed. Reg. 48355. *See also* 40 C.F.R. § 122.21(r)(7).

In this case, Schiller Station conducted site-specific entrainment survival studies and has presented results suggesting that survival rates of the larval stage of certain fish species appear to be quite high at the Facility. EPA does not find this study to be convincing, however, because the organisms sampled for entrainment survival were not exposed to a degree of trauma equivalent to what a larval organism would experience if it actually transited Schiller Station's full cooling

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[24] For EPA's New CWA § 316(b) Regulations, the Agency specifies that latent survival be assessed using holding times between 18-96 hours, unless the permitting authority specifies an alternative holding period. *See* 40 C.F.R. § 125.94(c)(7); 79 Fed. Reg. 48321, 48323, 48434. Ultimately, the exact duration of holding fish to assess latent survival is a balancing act. Fish should be held a sufficient quantity of time to allow them to succumb to any injuries incurred from being impinged. Conversely, being held in captivity is in its own right stressful for the fish and could lead to mortality.

system during typical plant operations. Larvae in the Schiller Station's entrainment survival study were collected at the screenhouse at a point *before* they had entered the facility's cooling system. As a result, larvae in the study were not exposed to the stressors that entrained organisms transiting the plant would experience (*e.g.*, very high water temperatures, physical impacts in the cooling system pumps and piping, sheer stress, chlorine exposure). As a result, EPA cannot find that the study conditions provide a valid comparison with actual conditions at the Facility. Therefore, EPA's analysis of entrainment losses at Schiller Station continues to reflect the default assumption of 100% mortality for entrained larvae.

In addition, to be more conservative, EPA's presentation of Schiller Station entrainment losses reflect the plant design flow of 124.4 MGD, which represents a 7.3% increase over Normandeau's estimates using a 5-year average operating flow.

EPA reviewed Schiller's Impingement Efficiency and Survival studies and found them to be reasonable and valid. Therefore, the impingement losses presented here reflect adjustments made based on the results of those studies.

Entrainment losses are presented in two ways, first they are presented in Tables 8-A and 8-B by species (both adjusted raw numbers at design flow); second, Figures 8-1 and 8-2 show entrainment losses by month. Impingement losses are presented in the same way in Table 8-C and 8-D and Figures 8-3 and 8-4.

Entrainment losses of ichthyoplankton peaked in July, with a much smaller peak in the winter (January-March) (Figure 8-1). Cunner eggs accounted for a large percentage of the losses in the July period (Normandeau, 2008). The peak in entrainment losses in the winter was comprised of winter spawners, such as American sand lance and rock gunnel (Normandeau, 2008). Macrocrustacean entrainment losses also peaked in July and were essentially almost non-existent during spring, fall and winter (Figure 8-2).

Fish impingement losses peaked in April, with secondary peaks in the fall and early winter (Figure 8-3). White hake, Atlantic herring and cunner were fish exhibiting the highest impingement losses in April (Normandeau, 2008). In the fall, rainbow smelt, grubby and white hake were the species with the highest impingement losses (Normandeau, 2008). Macrocrustacean impingement losses peaked in April and December (Figure 8-4), with green crabs and Atlantic rock crabs being the species comprising the largest percentages (Normandeau, 2008).

Table 8-A: Estimated Annual Entrainment Losses for Fish from Schiller Station

Common Name	Eggs & Larvae
Alligator fish	134,305
American eel	8,420
American plaice	1,061,867
American sand lance	13,677,174
Atlantic cod	329,888

Common Name	Eggs & Larvae
Atlantic cod/haddock	161,177
Atlantic cod/haddock/witch flounder	344,498
Atlantic herring	1,921,628
Atlantic mackerel	5,846,389
Atlantic menhaden	633,228
Atlantic seasnail	389,677
Atlantic tomcod	53,043
Cunner	32,539,552
Cunner/yellowtail flounder	72,955,812
Fourbeard rockling	1,723,189
Fourbeard rockling/hake	6,394,256
Goosefish	135,665
Grubby	3,393,233
Gulf snailfish	21,770
Haddock	7,072
Hake family	1,397,166
Longhorn sculpin	424,745
Northern pipefish	716,836
Pollock	661,273
Radiated shanny	201,269
Rainbow smelt	1,752,755
Rock gunnel	7,634,337
Sculpin family	59,139
Sea raven	13,329
Sea robin family	71,494
Shorthorn sculpin	93,113
Silver hake	275,997
Striped killifish	8,420
Summer flounder	11,904
Tautog	56,294
Unidentified	246,244
Windowpane	547,224
Winter flounder	372,846
Witch flounder	17,617
Wrymouth	5,790
Total Entrainment	**156,179,633**

Table 8-B: Estimated Annual Macrocrustacean Entrainment Losses from Schiller Station

Taxon	Larvae
American lobster	60,593
Artic lyre crab	309,518

Taxon	Larvae
Atlantic lyre crab	51,723
Atlantic rock crab	1,690,396
Cancer sp.	615,100,527
Green crab	782,297,724
Japanese shore crab	5,271,807
Jonah crab	281,774
Total Entrainment	**1,405,064,062**

Table 8-C: Estimated Annual Fish Impingement Losses from Schiller Station

Common Name	Fish Impinged
Alewife	25
American sand lance	9
Atlantic cod	38
Atlantic herring	297
Atlantic menhaden	328
Atlantic silverside	122
Atlantic tomcod	50
Blueback herring	68
Bluegill	64
Cunner	668
Emerald shiner	33
Grubby	491
Herring family	9
Inland silverside	16
Lumpfish	357
Ninespine stickleback	149
Northern pipefish	621
Pollock	25
Pumpkinseed	9
Rainbow smelt	622
Red hake	9
Roch gunnel	26
Sea raven	16
Shorthorn sculpin	8
Silver hake	9
Skate family	17
Striped bass	25
Tautog	9
Threespine stickleback	53
Unidentifiable	0
White hake	736
White perch	198
Windowpane	75

Common Name	Fish Impinged
Winter flounder	573
Total Impingement	**5,557**

Table 8-D: Estimated Annual Macrocrustacean Impingement Abundance from Schiller Station

Taxon	Estimated Impingement
American lobster	461
Atlantic rock crab	3,597
Green crab	9,474
Horseshoe crab	4
Total Impingement	**13,536**

Figure 8-1: Ichthyoplankton entrainment losses (all taxa and life stages combined)

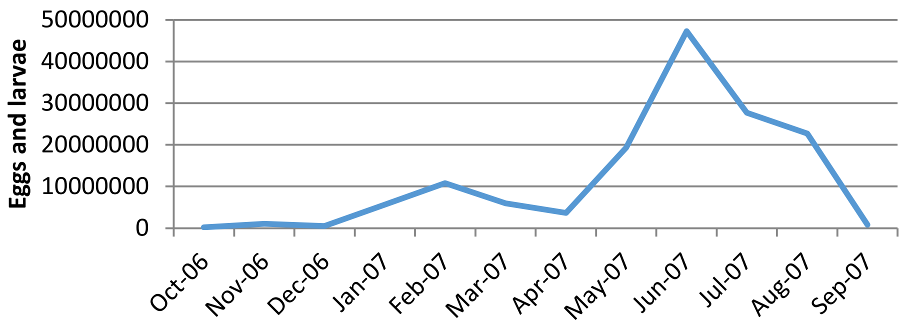
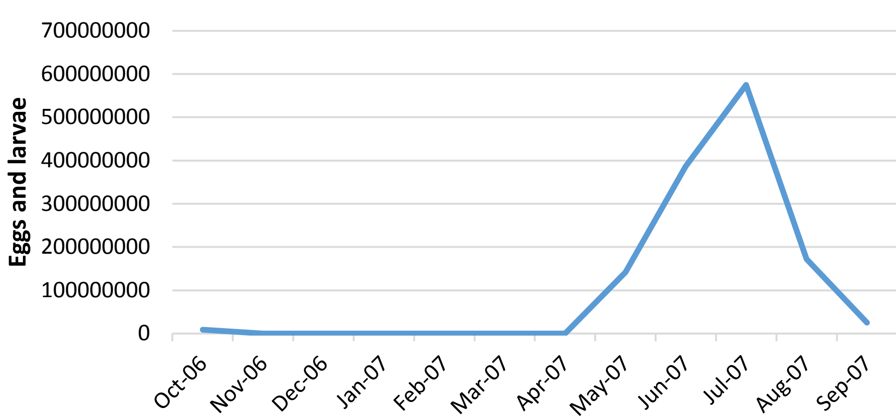
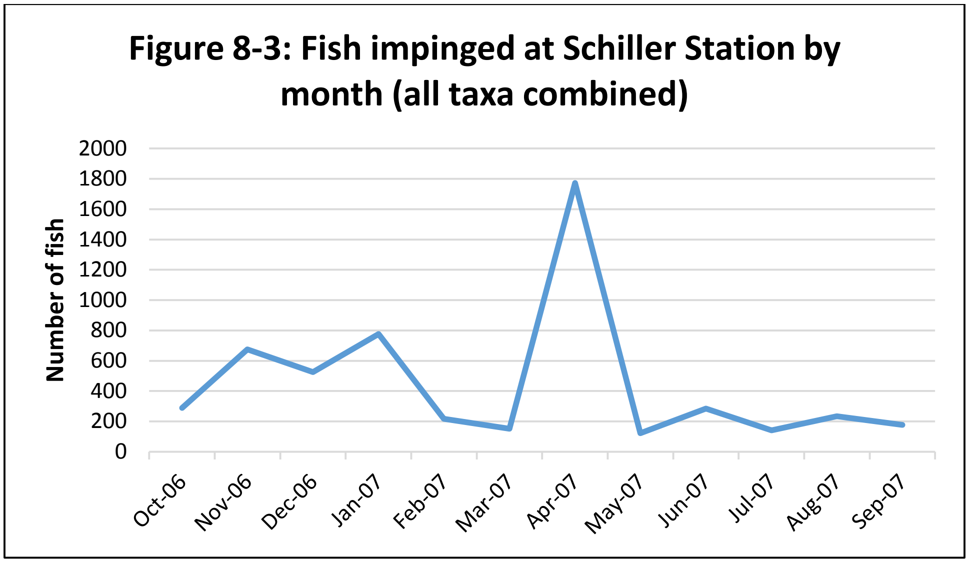
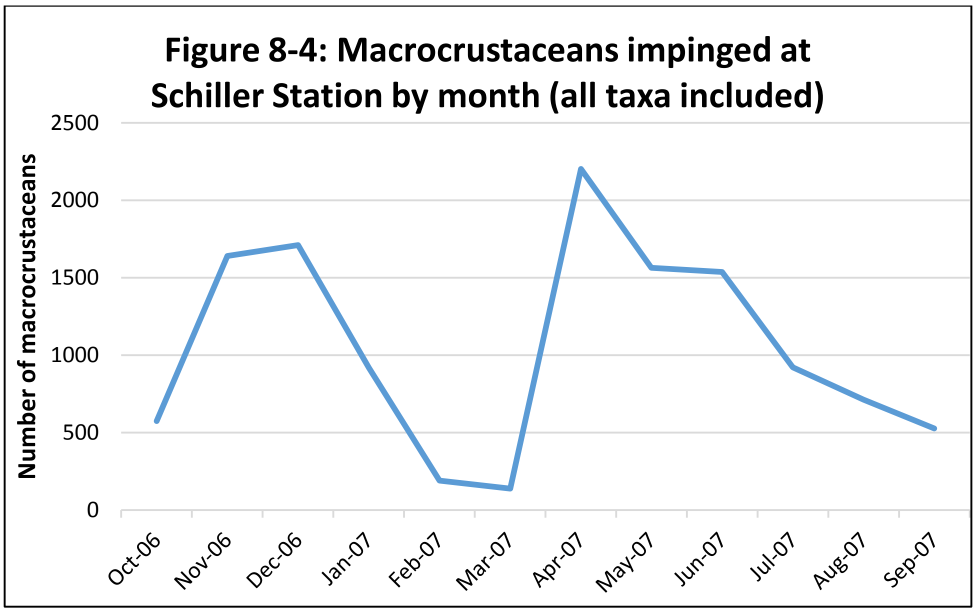


Figure 8-2: Macrocrustacean entrainment losses (all taxa combined)







Schiller Station entrains and impinges large numbers of fish and macrocrustacean eggs, larvae, juveniles and adults. EPA considers these entrainment and impingement losses from the current operation to be adverse environmental impacts. Under CWA § 316(b), the design, construction, location and capacity of the Facility's CWISs must reflect the BTA for minimizing these adverse environmental impacts. At the same time, the available information is insufficient to draw conclusions that these losses have caused either a particular reduction in the Great Bay estuary's populations of the affected species or an imbalance in the overall assemblage of aquatic organisms in the estuary.

9. BTA Options

This section evaluates Schiller Station's existing CWISs and discusses potentially available technological alternatives for ensuring that the location, design, construction, and capacity of each CWIS reflects the BTA for minimizing adverse environmental impacts, as required by CWA § 316(b). This discussion considers engineering, environmental, economic, and other issues related to each alternative (See Section 7.2 of this Fact Sheet for discussion of the methodology underlying the application of BPJ in this determination). Section 10 then concludes with EPA's determination of the CWIS BTA for this permit renewal.

As explained in more detail below, there is a range of alternatives for minimizing the adverse environmental impacts of CWISs. Each available alternative has advantages and disadvantages, both inherent to the technology and as applied specifically at Schiller Station. As described in Section 7, viewed broadly and as dictated by CWA § 316(b), several major aspects of CWISs must be considered in determining the BTA for reducing adverse impacts from CWISs. EPA must consider:

1) *location options*, which for an existing plant would involve *re*-locating the CWIS to a new, less biologically productive or sensitive site or part of the water column in order to reduce entrainment and/or impingement effects;

2) *design options* to lessen entrainment and/or impingement by reducing the velocity of the water drawn into the CWIS, by reducing the mesh size of intake barriers so that additional or all life stages are excluded from entrainment, and by enhancing screening and fish return systems to try to maximize the degree to which impinged organisms can be returned to the source water body unharmed;

3) *capacity (or flow) reduction options*, which reduce the number of organisms entrained and impinged by the CWIS as a result of reducing the volume of water withdrawn from the source water body; and

4) *construction options*, which are applicable for any option that requires construction, and which entails considering the adverse environmental impact of constructing the technology along with alternatives for minimizing those impacts. For example, moving a cooling water intake to a new location might offer potential reductions in entrainment and impingement, but the necessary construction could have adverse environmental effects that would also need to be considered in deciding whether such a re-location should be considered the BTA under CWA § 316(b).

Within the broad categories described above, there are numerous specific technological options to consider. Some of these technologies have been in use for many years and, as a result, are well-established and understood. Indeed, many of these options are discussed in EPA's 1977 Draft CWA § 316(b) Guidance, EPA's Development Document for Best Technology Available for the Location, Design, Construction and Capacity of Cooling Water Intake Structures for Minimizing Adverse Environmental Impact, EPA 440/1-76/015-a, April 1976 (hereinafter EPA 1976 Development Document), the 1994 EPA Background Paper No. 3, and the 1996 EPA Supplement to Background Paper No. 3. These longstanding technologies, as well as newer developing technologies, are also discussed in more recent regulatory preambles issued by EPA, such as the preambles for the proposed and final Phase I CWA § 316(b) regulations for new facilities (promulgated in 2001), the proposed and final Phase II regulations for large existing power plants (promulgated in 2004 and later withdrawn), and the proposed and final New CWA § 316(b) Regulations for existing facilities (promulgated in August 2014).

To determine the BTA for minimizing the adverse environmental impacts of the CWISs at Schiller Station, EPA examined the plant's existing CWISs as well as a range of technologies and operational measures for reducing their impingement and entrainment. EPA first evaluated the performance of the technologies and operational measures in terms of the extent to which they could reduce entrainment and impingement if installed at Schiller Station, and then considered additional relevant factors, such as secondary environmental effects, energy effects, and cost.

9.1 Schiller Station's Existing CWIS Technologies

9.1.1 Existing CWIS Location

The location of a CWIS can vary in terms of where they are placed in relation to the shoreline (*i.e.*, at the shoreline or offshore) as well as in terms of where they are located in the water column (*e.g.*, near the bottom). Furthermore, the location chosen for a CWIS can affect the type or amount of organisms present in the water body and impacted by the CWIS. For example, a CWIS could be located within an estuary, a lake, a river, or another type of water body, and the water body in question might or might not provide spawning and nursery habitat, migratory corridors, or some other type of significant habitat. One of EPA's original guidance documents for minimizing adverse environmental impacts from a CWIS recommends selecting CWIS locations to avoid important spawning areas, juvenile rearing areas, fish migration paths, shellfish beds, or other areas of particular importance for aquatic life. *See* EPA 1976 Development Document.

Schiller Station has two CWISs located on the southwestern bank of the lower Piscataqua River in Portsmouth, New Hampshire. These CWISs provide once-through cooling water to the facility's condensers. The Unit 4 CWIS is located approximately 50 feet north of the CWIS that services Units 5 and 6.

The Unit 4 CWIS (Screen House #1) is equipped with a submerged offshore intake tunnel. PSNH has claimed the precise length of the tunnel to be confidential business information (CBI) under 40 C.F.R. Part 2 Subpart B. PSNH reports that dredging is performed "to preserve the 2-foot elevation difference between the river bottom and the floor of the intake." Enercon Services, Inc. for PSNH, Response to Environmental Protection Agency CWA §308 Letter, PSNH Schiller Station, Portsmouth, New Hampshire, October 7, 2008 (hereinafter "Enercon, 2008"), p. 4. One conventional single-entry, single-exit vertical traveling screen within the bulkhead is used to prevent debris from entering the circulating water system for Unit 4. Screen House #1 was also used for Unit 3, which is now retired. Two additional intake tunnels that used to provide water to the Unit 3 intake well are no longer in use. *Id*.

The CWIS for Units 5 and 6 (Screen House #2) draws water from the Piscataqua River through a nearshore intake. *Id*. at 88. This CWIS has four conventional traveling screens and four corresponding circulating water pumps. Two screens/pumps are operated for each unit. *Id*. at 5.

The location of a CWIS opening within the water column is an important characteristic that affects the structure's capacity to impinge particular organisms. Structures that withdraw from mid-water column or surface waters tend to impinge pelagic (i.e., open water) species of fishes, while intakes that withdraw from bottom waters are more likely to impinge demersal (i.e., bottom-oriented) species. The intake for Unit 4 withdraws water from a 6.5 foot diameter tunnel located about 2 feet above the river bottom. *Id*. at 4. The Unit 5 and 6 CWIS, withdraws from nearly the entire water column, from two feet above the bottom up to the deck at elevation 10 feet above mean sea level (MSL). *Id*. at 5. Based on location of the openings of Schiller Station's CWISs, which collectively withdraw nearly from the entire water column, the plant's intakes have the capacity to impinge and entrain organisms that occupy any portion of the water column, including areas near the bottom.

9.1.2 Existing CWIS Design

Power plant CWISs must be designed to provide a sufficient volume of cooling water necessary for condensing steam in the plant's condensers. In the context of a CWA § 316(b) BTA evaluation, the "design" of a CWIS refers to technological features of the intake structure itself that tend to influence the number of organisms that are entrained and impinged, such as an intake screening system of one type or another, while still allowing the necessary volume of cooling water to be provided.

The Electric Power Research Institute (EPRI) indicates that

> … there are numerous designs for debris and fish protection screens that are contained in the intake structure. Cannon et al. (1979) reviewed intake structures and concluded that the design features that contributed to high rates of impingement are (1) undesirable location in biologically productive areas; (2) relatively large intake system flow; (3) high screenwell velocities; (4) intake conveyance channels; (5) intrusion of the intake structure into the main streamflow; (6) non-uniform velocities across the screen face that may reduce the effective screen area; and (7) screenwell entrapment areas.

EPRI, Technical Evaluation of the Utility of Intake Approach Velocity as an Indicator of Potential Adverse Environmental Impact under Clean Water Act Section 316(b), December 2000, (hereinafter EPRI, 2000), p. 2-1. Some fish species and other aquatic organisms are generally capable of surviving impingement if they are quickly and gently returned to their environment. Several components of a CWIS's design affect whether an impinged organism is likely to be harmed or returned alive and uninjured to the receiving water. These critical components include the intake opening, intake velocity, the type of traveling screen technology, the type of power spray wash system, and the characteristics of the fish return system. These aspects of the existing intake design will be discussed below. Proper maintenance and operation of the existing technologies are also critical to minimizing impingement losses.

a. Existing Intake Opening Design and Velocities

The quantity of water required for cooling and the dimensions of the intake structure openings dictate the velocity at which the water is withdrawn from the source water body. The speed of the water passing through CWIS screens is commonly referred to as the "through-screen velocity." The speed of water being drawn into the CWIS and toward the screens is often referred to as the "approach velocity." Higher intake velocities tend to represent a greater potential for impingement. When aquatic organisms swim or are pulled into a CWIS, high intake velocities may overwhelm their ability to swim away. Once impinged against the intake screens, the pressure of the fast flowing water can then hold the fish (or other organism) against the screens, increasing the potential for killing or injuring them.

Schiller Station operates two CWISs that withdraw water from the Piscataqua River. Each CWIS provides cooling water to two circulation pumps. As previously indicated, Unit 4 has a submerged offshore intake pipe that is 6.5 feet in diameter. The opening is equipped with a course mesh (12-inch by 12-inch grating) stationary bar rack type screen to prevent large debris from entering the intake. In addition, there is another 1.5 inch mesh fixed screen at the bottom of the tunnel entrance to divert lobsters from crawling into the intake, which had been a problem in the past. Enercon, 2008, p. 4. PSNH first reported that the through-screen velocity at the rotating screens within the screen house is 1.38 feet per second (ft/sec or fps) at mean low water (MLW). *Id*. at 12. However, PSNH later reported to EPA that the intake velocity at the tunnel entrance is 1.97 fps. PSNH, Response to EPA's Information Request for NPDES Permit Re-Issuance, August 19, 2013, (hereinafter Enercon, 2013), p. 6. This configuration may result in entrapment. *See* 40 C.F.R. § 125.92(j).

The four screen openings used for Units 5 and 6 are approximately 5.5-feet wide each. The openings are protected by bar racks with 4 3/8-inch by 4-inch gratings. The mesh size of the traveling screens is 3/8-inch square. Enercon, 2008, p. 5. According to PSNH, the through-screen velocities for these two units at the intake screens is 0.68 fps at MLW. *Id*. at 12.

EPA has identified an intake velocity of 0.5 ft/sec as being effective for minimizing impingement because a broad range of fish species are strong enough swimmers to escape an intake velocity equal to or less than 0.5 ft/sec. This rate "has been an informal guideline since the 1970s. It has been used in National Environmental Policy Act Environmental Impact Statements and numerous licensing proceedings." EPRI, 2000, p.1-2. EPA identified this target intake velocity in the Phase I CWA § 316(b) Rule, which applies to new facilities with CWISs (*See* 40 C.F.R. § 125.84(b)(2)), and the New CWA § 316(b) Regulations (*See* 40 C.F.R. § 125.94(c)(2)); 79 Fed. Reg. 48125, 48325, 48336.

Looking at the information underlying this intake velocity standard, EPA found that studies assessing the ability of fish to swim against current velocities found wide variation depending on species, body length, and water temperature. In general, based on the species reviewed, the shorter the length of the fish and/or the lower the temperature, the lower the mean critical velocity observed. *See* EPRI, 2000. The critical velocities of Atlantic menhaden (a resident species of the Piscataqua River) ranged from 0.31 ft/sec to 0.98 ft/sec. Critical velocities of Atlantic herring (also a resident species of the Piscataqua River), however, ranged from 1.2 ft/sec to 4.7 ft/sec depending on the size of fish and ambient temperature of the water. *Id*., Table A-1.

Prolonged swimming speeds are highly dependent on fish length, with smaller (and younger) fish of a particular species typically being weaker swimmers. EPRI found that water temperature had a strong effect on the critical swimming speed of nearly all species tested. According to the report, all fish appeared "less motivated" to swim at lower temperatures. *Id*. at 4-20.

b. Existing Traveling Screens

Schiller Station still utilizes the same traveling screen design and technology that was originally installed with each unit: Unit 4 in 1952, Unit 5 in 1955, and Unit 6 in 1957. Enercon, 2008, p. 15. *See* Figure 9-1 below. The mesh size of the traveling screens is 3/8-inch (9.5 mm) square, which is a size commonly used in the industry for CWIS screens. This mesh size should be small enough to prevent the entrainment of adult fish and most juvenile fish, but not all juvenile fish and earlier lifestages (*i.e.*, eggs and larvae). In addition, narrow shelves (2–3 inches wide) are attached to the screens which carry debris and fish up as the screen rotates. These shelves are designed primarily for moving debris, not fish. Since there are no buckets or troughs used to carry fish safely (in water) to the fish return trough, fish can fall off the screen shelves as the screens emerge from the water. Consequently, fish can suffer injury or exhaustion from being dropped and re-impinged as the screens rotate.

Schiller Station's traveling screens are typically rotated twice daily and more frequently when debris load is high. Fish that are impinged when the screens are stationary suffer the physical trauma of being pinned against the screen, potentially for hours, until the screens are rotated. These fish are much less likely to survive than fish that are promptly removed from the screens and returned to their habitat in a safe and gentle manner. *See* EPRI, 2006, p. 3-18, 3-19. *See also* EPA, Technical Development Document for Final Section 316(b) Existing Facilities Rule, May 2011, EPA-821-R-14-002, (hereinafter TDD, 2014), p. 6-22 ("Insufficiently strong species or life stages may suffocate after prolonged contact with the screens."). Fish impinged on the screens may also be exposed to biocides such as chlorine, which is injected periodically to remove fouling organisms throughout the cooling system.[25] These exposures, combined with the physical stresses of being impinged, are likely to further reduce the chance of survival.

[25] Sodium hypochlorite is pumped to each of three intake forebays (in front of the screens) for 15 minute intervals once per hour for 8 hours. This amounts to 2 hours of biocide use per Unit per day. Enercon, 2008, p. 12.

Figure 9-1: Schiller Station's Unit 5 Intake Screen

Photographed during EPA site visit February 13, 2013.

c. Spray Wash Systems

As rotating traveling screen panels emerge from the water, containing fish and debris, a power spray wash system clears the material from the screens. Each traveling screen has a single-pressure spray header. According to information provided by Schiller Station, the pressure of all the spray wash systems is 40 pounds per square inch (psi). Enercon, 2008, p. 19. EPA considers this pressure higher than that used in a low pressure spray systems designed specifically for fish removal, but lower than the high pressure systems used primarily for debris removal. More recently, spray wash systems have been developed for use by power plants that use both high and low pressure spray washes for the removal of debris and fish, respectively. With such systems, as the traveling screens rotate, they are first hit by the low pressure spray wash (typically 20 psi or less), which is intended to remove fish from the screens without injuring them. The screen is then hit by a high pressure wash (60 psi or greater) that clears off all remaining debris. However, "[d]epending on the spray head's position relative to the screen panel, it may be advantageous to remove debris before fish." TDD, 2014, p. 6-29. The Arthur Kill Station in New York uses a 10 psi low pressure spray wash. *Id*. at 6-34. In addition, the low pressure spray wash used in an EPRI impingement survival study was 10 psi. *See* EPRI, Laboratory Evaluation of Modified Ristroph Traveling Screens for Protecting Fish at Cooling Water Intakes, June 2006.

EPA considers the spray wash systems at Schiller Station to have been designed to remove debris from the traveling screens, not to safely remove fish and other soft-bodied aquatic organisms. These systems are typical for CWISs built during the 1950s and 1960s.

An additional concern for impinged organisms at Schiller Station is posed by the Facility's practice of spraying steam on the travelling screens during times of cold weather to prevent them from freezing. *See* PSNH, Schiller Station NPDES Reapplication, September 2010 (Outfalls 020, 021/022). Spraying steam onto any fish or other aquatic organisms trapped on the screens is likely to injure the creatures and make them less likely to survive being impinged.

d. Fish Return Conduits

Power plants that utilize once-through cooling typically power spray fish and debris off their traveling screens into some form of fish return system which transports the fish (and in some cases debris as well) back to the aquatic habitat from which they were withdrawn. At Schiller Station, fish and debris washed from the Unit 4 traveling screens drop together into a trough where they are carried with wash water into a cement trough and then to a 14-inch covered vinylester resin fiberglass sluice that discharges into the air above the Piscataqua River at an elevation of 4 feet above MSL. The trough servicing both Units 5 and 6 screens carries fish, debris, and wash water from the screens to another fiberglass chute that also discharges to the air above the Piscataqua River at an elevation of 8 feet above MSL.

Both fish return sluiceways return fish to a location between the two intake screen houses, close to Screenhouse #2. Re-impingement of fish from both fish returns systems is likely to be a problem for Screenhouse #2 (Units 5 and 6) because of the close proximity of the fish/debris return locations to the intake, which is located at the shoreline and includes surface withdrawal. Re-impingement of fish into Screenhouse #1 (Unit 4) is less likely because the intake is submerged and offshore, while the fish are returned to the water surface.

9.1.3 Existing Cooling Water Flow Requirements

Schiller Station's once-through cooling system is designed to withdraw up to 125.7 MGD of water from the Piscataqua River.[26]

As discussed above, the facility uses this water for condensing steam in the power plant's condensers. Until the relatively recently (*i.e.*, 2011 or so), Schiller Station operated as a "base-load" plant, meaning that it operated more or less continuously except for scheduled or unscheduled maintenance outages. The common practice of the facility has been to run all six pumps the majority of the time.

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[26] This includes a relatively small amount used for spray washing the intake screens.

For Units 4 and 6, maintenance outages occur every 18 months, and last approximately four weeks. For Unit 5, maintenance outages occur every year, and last approximately three weeks with a six week outage scheduled every five years. "[T]he maintenance outages are staggered so that all Units are not offline at the same time." Enercon, 2008, p. 10.

As part of issuing the existing NPDES permit to Schiller Station in 1990, EPA determined that Schiller Station's existing system satisfied the BTA standard of CWA § 316(b). *See* 1990 Schiller Station NPDES Permit, Part I.A.1.f and EPA Fact Sheet for the 1990 Permit, pp. 6-7. In addition, the 1990 permit requires that:

> All live fish, shellfish and other aquatic organisms collected or trapped on the intake screens shall be returned to their natural habitat. All solid materials removed from the screens shall have land disposal.

1990 Schiller Station NPDES Permit, Part I.A.1.c. EPA is now applying CWA § 316(b) to Schiller Station once more in light of the now existing facts and law.

9.2 EPA's Assessment of Schiller Station's Existing CWIS

EPA considered the location, design and capacity of Schiller Station's existing CWIS (i.e., without any additional "construction" needed) and concluded that these aspects of the CWIS do not reflect the BTA for minimizing adverse environmental impacts (specifically entrainment and impingement). As a power plant with an open-cycle cooling system, Schiller Station uses a maximally water-intensive process for condensing steam in its process for generating electricity. Given the moderately large water withdrawals (maximum 125.7 MGD) coupled with the location of the Facility's CWISs in highly productive estuarine waters, the facility entrains and impinges large numbers of fish and crustaceans of different life stages. (Data from the Facility, as presented above, indicate that the highest entrainment rates occur in the warmer weather months, whereas impingement is generally more consistent across the year.) Furthermore, given the relatively high intake velocities and the lack of updated, fish friendly screening technologies and fish return system equipment, the effects of impingement on aquatic organisms are likely far more adverse than they would be with alternative, update technology. In light of these considerations, EPA determines that the location, design and capacity of Schiller Station's existing CWISs do not, in combination, reflect the BTA for minimizing adverse environmental effects, as required by CWA § 316(b).

9.3 Alternative Intake Location Option

In evaluating the location of Schiller Station's CWISs, it is critical to recognize that because Schiller Station is an existing facility, the question to be answered is whether *relocating* the CWISs would be appropriate. EPA evaluated the existing location of Schiller Station's CWISs in the water body (e.g., proximity to a shoreline), the type of waterbody, and the depth of the intake structure.

As noted above, Schiller Station is located on the tidally influenced Piscataqua River, which makes up part of the Great Bay estuary. Locating the CWIS for an open-cycle cooling system in an estuary will typically present serious entrainment and impingement concerns. Estuaries, such as the tidal portion of the Piscataqua River, are biologically highly productive environments. They are also ecologically critical to other marine systems and are valuable to people. Estuaries provide foraging habitat and migratory pathways for adult organisms, thereby increasing the abundance of impingeable organisms in the waterbody, as well as spawning and nursery habitat for many species, which increases the abundance of entrainable organisms (e.g., eggs and larvae). *See e.g.*, 67 Fed. Reg. 17140 (April 9, 2002) (preamble to the Proposed Phase II rule). Estuaries also maintain hydrologic balance, filter pollutants from water, and provide habitat for birds, mollusks, crustaceans, fish, and other commercially and ecologically important organisms. Millennium Ecosystem Assessment, Current State and Trends Assessment Chapter 19: Coastal Systems, Ecosystems and Human Well-Being, Island Press, Washington, D.C., 2005.

In developing national standards for § 316(b), EPA has recognized that tidal rivers and estuaries are particularly sensitive water bodies and that both impingement and entrainment are of concern. 79 Fed. Reg. 48424. With regard to locating new CWISs, as long ago as 1976, EPA has recommended selecting locations to avoid important spawning areas, juvenile rearing areas, fish migration paths, shellfish beds or areas of particular importance for aquatic life. See EPA 1976 Development Document.

At the same time, Schiller Station is an existing facility with CWISs that are already in place. The CWISs would need to be extended a very long way to get outside of the Great Bay estuary and the Piscataqua River and the cost and environmental effects of such an undertaking would be huge. Moreover, it is not clear that a location outside the estuary in more of an open ocean environment would necessarily have lesser adverse environmental effects. Certainly EPA does not have any data identifying a feasible, environmentally preferable location for the CWISs outside of the river and estuary.

EPA also considered more modest changes to the location of the Facility's CWISs. PSNH evaluated the conversion of Unit 4's offshore intake to a nearshore intake. Based on the biological data collected for the Units 5 and 6 nearshore intake,[27] PSNH determined that relocating the offshore Unit 4 intake to a nearshore location could reduce impingement of fish and macrocrustaceans. Entrainment was not evaluated for an alternative intake location due to the lack of icthyoplankton data for any new alternative intake location. PSNH cautioned that this determination is dependent on conducting field studies, including biological monitoring, to establish if this option is technologically feasible and whether it would also be beneficial in terms of entrainment reduction. In addition, PSNH rejected the option of converting the nearshore Unit 5 and 6 intake to an offshore location because of the potential to increase impingement. *See* Enercon, 2008, pp. 88-89.

EPA suspects that the high impingement rate for Unit 4 compared to Units 5 and 6 is at least partly due to the high intake velocity at the tunnel entrance to the Unit 4 intake structure, thereby trapping aquatic life in the Unit 4 screen well. EPA agrees that further studies would be required to determine both the feasibility and potential biological benefits of this option. Based on

[27] "For EA fish, the Unit 4 impingement was approximately two times the average of Units 5 and 6. For macrocrustaceans, the Unit 4 impingement was approximately six times the average of Units 5 and 6." Enercon, 2008, p. 88.

insufficient information, EPA cannot conclude at this time that relocating the Unit 4 intake to a near-shore location is a potential BTA for minimizing impingement and entrainment. In addition, EPA agrees with the Facility that relocating the Units 5 and 6 intake to an offshore location does not constitute an option for the BTA for this CWIS.

9.4 CWIS Design and Construction Options

CWISs can be designed to include various types of "exclusion" technologies that aim to prevent or minimize mortality to aquatic organisms from entrainment and/or impingement by excluding them from being drawn into the CWIS and/or through the intake screens. Exclusion technologies typically use some type of screening system to block organisms from being taken from their aquatic habitat and pulled into the CWIS and through the intake screens.[28] There are many different exclusion technologies, but they can generally be grouped into two broad categories: coarse-mesh or fine-mesh screening systems.

It must also be understood, however, that to the extent that a screen blocks an organism from being entrained, that organism has necessarily been impinged against that screen. As a result, in order to assess the ultimate benefit of the technology, EPA must also assess whether or not these impinged organisms can safely be removed from the screens and returned to their habitat. This is a particular challenge with regard to tiny, fragile icthyoplankton. Moreover, successful methods for monitoring whether eggs and larvae survive after being impinged, removed from screens and returned to the water are not widely available. Just the process of collecting and examining these organisms can destroy them. Nevertheless, EPA must assess whether an exclusion technology capable of preventing entrainment mortality is merely replacing it with impingement mortality.

Fine-mesh screening technologies attempt to reduce both the entrainment of fish eggs and larva and impingement mortality. According to PSNH, a mesh size of no greater than 1.0 mm is necessary to effectively screen most fish eggs and larvae. Enercon, 2008, p. 80. The degree of success that mesh of different sizes would have at any particular site will depend, in part, on the size of the mesh relative to the size of the eggs and larvae present at the site. It will also depend, in part, on intake velocity, as excessive intake velocity can result in eggs and/or larvae being impinged and pulled through the screens. Fine-mesh traveling screens rely on small mesh-size and low intake velocity to try to reduce or prevent entrainment by excluding (or blocking) organisms from being pulled into the plant's CWIS, but may substitute impingement mortality for entrainment. If intake velocity is reduced, passing currents in the water body may be more likely to sweep organisms past the intake. At the same time, however, if intake velocity and screen mesh size are both to be reduced, the intake area will need to be increased to provide adequate water volume. *See* TDD, 2014, p. 6-50. Another exclusion technology, wedgewire screens, also relies upon very small mesh sizes and low intake velocities to exclude organisms and enable passing currents to sweep organisms past the CWIS. Indeed, the design of wedgewire screens is intended particularly to minimize any contact of eggs and larvae against the fine-mesh screens and to facilitate any eggs and larvae that do contact the screens being washed off by

[28] For this Fact Sheet, EPA does not evaluate "behavioral" systems that have been discussed in the literature and that use lights or sounds to try to prevent impingement (primarily). To EPA's knowledge, the effectiveness of this type of system has not been demonstrated. Moreover, PSNH has not proposed such a system for Schiller Station. Therefore, EPA focuses its evaluation of exclusion system options that seek to prevent or reduce entrainment and/or impingement by reducing intake velocities and/or by blocking organisms with some type of screening system.

passing currents.

PSNH reviewed several exclusion technologies. The Enercon, 2008 report evaluates coarse-mesh Ristroph screens, dual flow conversion traveling screens, Geiger MultiDisc® screens, Beaudrey's W Intake Protection Screen (WIP), aquatic microfiltration barrier, as well as "wide-slot" and "narrow-slot" wedgewire screens. Below EPA reviews the exclusion technologies presented by PSNH as potential BTA options.

The following is a discussion of the exclusion technologies evaluated by PSNH, including EPA's assessment of whether these technologies are "available" for Schiller Station.

9.4.1 Wedgewire Screens

"Wedgewire screens utilize "V" or wedge-shaped, cross-section wire welded to a framing system to form a slotted screening element." Taft, 2000, p. S354. In its evaluation of this technology, PSNH differentiated between "wide slot" and "narrow slot" screens. Although neither is specifically defined in the evaluation, PSNH provides data for slot sizes ranging from 0.6 mm – 1.0 mm in its discussion of "narrow slot" wedgewire screens. In the present discussion, the terms "wide slot" and "narrow slot" when used in the context of wedgewire screens are equivalent to the terms "coarse-mesh" and "fine-mesh," respectively, when used in the context of other types of screening systems.

Wedgewire screens can potentially reduce both entrainment and impingement by physically excluding organisms from being drawn into the CWIS and by generating low intake velocities that allow motile organisms to swim away from the screens and avoid being impinged. This technology relies on the presence of swift ambient currents passing by the screens so that organisms will be swept away from the CWIS to safety. Thus, the extent to which installing wedgewire screens at a particular facility will reduce mortality to aquatic organisms from impingement or entrainment will depend on a variety of factors including the screen slot size relative to the size of the organisms, the characteristics of the organisms present (*e.g.*, their size, life stage, motility or lack thereof, swimming strength, durability or hardiness), water depths, water withdrawal volumes and intake velocities, the type of system used to prevent screen clogging by debris or biological growth (*e.g.*, air-burst systems, application of biocides, physical cleaning techniques), and the presence of sufficient ambient current to sweep organisms away from the intake screens. To the extent that a small slot size wedgewire screen prevents entrainment by physically blocking or excluding the organism from entering the CWIS, a key question is whether the organism will survive being impinged against the screen. This is discussed in more detail below. *See* 79 Fed. Reg. 48331.

An important issue for fine-mesh screens is whether and to what extent the screens may suffer clogging problems, either from debris in the water body or biological growth. If the screen openings are clogged, intake velocities may increase and/or the facility may have trouble obtaining adequate water volumes. There are several methods that a facility may use alone or in combination to deal with clogging, such as an air burst system (low or high pressure), application of biocides, physical scraping. Depending on the method chosen, it may be more or less detrimental to any organisms caught on the screens.

Wedgewire Screens – PSNH's Review

In its 2008 analysis, PSNH rejected wide-slot wedgewire screens for Schiller Station because they would not help to reduce entrainment. *See* Enercon, 2008, p. 79.

With regard to screens with smaller slot sizes, PSNH's 2008 analysis evaluated four sizes (0.6 mm, 0.69 mm, 0.8 mm, and 1.0 mm). These slot sizes were chosen to provide entrainment reduction based on the size of different life stages of organisms found in the Piscataqua River in the vicinity of Schiller Station. In order to maintain a through-screen velocity less than 0.5 fps, PSNH indicated that an installation of six screens would be necessary. PSNH also indicated that if the 1.0 mm slot size was chosen, each of the six screens would be 166" long and 54" in diameter. PSNH further reported that the other 3 options would have screens with lengths of 190" and 60" diameters. *Id*. at 81.

PSNH also indicated that the wedgewire screen system would include an airburst cleaning system to remove accumulated debris, but that calcareous algae, barnacles, mussels and other organisms would require manual removal quarterly. To aid in the prevention of biological growth on the screen mesh, PSNH stated that copper-based alloy screen materials would most likely be used, as well as the potential routine application of biocides. PSNH indicated that operation costs would slightly increase with the need to use the airburst system at a higher frequency than normal (i.e., three times per day versus once per day).

PSNH proposed that the screens would require quarterly inspection for the first 12 to 15 months after installation in order to evaluate the rate of fouling. According to the company, both the internal and external surfaces of the screens would require periodic cleaning using either scraping tools or high-pressure hydro-lancing. To facilitate cleaning, PSNH also indicated that either a man-way could be installed to allow internal access to the screens or the screens could be designed to be removable, allowing for cleaning above the water surface.

In addition, PSNH estimated a range for the capital cost of replacing the existing traveling screens with the narrow-slot wedgewire screens, which is considered CBI. *Id*. at 85.

Ultimately, PSNH concluded that wedgewire screens could effectively reduce impingement and entrainment mortality. The company indicated that impingement would be minimized by maintaining through-screen velocities less than 0.5 fps while the Piscataqua River would provide sufficient ambient river current velocity to sweep eggs, larvae, and fouling debris past the screens. According to PSNH, the use of wedgewire screens with different slot widths would decrease impingement mortality and entrainment by the percentages shown in Table 9-A. (The Region notes that the figures for entrainment reduction do not necessarily represent an equal reduction in entrainment *mortality* because they do not reflect an evaluation of whether or to what extent organisms will contact the screens and survive such contact.)

Table 9-A: PSNH Estimates of Impingement Mortality and Entrainment Exclusion for Equivalent Adult Fish and Macrocrustaceans Using Wedgewire Screens

Slot/Mesh Size	Estimated % Reduction in EA Fish Impingement Mortality	Estimated % Reduction in EA Macrocrustacean Impingement Mortality	Estimated % Reduction in EA Fish Entrainment	Estimated % Reduction in EA Macrocrustacean Entrainment
1.0 mm	80-95	80-95	73.3	100
0.8 mm	80-95	80-95	89.6	100
0.69 mm	80-95	80-95	92.4	100
0.6 mm	80-95	80-95	98.9	100

Id. at 85 and 105. Citing the then suspended 316(b) Phase II Rule, PSNH pointed out that the estimates for impingement reduction are based on reducing the through-screen velocity to 0.5 fps or less. PSNH also recommended a one year pilot study in order to evaluate (1) the effectiveness of different slot for reducing entrainment, and (2) the ability of different construction materials to hold up to the marine environment without clogging.

In October 2014, PSNH submitted a supplemental information report to Region 1 titled, Engineering Response Supplement to United States Environmental Protection Agency CWA § 308 Letter, prepared by Enercon Services, Inc., October 2014 (hereinafter Enercon, 2014). In this report, PSNH proposed wide-slot wedgewire screens as a compliance candidate for Section 316(b) of the CWA under §125.94(c)(2).[29] According to PSNH, this option would include two Johnson Screens Model T-78HC half-screens with a slot width of 3/8 inches (9.5 mm) for Screen House #1 (the Unit 4 intake) and three of the same screens for Screen House #2 (Units 5 and 6 intakes). The company indicated that each of the two screens installed for Screen House #1 would be 18.25 feet long and have a diameter of 78 inches, and that each of the three Screen House #2 screens would be 20.75 feet long and have a width/diameter of 84 inches. PSNH further stated that "the maximum through-screen velocity would [be] 0.33 fps, which is less than the 0.5 fps design intake velocity required to be considered a candidate technology under §125.94(c)(2)." Enercon, 2014, p. 29. Similar to the smaller slot size screens discussed above, PSNH also indicates that this option would include an airburst cleaning system to remove accumulated debris.

Compared to the Enercon 2008 report, the 2014 report adds an evaluation of the variables that need to be considered in the design and construction of wedgewire screens. These considerations include the use of high grade stainless steel, hydrodynamic load, hydrostatic load, wave load, impact load[30] weight of the structures and the stability of the bedrock underneath, marine construction methodologies, potential concerns of having lower water levels in the intake bays

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[29] This report also evaluates Parallel Condensing System™ technology and drum screens, which are not considered feasible and not discussed in this Fact Sheet.

[30] "The wedgewire screens are installed on the bottom of the river, and the probability of direct impact from the floating debris is low. Therefore, the 'normal impact' case would be considered during detailed design. Previous project experience has also shown that impact of debris on wedgewire screens at water velocities similar to this case results in localized damage of the wedgewire screens, but not complete failure." Enercon 2014, p. 32.

and increased hydraulic head across the circulating water pumps, as well as the need for wedgewire screen by-pass capabilities during emergency situations.

PSNH provides cost estimates for the wide-slot screens, but again claims that they are CBI. As a result, these values are not reported here.

Finally, the biological efficacy of wide-slot wedgewire screens was not evaluated in Enercon, 2014 since, according to Enercon, "biological efficacy is not required under the final § 316(b) regulations." Enercon, 2014, p. 48.

Wedgewire Screens – EPA's Review

As discussed below, EPA's analysis concludes that wedgewire screens are a viable, promising BTA option for Schiller Station. Depending on the configuration of the wedgewire screens that would be applied at the Facility, this technology may be able to substantially reduce mortality to aquatic organisms from impingement and entrainment by Schiller Station's CWISs. That said, the exact percentage by which entrainment mortality would be reduced by this technology is scientifically uncertain.

Necessary Site Characteristics

Adequate water depth near the intakes is required to ensure that wedgewire screens remain submerged at all times. PSNH reports that the depth in front of the current intakes is nearly 20 feet and that it must periodically dredge sediment that accumulates in front of the intake structures. Enercon, 2008, p. 4 and 5. Based on a proposed maximum wedgewire screen diameter of 60 inches, adequate water depth would be expected to be maintained at all times. Generally, "[t]he available water depth should be at least twice the diameter of the intake screen." http://www.wedgewire.com/intakescreen.htm. Further, dredging would not likely be necessary with wedgewire screens because the screen cylinders are commonly located off the river bottom mounted on a central intake pipe as shown in the figure below (shown with an active airburst system for removing small debris and silt from the screens) (TDD, 2014, p. 6-22).

Figure 9-2: Example Wedgewire Screen Installation

Not only is adequate water depth needed, but the water body itself must be large enough to accommodate the wedgewire screen installation without excessive interference with the water body's beneficial uses, such as navigation. As wedgewire screen slot sizes are reduced, and through-screen intake velocities are reduced, both of which are necessary to maximize entrainment and impingement mortality reductions, the size of a wedgewire screen installation must increase in order to ensure that an adequate volume of cooling water is provided to the facility. For this reason, wedgewire screens are best suited – though they may or may not prove to be viable or effective – in cases where the cooling water withdrawal volumes are low relative to the size of the water body in which they are to be located. In such cases, the water body is most likely to be able to accommodate an adequate number of wedgewire screens to meet the facility's cooling water demand. At Schiller Station, the intake flow of 125 MGD is relatively small as compared to the river width and depth, and an adequately sized wedgewire screen installation is not likely to interfere with other uses of the river. The proposed locations of the wedgewire screens are inshore of the facility's pier. Navigation and use of this area is already restricted due to the presence of the company's pier and other infrastructure. Thus, the installation of the wedgewire screens would not alter its use. (The number and size of screens proposed for Schiller's two CWISs are specified above.)

As mentioned above, the presence of adequate ambient sweeping current velocities in the source water body is critical to the success of wedgewire screen technology. Sweeping currents must be sufficient to move organisms away from the CWIS to minimize any entrapment against the screens. Currents in the Piscataqua River in the vicinity of Schiller Station appear to be sufficient for this purpose. PSNH reports that the average maximum ebb velocity (seaward flow) is 4.89 feet per second ("fps") and the average maximum flood velocity (landward flow) is 4.39 fps.[31] The velocity of the river current drops below 0.5 knots (0.8 ft/sec) only for short periods around slack tide. For the great majority of the time, the upstream and downstream forces exerted by the tidal river velocity would be much greater than the 0.5 ft/sec through-screen velocity of the proposed wedgewire screen installation. Fish swimming in the vicinity of the screens must also contend with these tidally induced river velocities that move across the intake screens. In this high energy estuarine environment, the relatively small through-screen velocity would not be expected to significantly influence adult and juvenile fish. These currents would also be sufficient to move a proportion of drifting organisms past the screens.[32] EPA considers the relatively high velocity conditions (except the brief slack tide periods) in the Piscataqua River

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[31] NOAA reports the following average river current velocities (depth in parentheses) for the area of the river adjacent to Schiller Station: flood tides - 4.0fps (9d), 3.8fps (29d), and 3.5fps (52d); and ebb tides - 3.6fps (9d), 3.5fps (29d), and 2.9fps (52d). http://tidesandcurrents.noaa.gov/currents12/tab2ac1.html.

[32] The Piscataqua's high velocity currents are already capable of sweeping some portion of the river's aquatic organisms past the existing CWISs, but the intake velocity and wide-mesh traveling screens still result in the impingement and entrainment, as evidenced in the data presented above. By reducing the intake velocity, wedgewire screens would reduce impingement by potentially enabling adult and juvenile fish to escape from the intakes and may also facilitate drifting organisms being swept past the intakes. This effect on drifting organisms may, to some extent, be counteracted by the larger surface area of the wedgewire screens in the river as compared to the area of the existing intakes. EPA does not have sufficient information enabling the Agency to quantify the result of these opposing forces. Therefore, at present, EPA is conservatively assuming that the same number of eggs and larvae will be drawn to the wedgewire screens as are currently entrained at the Facility. EPA expects that this is a conservative assumption because of the information, discussed below, suggesting that eggs and larvae may be swept past a wedgewire screen installation.

suitable for the effective use of wedgewire screens.

In its evaluation of wedgewire screens in support of New CWA § 316(b) Regulations, EPA has also noted the following additional logistical issue:

> As with any intake structure, the presence of large debris poses a risk of damage to the structure if not properly managed. Cylindrical wedgewire screens, because of their need to be submerged in the water current away from shore, might be more susceptible to debris interaction than other onshore technologies. Vendor engineers and facility representatives indicated that large debris has been a concern at several of their existing installations, but the risk associated with it has been effectively minimized by selecting the optimal site and constructing debris diversion structures. Significant damage to a wedgewire screen is most likely to occur from fast-moving submerged debris. Because wedgewire screens do not need to be sited in the area with the fastest current, a less damage-prone area closer to shore or in a cove or constructed embayment can be selected, provided it maintains a minimum ambient current around the screen assembly. If placement in the main channel is unavoidable, deflecting structures can be employed to prevent free-floating debris from contacting the screen assembly. Typical installations of cylindrical wedgewire place them roughly parallel to the direction of the current, exposing only the upstream nose to direct impacts with debris traveling downstream. EPA has noted several installations where debris-deflecting nose cones have been installed to effectively eliminate the damage risk associated with most debris.

TDD, 2014, p. 6-42 to 6-43. Given the size and characteristics of the river around Schiller Station, and the size of the wedgewire screen array that would likely be needed, EPA concludes that wedgewire screens could be installed at Schiller Station in a location that would minimize the threat of damage from large debris. For example, wedgewire screens at Schiller Station would be located in the shadow of the Facility's pier, which is likely to offer some protection from vessels and debris.

Reductions in Impingement Mortality

Wedgewire screens prevent or minimize impingement by maintaining intake velocities low enough that most fish and other motile organisms should be able to swim away from the screens and avoid being pulled against them. Low intake velocities result from the cylindrical shape and relatively large surface area of a wedgewire screen, which quickly dissipates through-screen intake velocity. As mentioned above, if a large amount of cooling water is needed, the size of the wedgewire screen array may need to be quite large to provide enough water while maintaining a low intake velocity. Yet, even if the installation is large, organisms should still be able to avoid becoming impinged as long as the intake velocity is low.

Although an intake velocity of 0.5 fps is generally expected to protect 96% of fish from impingement, *see* Phase I Rule (66 Fed. Reg. 65256); TDD, 2014, p. 6-66), EPA has decided to use PSNH's lower value of an 80-95% (87.5% average) impingement reduction for both fish and macrocrustaceans for this case because the critical swim speeds for some resident species in the Piscataqua River are below 0.5 fps. In other words, some species may not be able to escape certain intake velocities below 0.5 fps. For example, the critical velocities of Atlantic menhaden ranged from 0.31 ft/sec to 0.98 ft/sec. *See* EPRI, 2000, Table A. Thus, even using PSNH's lower values, wedgewire screens are estimated to achieve a large reduction in impingement mortality.

All of the wedgewire screen options proposed would be designed to achieve an intake through-screen velocity of 0.5 fps or less under all conditions. As a result, all of these options would satisfy the impingement mortality reduction standard for the BTA under the New CWA § 316(b) Regulations. *See* 40 C.F.R. § 125.94(c)(2).

Reductions in Entrainment and Entrainment Mortality

Wedgewire screens can also reduce entrainment and entrainment mortality. This technology achieves these reductions in two different ways. *See* 40 C.F.R. § 125.92(h) and (i) (definitions of "entrainment" and "entrainment mortality" in New CWA § 316(b) Regulations). First, by siting the screens in an area with sufficiently rapid ambient sweeping currents, wedgewire screens may make it more likely that organisms will be swept past the CWIS rather than ever coming into contact with it. *See* 79 Fed. Reg. 48334 ("Limited evidence also suggests that extremely low intake velocities can allow some egg and larval life stages to avoid the intake because of hydrodynamic influences of the crossflow"); TDD, 2014, pp. 6-50 to 6-51; EPRI, 2003. At the same time, maintaining adequate water withdrawal volumes despite low intake velocities and small slot sizes will require a larger screen area than a CWIS with a higher intake velocity and wider-mesh screens. *See* TDD, 2014, p. 6-50. The increased area of the screen array in the water may, in turn, tend to result in more drifting organisms coming into contact with the screens as water is drawn through them. *See id.* at p. 6-44 (wedgewire screens oriented parallel to river current may result in more contact with the screens for aquatic organisms). In other words, this appears likely to lessen the chance that organisms will avoid the screens entirely. EPA does not have sufficient information to quantify the product of these potentially offsetting processes at Schiller Station (*i.e.*, the effect on screen avoidance of reduced intake velocity versus increased screen area).

Second, wedgewire screens can also reduce entrainment by making the slot width of the wedgewire screen mesh small enough to preclude organisms in the source water body from passing through the screen along with the water being withdrawn for cooling purposes. Entrainment is typically a problem for very small organisms (eggs, larvae and potentially juvenile organisms), which are immotile or weak swimmers and tend to drift with prevailing currents. As a result, the screen slot size must be quite small to prevent entrainment. More specifically, the screens' slot size must be small enough relative to the size of the organisms that are present to exclude or prevent their being pulled through the screens.[33] PSNH has presented exclusion estimates for wedgewire screens with different slot sizes, as indicated in the table above.

Based on the size of the resident species' eggs and larvae, EPA agrees with PSNH that a slot size of 0.6 mm to 0.8 mm will likely be needed to maximize entrainment reductions at Schiller

[33] For larvae, the critical measurement is not their length, but their head capsule width. This is because even if a larva is longer than a particular screen opening, it can be pulled through that opening if the head capsule is narrower than the opening.

Station. As a result, EPA rejects PSNH's 2014 proposal of wide-slot wedgewire screens (9.5 mm), as presented in the Enercon, 2014 report, as a possible BTA for reducing entrainment mortality at Schiller Station because such screens would be of limited value for reducing entrainment. With a mesh size that large, as PSNH has recognized previously, eggs and larvae will be entrained with the water withdrawn by the Facility through its CWISs.[34]

At the same time, smaller slot sizes may be more likely to have screen fouling problems from debris and/or biological growth. Screens with very small slot sizes require greater screen surface areas to provide adequate water volumes while maintaining sufficiently low intake velocity. Thus, all of these factors must be balanced to decide upon the optimal screen slot size for a particular facility. *See* TDD, 2014, p. 6-50 (citing EPRI study which cautioned "that the available data are not sufficient to determine the biological and engineering factors that would need to be optimized, and in what manner, for future applications of wedgewire screens").

According to PSNH's proposal, six wedgewire screens would need to be installed in the Piscataqua River based on a range of mesh sizes from 0.6 mm to 1.0 mm. Screen house #1 would require two screens and screen house #2 would have four screens. As reported above, PSNH has indicated that with a 1.0 mm slot size, each screen would be 166" long and 54" in diameter, while the other 3 slot size options would have screens with a length of 190" and a diameter of 60". Enercon, 2008, p. 81. Each screen installation configuration was determined to result in a through-screen velocity less than 0.5 fps. *See id*. Of course, as screen fouling increases, screen intake velocity increases, too. Therefore, the proposed air burst system and periodic manual cleaning would be necessary to prevent such fouling of the screens and any attendant increase in intake velocity. In addition, EPA agrees that the screens may need to be constructed with copper (or nickel) alloys to discourage biofouling. *See* TDD, 2014, p. 6-42. However, EPA does not necessarily agree that emergency by-pass capability is warranted at this location and welcomes comment and more information on this design feature.

PSNH's consultants estimated the number of eggs and larvae that would be excluded by wedgewire screens with different slot sizes (see Table 9-A above). However, these values are based on adult equivalents. [35] EPA considers adult equivalents, but also focuses on absolute loss numbers of eggs and larvae when making control decisions. Basing decisions solely on adult equivalents would ignore the valuable ecological role eggs and larvae play in the food chain. Tables 6-19 through 6-20 in Attachment 6 of the Enercon 2008 report show the total number of fish eggs and larvae entrained per unit and wedgewire slot size. These estimates are based the dimensional sizes of various eggs and larvae from literature sources plus assumptions of the percent of eggs and larvae retained on the screens. Accordingly, PSNH estimated the % entrainment reduction for total numbers of fish eggs and larvae is 11.5% for 1.0 mm screens,

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[34] To the extent that PSNH is suggesting that Schiller Station is not subject to entrainment controls under the New CWA § 316(b) Regulations, this is incorrect. The Facility plainly is subject to entrainment control requirements under 40 C.F.R. § 125.94(d), as well as impingement control requirements under 40 C.F.R. § 125.94(c). This is so regardless of whether information submission requirements vary under the New CWA § 316(b) Regulations based on whether a facility withdraws more or less than 125 MGD.

[35] An adult equivalents analysis estimates the number of adult fish of a certain age that a particular number of eggs and larvae would produce based on certain assumptions about the normal development and survival of the early life stages of each species.

79.2% for 0.8 mm screens, 85% for 0.69 mm screens and 94.4% for 0.6 mm screens. The same type of analysis is also presented for macrocrustaceans (*e.g.*, various species of crab and lobsters) and concludes that all the mesh sizes would reduce the entrainment of these organisms by 100%.

Based on PSNH's evaluation of total numbers of organisms, including fish eggs and larvae and macrocrustaceans, the following numbers of individuals are expected to be excluded from wedgewire screens:

Table 9-B: Entrainment Exclusion Estimates for Total Numbers of Organisms Using Wedgewire Screens

Slot/Mesh Size	Estimated % of Fish Excluded from Entrainment	Estimated % of Macrocrustacean Excluded from Entrainment	Total % of Organisms Excluded from Entrainment
1.0 mm	11.5	100	85.9
0.8 mm	79.2	100	96.7
0.69 mm	85.0	100	97.6
0.6 mm	94.4	100	99.1

Another critical issue to consider when assessing whether wedgewire screens should be the BTA at a particular facility is whether organisms (primarily eggs and larvae) being excluded from entrainment by the screens will *survive* any contact that they may have with the screens. Because such organisms tend to be relatively fragile, befitting their small size and early stage of development, using a screen to exclude eggs and larvae from being entrained is not necessarily the same thing as providing for their survival. The organisms may die from being impinged against the screens. *See* 79 Fed. Reg. 48330-48331, 48334-48335, 48340-48341, 48377; TDD, 2014, pp. 6-23, 6-50; 76 Fed. Reg. 22186 (Apr. 20, 2011) (preamble to Proposed CWA § 316(b) Regulations for Existing Facilities). *See also* New CWA § 316(b) Regulations, 40 C.F.R. §§ 125.92(h) and (i) (definitions of "entrainment" and "entrainment mortality"). To reduce mortality, therefore, the eggs and larvae excluded from the intake by fine-mesh wedgewire screens must also survive any impingement on those screens and be safely returned to the aquatic habitat. If egg and larval mortality by entrainment is simply replaced with mortality by impingement, the CWIS's adverse environmental impact will not have been reduced. PSNH's consultants did not, however, evaluate such survival. They only assessed the ability of different screen slot sizes to exclude organisms from being entrained.

At present, EPA has insufficient information that directly assesses egg and larval survival after contacting a fine-mesh wedgewire screen. 79 Fed. Reg. 48335-48336, 48435. *See id.* at 48331. Studying egg and larval survival after contact with a wedgewire screen would be difficult. Indeed, larvae in particular can be so fragile that they are killed merely by the process of trying to collect them for analysis. *See* 79 Fed. Reg. 48323; TDD, 2014, p. 11-10. That said, EPA has collected and reviewed some information from the scientific literature concerning the survival of eggs and larvae after being impinged against a fine-mesh traveling screen. This is not the same technology, but they exclude organisms from entrainment by relying, at least in part, on a small screen mesh size relative to the size of the otherwise entrainable organisms. This data suggests that under some circumstances (*e.g.*, low intake velocity) the eggs of some fish species, as well as crustacean larvae, may be capable of surviving contact with a fine-mesh wedgewire screen. Given the manner in which wedgewire screens are intended to take advantage of passing currents to move organisms, EPA would expect fish eggs to do equally well or better after contact with a wedgewire screen as with a travelling screen. The literature data also suggests, however, that fish larvae are unlikely, or at least are much less likely, to survive such an impact against a fine-mesh screen. Again, EPA would expect fish larvae to have similar or somewhat better survival after contact with a wedgewire screen. Region 1 discussed this information in some detail in its Fact Sheet (*see* pp. 27-29) for the Draft NPDES Permit for the GE Aviation facility in Lynn, Massachusetts (NPDES Permit No. 0003905). *See also* 76 Fed. Reg. 22186 (Apr. 20, 2011).

EPA further evaluated the issue by considering (1) the prevalence of each species and life stage identified in Schiller Station's entrainment samples, and (2) the characteristics of the egg and larval stages of these species that would or would not tend to promote their survival. EPA used the results from the Schiller Station entrainment study and site specific egg and larval exclusion rates supplied by Normandeau (Enercon, 2008, p. 85) to calculate an estimate of the quantity of eggs and larvae that would be excluded from going through the plant. EPA then applied a conservative survival estimate of 80% for eggs and 12% for larvae based on the performance of fine mesh traveling screens[36]. *See* TDD, 2014, p. 6-45 to 6-48. Based on the calculation shown below, the effective reduction in entrainment mortality of fish eggs and larvae for the 1 mm mesh size would be approximately 6%, for 0.8 mm mesh it would be 37%. For the 0.69 mm mesh size, the effective reduction would be 44% and for 0.6 mm the effective reduction would be 49%. All mesh sizes performed equally for macrocrustaceans with a high level of exclusion and subsequent survival.

Total Entrainment = E_T = 156,179,633 (See Section 8.2.3)
Eggs Entrained (E_E) = $E_T \times 0.58$ (eggs comprise 58% of the entrainment losses) = 90,584,187
Larvae Entrained (E_L) = $E_T \times 0.42$ (larvae comprise 42% of the entrainment losses) = 65,595,446

Eggs Screened Out (S_E) = E_E × (Enercon, 2008 slot size %)[37]

1 mm	90,584,187 × 0.115 = 10,417,182
0.8 mm	90,584,187 × 0.729 = 66,035,872
0.69 mm	90,584,187 × 0.85 = 76,996,559
0.6 mm	90,584,187 × 0.944 = 85,511,473

Larvae Screened Out (S_L) = E_L × (Enercon, 2008 slot size %)

1 mm	65,595,446 × 0.115 = 7,543,476
0.8 mm	65,595,446 × 0.729 = 47,819,080
0.69 mm	65,595,446 × 0.85 = 55,756,129
0.6 mm	65,595,446 × 0.944 = 61,922,101

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[36] Based on EPA's review of various EPRI reports (2003, 2005, 2007), EPA's TDD for the 316(b) rule and our site specific knowledge of the Piscataqua River, EPA estimated egg survival to be 80% and larval survival to be 12%. The high ambient velocity in the Piscataqua produces a substantial sweeping flow that should minimize egg and larvae contact time with the screens. Obviously, complete avoidance of the screens would produce the lowest mortality rates for larvae and eggs, but EPA believes that reducing contact time with the screen is an important factor is reducing egg and larval mortality.

[37] See Tables 6-19, 6-20, and 6-21 of the Enercon 2008 Report.

Egg Survival (A_E) = S_E × 0.8 (80% of screened out eggs survive)

1 mm	10,417,182 × 0.8 = 8,333,745
0.8 mm	66,035,872 × 0.8 = 52,828,698
0.69 mm	76,996,559 × 0.8 = 61,597,247
0.6 mm	85,511,473 × 0.8 = 68,409,178

Larvae Survival (A_L) = S_L × 0.12

1 mm	7,543,476 × 0.12 = 905,217
0.8 mm	47,819,080 × 0.12 = 5,738,290
0.69 mm	55,756,129 × 0.12 = 6,690,735
0.6 mm	61,922,101 × 0.12 = 7,430,652

Total Survival (T_S) = A_E + A_L

1 mm	8,333,745 + 905,217 = 9,238,962
0.8 mm	52,828,698 + 5,738,290 = 58,566,988
0.69 mm	61,597,247 + 6,690,735 = 68,287,982
0.6 mm	68,409,178 + 7,430,652 = 75,839,830

Effective Reduction = T_S/E_T × 100%

1 mm	9,238,962 / 156,179,633 × 100 = 6%
0.8 mm	58,566,988 / 156,179,633 × 100 = 37%
0.69 mm	68,287,982 / 156,179,633 × 100 = 44%
0.6 mm	75,839,830 / 156,179,633 × 100 = 49%

In sum, under certain environmental conditions, narrow slot wedgewire screen technology may be capable of substantial reductions in entrainment and impingement mortality at facilities with certain characteristics. EPA concludes that the necessary conditions for an effective wedgewire screen installation are likely present at Schiller Station. Therefore, this technology warrants further consideration as a potential BTA for reducing both entrainment and impingement mortality under the New CWA § 316(b) Regulations.

That said, any estimate of the amount of entrainment mortality reduction that this technology will achieve at Schiller Station unavoidably will reflect considerable uncertainty. Section 10 of this Fact Sheet presents EPA's BTA determination.

9.4.2 Traveling Screens and Intake Renovations

Traveling screens at a power plant are self-cleaning screening devices used to remove fish and debris from flowing water prior to its being drawn into the plant's condenser cooling system. Early designs, such as those still in use at Schiller Station, include a series of screen panels oriented perpendicular to the water flow. When operating, which may be continuously or periodically, these panels rotate vertically on a track, rising upwards on the upstream-side of the screen structure. Fish and debris are collected on shelves or baskets on the upstream-side of the screens structure, raised out of the water, and then washed off by a power spray system into a fish/debris return sluice before the screen descends back down into the water on the downstream side. Fish and debris that are not removed from the screen may drop off on the downstream side of the screen structure. This "carryover" continues into the intake screen well and potentially into the circulating water pump intake. Enercon, 2008, p.6.

PSNH identifies the features of a traveling screen that it considers "desirable" for minimizing impingement and entrainment. They are as follows:

- approach and through-flow intake velocities less than 1 fps;
- open or short intake channels with "escape routes";
- small mesh openings;
- provisions to gently handle impinged fish;
- continuous operation; and
- low-pressure wash system to gently remove impinged fish.

See Id. at 18. EPA has previously identified additional design features to minimize impingement mortality, including the following:

- using redesigned collection buckets with flow spoilers to minimize injuries;
- using fish guard rails to keep fish from escaping the buckets or baskets;
- determining the best order for performing fish removal with low-pressure spray and debris removal with high-pressure washing; and
- using smooth-woven screen mesh to minimize fish de-scaling.

See TDD, 2014, p. 6-25. In addition, another design feature is to relocate chlorine (biocide) dosing from in front of the screens to the back-side of screens to reduce exposure to impinged fish and other organisms. Furthermore, in the Phase I CWA § 316(b) Rule, EPA designated a maximum through-screen intake velocity rate of 0.5 ft/sec as a component of the BTA for minimizing impingement mortality at new facilities.

PSNH evaluated several types of traveling screen technologies; namely Ristroph, MultiDisc®, Dual Flow, and Beaudrey W Intake Protection screens. Some of these technologies use coarse-mesh screening designed to prevent the entrainment of juvenile and adult fish, but not the smaller egg and larval stages. Other technologies employ (or are capable of employing) fine-mesh screens designed to prevent the entrainment of all life stages of fish. These technologies, and evaluations of their suitability for Schiller Station by EPA and PSNH, are discussed below.

a. Ristroph Screens

Coarse-Mesh Ristroph Screens

Conventional traveling screens can be replaced with coarse-mesh Ristroph screen panels fitted with fish buckets. PSNH identifies the following features of the Ristroph screen that are designed to significantly reduce impingement mortality:

- mesh size that minimizes harm to fish;
- basket that maximizes the screening area available;
- fish bucket with opening designed to encourage fish to enter the bucket;
- bucket large enough to safely retain fish in the bucket;
- bucket that provides a hydraulically stable "stalled" fluid zone that attracts fish,

prevents injury to the fish while in the bucket, and prevents fish from escaping the bucket;

- bucket that is shaped to allow gentle and complete removal of impinged fish; and
- bucket that maintains a minimum water depth while transporting fish.

See Enercon, 2008, p. 67-68. The buckets on Ristroph screens are designed to collect fish and hold them in water as the screen rotates up, lifting the fish to a point where they can be gently sluiced away with a low-pressure spray prior to debris removal. Converting to this type of system would not change the through-screen velocity.

Coarse-Mesh Ristroph Screens – PSNH's Review

PSNH estimates that Ristroph screens would reduce fish impingement mortality by 75.5 percent for Unit 4, 73.5 percent for Unit 5, and 75.3 percent for Unit 6. Impingement reduction of macro crustaceans was not quantified. The capital cost for this option was estimated but is considered CBI, and PSNH expects only a slight higher maintenance cost compared to the existing screens. *Id*. at 63 and 69.

Coarse-Mesh Ristroph Screens – EPA's Review

PSNH's estimates for impingement survival using coarse-mesh Ristroph screens are based on studies conducted from April 15 to December 7, 1985, at a plant (Indian Point, Unit 2) in New York on the Hudson River. PSNH then compares these results with results from its own "impingement rates and collection efficiencies" observed in 2008 at Schiller Station using "non-Ristroph" screens and assuming continuous screen washing. There are, however, a number of problems with this comparison. To begin with, the Indian Point information is not adequately explained to demonstrate whether data from that facility can be considered representative of the specific conditions and species found in-the Piscataqua River, or if the components of Indian Point's CWIS are similar to those of Schiller Station.

Approximately 24% of the fish impinged at Schiller are pelagic (most are also anadromous) species. According to Schiller's own impingement survival study, these types of species generally have very low impingement survival rates, often expiring shortly after contacting the screens. Of the six pelagic/anadromous species (pollock, alewife, Atlantic herring, Atlantic menhaden, blueback herring and rainbow smelt) collected, survivability at time 0 (i.e., shortly after contact with screen) was 3%. These species would be considered "fragile species" under the New CWA § 316(b) Regulations. *See* 40 C.F.R. § 125.92(m). In addition, initial survival of some demersal species (winter flounder, grubby, lumpfish, pipefish, hake, and cunner) was better at 55%. The long term survival of these demersal species (based on 12 hour post screen contact) was lower, ranging from 0-30%.

It is unlikely that Ristroph screens will significantly improve initial survival for the pelagic fragile species. Ristroph screens may, however, improve the initial survival and latent impingement survival for the demersal fish to some degree. The most optimistic estimate of demersal fish survival would yield a 76% reduction in impingement mortality overall for Schiller Station's CWIS's. This, however, assumes 100% survival of the demersal species, which seems unlikely based on how poorly they did with the existing screens in PSNH's study at Schiller

Station. EPA does not, however, have a good basis for proposing a different number at this time. Therefore, EPA has decided to use PSNH's estimates for the average for the three units (74.8%) as the metric for further evaluating Ristroph Screens in Section 10 for this Fact Sheet, while recognizing that this is likely an overestimate, and perhaps a substantial overestimate, of survival. While it appears, therefore, that this technology could satisfy the impingement mortality reduction standard in 40 C.F.R. § 125.94(c)(5) or (7), it could be ruled out if additional measures are required to protect fragile species under 40 C.F.R. § 125.94(c)(9) and 125.98(d).

In addition, EPA agrees with PSNH's assessment that they "[do] not expect appreciably higher maintenance of Ristroph screens compared to the existing screens." EPA finds that Ristroph screens could potentially be part of the BTA for reducing impingement mortality, and that this technology warrants further review for this purpose. This technology does not, however, reduce entrainment. Section 10 of this Fact Sheet consists of EPA's BTA determination.

Fine-Mesh Ristroph Screens

Unlike coarse-mesh screens, fine-mesh Ristroph screens have mesh small enough to reduce entrainment by excluding fish eggs and larvae from being drawn into the condenser cooling system. The efficacy of the screens for preventing entrainment at a specific site will depend primarily on the size of the mesh relative to the sizes of the aquatic organisms of concern. In essence, entrainment is reduced or prevented by impinging eggs and larvae on the fine-mesh screens. The extent to which any of these tiny, fragile organisms may survive being impinged on the screens will depend on how hardy the organisms are, the nature of the contact they have with the screens, and whether a system can be designed to safely remove them from the screens and return them to the aquatic environment. In addition to fine mesh screens, the other modifications identified for coarse-mesh Ristroph screens would also need to be provided.

The existing 3/8-inch (9.5 mm) screens at Schiller Station are ineffective for excluding fish eggs and larvae from being entrained through the facility. In fact, entrainment studies conducted at Schiller Station in 2006-2007 captured fish from seven different species as large 34 mm (1.3 inches). *See* Normandeau Associates, Entrainment and Impingement Studies Performed at Schiller Generating Station from September 2006 through September 2007, April 2008. R-20887.000.

Although more than three times as long as the width of the screen mesh, these fish are not as wide as they are long, and they may have been extruded through the screens due to the CWISs' relatively high through-screen intake velocities (0.68 fps at MLW for Units 5 and 6 and 1.97 fps at the Unit 4 intake tunnel entrance). Alternatively, they may have been carried over the traveling screens and into the circulating water pump intake.

Fine-Mesh Ristroph Screens – PSNH's Review

PSNH rejected fine-mesh Ristroph screens because the intake would need to be greatly expanded to maintain existing through screen velocities and not cause additional head loss across the screens, which would reduce pumping efficiency. In addition, PSNH is concerned that impingement mortality of previously entrained organisms would increase to a level above the current entrainment mortality caused by the circulating water system. PSNH does not consider retrofitting its CWISs with fine-mesh Ristroph screens to be a viable option and therefore, did not provide further analysis of cost or biological effectiveness.

Fine-Mesh Ristroph Screens – EPA's Review

EPA evaluated the availability of fine-mesh traveling screens at Schiller Station. At Schiller Station, a 0.6-0.8 mm mesh size would be needed to effectively prevent the entrainment of eggs and larvae. As PSNH has pointed out, the surface area of the screens would need to be substantially larger than the current configuration in order to provide enough water for cooling and still maintain a low through-screen velocity. As a result, the existing CWISs would need to be totally replaced and expanded, and new fine-mesh traveling screens, with their associated machinery, would need to be added.

As explained above, preventing entrainment by using fine-mesh screens to block eggs and larvae from being drawn into the facility's condenser cooling system necessarily results in the impingement of these organisms. Thus, the survival of eggs and larvae following impingement on fine-mesh screens is integral to the overall performance of the technology. The probability of such survival is species- and life stage-specific, and is influenced by a number of factors, including the hardiness of the organisms, the through-screen intake velocity, the duration of impingement, and the methods of removing organisms from the screens and returning them to the receiving waters. The survival of post-yolk-sac rainbow smelt fish eggs and larvae impinged on 1 mm Ristroph-type traveling screens was evaluated at Somerset Station, located on the southern shore of Lake Ontario. The 96-hour survival rate was estimated to be only 26.9 percent. *See* McLaren, J.B., and L.R. Tuttle, Jr., Fish survival on fine mesh traveling screens, 2000, Environmental Science and Policy 3(S): 369-376. (hereinafter McLaren and Tuttle, 2000)

Like PSNH, EPA does not consider fine-mesh Ristroph screening technologies to be the BTA for Schiller Station. It appears likely that to the extent that this technology can reduce entrainment of fish eggs and larvae, it will simply replace it with impingement mortality for those organisms. Without site-specific survival studies to demonstrate the efficacy of this system in keeping impinged organisms alive and uninjured, EPA must assume that impinging these tiny, delicate organisms will lead to their mortality. In addition, converting to fine-mesh Ristroph screens would require a major expansion of the CWISs, which PSNH does not consider viable.

b. MultiDisc® Screens – Coarse Mesh

Geiger MultiDisc® screens are oriented the same way as traditional through flow screens but have different designs. *See* Enercon, 2008, p. 72-74. Geiger MultiDisc® screens are comprised of circulating sickle-shaped mesh panels that are connected to a frame via a revolving chain. For Schiller Station, PSNH evaluated only the coarse-mesh version of this technology.

Like Ristroph screens, MultiDisc® screen systems include special components that should be more protective of impinged fish and other aquatic organisms compared to Schiller Station's existing equipment. Fish buckets attached to the screen panels retain some of the water during their upward travel, thereby allowing any captured fish to remain within water once the buckets rise above water level. A low pressure spray header recovers organisms that are transported upwards on the screen surface to the bucket. Fish buckets are gently discharged into the fish return sluice.

MultiDisc® Screens – Coarse Mesh – PSNH's Review

Due to the manner in which Geiger MultiDisc® screens would be installed across the intake chamber, they can be can retrofitted into the space of the existing traveling screens, minimizing structural modifications. The construction cost, including the renovations made to the Unit 3 intake, was estimated by PSNH but not included in this fact sheet because it is considered to be CBI. *Id*.

Maintenance requirements for MultiDisc® screens are predicted to be lower than those of the existing traveling screens because 1) each screen can be removed for cleaning/maintenance and 2) carryover of organisms and debris is eliminated, thereby reducing maintenance of the condensers.

PSNH contends that retrofitting Schiller Station's intakes with MultiDisc® screens would not be the BTA because it would provide no biological benefit. PSNH explains that the configuration of the intakes with MultiDisc® screens, including renovations made to the Unit 3 intake structure, would result in higher through-screen velocities.

MultiDisc® Screens – Coarse Mesh – EPA's Review

PSNH explains that if renovations to Unit 3 intake are done along with the installation of MultiDisc® screens on Unit 4's intake, the resulting through-screen velocity would be approximately 0.55 fps, which is significantly lower than the current value of 1.38 fps. Enercon, 2013, p. 11. For Units 5 and 6, however, the through-screen velocity would increase to approximately 0.82 fps from 0.68 fps because these intakes are independent from any renovations made to the abandoned Unit 3 intake structure and screen area available for flow is smaller than that of the existing screens. *Id*.

Considering the increase in through screen velocity for Units 5 and 6 and the higher cost of MultiDisc® screens compared to Ristroph screens, EPA has determined that the installation of Geiger MultiDisc® screens coarse-mesh screens is not considered an available technology for further consideration.

c. Dual-Flow Traveling Screens

Dual-flow traveling screens are essentially a through-flow system turned 90 degrees, placing the screens' surfaces parallel to the flow. This re-orientation allows more of the screen surface to be utilized at one time, which results in a decrease in the current velocity through the screens. Additionally, since all the flow is going through the screens, the potential for carryover of fish and debris into the condenser cooling system is eliminated. Enercon, 2008, p. 71-72. A dual flow system typically uses a low-pressure wash to transfer organisms to a sluice and return them to the river, followed by a high-pressure wash to remove debris. For Schiller Station, PSNH evaluated only the coarse-mesh version of this technology.

Dual-Flow Traveling Screens – Coarse Mesh – PSNH's Review

PSNH determined that dual-flow screens were technologically infeasible at Schiller Station because the size of the existing intake structure cannot accommodate a dual-flow retrofit. Total replacement or extensive modifications of the intake structures would be required at a cost much higher than the cost of the screens themselves.

Dual-Flow Traveling Screens – Course Mesh – EPA's Review

EPA asked for further explanation or supporting information to document or explain the issues that PSNH initially raised. In the Enercon 2013 report, page 19, PSNH explains that

> [d]ual flow screens create higher flow velocities as the flow approaches the screen. Because the plate and gull wings that are installed to divert the flow to either side of the dual flow screen, there is less flow area in the region after the flow splits. This creates higher approach velocities as the flow passes around the plate and turns in towards the screening surface.

PSNH further details that the through-screen velocity would be 0.5 fps but that the velocity through the side entrances would be as high as 1.27 fps. Furthermore, "[e]xpanding the intake channel to achieve a side entrance velocity of 0.5 feet per second around the dual flow screens requires more space than is available and therefore is not feasible." *Id*. at 20. Based on this explanation, EPA has eliminated dual-flow screens from further consideration as the potential BTA for minimizing impingement mortality.

d. Beaudrey W Intake Protection Screen

A Beaudrey W Intake Protection Screen (WIP) system places a rotating screening disk with a mesh panel in the intake to arrest debris and fish. A recuperation channel or scoop is situated adjacent to the mesh panel, with the concave side of the scoop facing the filter element. The rotating screening disk guides fish to this scoop where suction is applied by a "fish safe pump" to cause an opposite circulation of water through the mesh panel in the area of the scoop. The scoop acts as a safeguard for the fish and the opposite circulation of water at the scoop detaches fish from the filter element in the area of the scoop and carries them to a fish return pipe. The WIP system utilizes coarse-mesh screens and, therefore, is not designed to reduce the entrainment of eggs and larvae.

WIP System – PSNH's Review

PSNH determined that retrofitting Schiller Station's intakes with the WIP system would not provide any biological benefit. Replacing all intake screens, including the renovated Unit 3 screens with WIP would result in a smaller screen surface area overall. This would in effect increase through-screen velocity and potentially increase impingement mortality.

The WIP system is designed to fit into the existing traveling screen guides, therefore no modifications to the intake would be required. Enercon, 2008, p. 76. Since the WIP system can be raised out of the water, PSNH expects that it would be easier to maintain than its existing traveling screens. The construction cost for this option was estimated by PSNH but is considered CBI. *Id*. at 77.

WIP System – EPA's Review

In the Enercon 2013 report, PSNH explains that the screen area of WIP screens are smaller than that of traditional traveling screens, Ristroph screens, or MultiDisc® screens. Therefore, even with the Unit 3 renovations, "installing WIP screens would result in higher through-screen velocities over other comparable screening technologies." Enercon, 2013, p. 13. For this reason, EPA does not consider the WIP System to be worthy of further consideration as the potential BTA for minimizing impingement mortality.

e. Unit 3 Intake Renovation

Unit 3 Intake Renovation - PSNH's Review

PSNH proposes to restore the retired Unit 3 intake structure and reopen the gate valves that previously connecting the now retired Unit 3 and Unit 4 forebays. The gate valves are located downstream of the traveling screens. The use of the two Unit 3 off-shore tunnels to provide an additional source of water to the Unit 4 intake would potentially reduce the through-screen velocity to 0.46 ft/s at MLW. In addition, two new Ristroph screens would be installed, as well as trash racks, lobster diversion piping, and a fish return system. The capital cost of the renovation is considered CBI by PSNH but the increased maintenance costs would be $20,000 per year. Enercon, 2008, p. 63. Based on through-screen velocities of less than 0.5 ft/s in the Unit 4 screen house, the reduction in impingement mortality is expected to be 80 – 90 percent.

Unit 3 Intake Renovation - EPA's Review

EPA agrees that the renovation of the Unit 3 intake is feasible and available. However, a reduced through screen velocity is of little consequence if the intake velocity at the tunnel entrances are high enough to prevent fish from escaping. The increase in screen area with the use of all three tunnels in this case would still result in the average maximum velocity <u>within</u> the tunnels of approximately 0.66 fps, even though the through screen velocity would be below 0.5 fps. Therefore, EPA expects impingement mortality may be slightly higher than the company estimates. However, this option includes Ristroph screens and a marginal reduction in the intake velocity at the tunnel entrances and therefore is considered worthy of further consideration as the potential BTA or component of BTA for minimizing impingement mortality. Section 10 of this Fact Sheet consists of EPA's BTA determination.

f. Continuous Operation of Screens

Continuous Operation of Screens – PSNH's Review

PSNH evaluated the cost and environmental benefit of continually operating the Station's existing intake screens. Removing the opportunity for debris build up on the screens by continuous operation would result in the through-screen velocity remaining near or at the design through-screen velocity, thereby reducing impingement. Further, organisms that are impinged will be returned to the source water body in a timelier manner, reducing stress and mortality, depending on the species. To carry out this option, two additional screen wash pumps would need to be installed. The capital and maintenance costs were estimated by PSNH but are considered CBI. *Id*. Although PSNH affirms that continuous washing provides improvement in impingement survival, they did not quantify the benefits.

Continuous Operation of Screens– EPA's Review

Without continuous screen rotation, fish impinged on the screens during times the screens are not rotating could remain impinged for hours, which greatly increases the risk of impingement mortality. Furthermore, the accumulation of fish and debris on the screens reduces the amount of screen area through which water can pass. This accumulation can cause an increase in through-screen velocity which, in turn, can increase the impingement of fish unable to escape the higher intake velocities. EPA acknowledges that the existing screens are not likely designed to be operated continuously and excessive wear and need for a complete overhaul and upgrade would eventually result.

EPA expects little environmental benefit with this option alone, considering both the high through-screen velocity with the existing screens and that a majority of resident species do not survive impingement. With that said, however, BTA may include this option as a component of BTA along with other technology options such as the combination of one or more of the following: 1) the addition of low pressure (<20 psi) screen wash pumps; 2) reduced approach velocity <0.5 fps; 3) new more fish friendly traveling screens; and 4) upgraded fish return systems as discussed below. Section 10 of this Fact Sheet consists of EPA's BTA determination.

g. Upgraded Fish Return Troughs

After having been drawn into a plant's cooling system through the CWIS, impinged against a traveling screen, raised out of the water, and dislodged from the screen with a pressurized spray wash, an impinged organism then begins the trip back to its aquatic habitat. The fish return system is a critical component of any CWIS designed to return fish safely to the waters from which they were taken. All of the screening technologies discussed above (excluding wedgewire screens) would require the construction of a new fish return sluice or trough.

Upgraded Fish Return Troughs – PSNH's Proposal

PSNH describes what it considers to be a "quality" fish return trough, or sluice, that would adequately return fish to the Piscataqua River with a minimum of stress. Such a trough would be designed so that:

- maximum water velocities within the trough are 3-5 fps;
- a minimum water depth of 4-6 inches is maintained;
- there would be no sharp-radius turns;
- it would discharge slightly above the low water level;
- it would be covered with a removable cover to prevent access by predators, such as birds;
- it would use the optimal slope for maximum survival, which is a 1/16 foot drop per

linear foot; and

- it would return impinged fish downstream of the intakes, thereby reducing re-impingement.

See Enercon, 2008, p. 66. In order to maintain a 1/16 slope and discharge the fish downstream from the plant's cooling water intakes – which is needed to avoid re-impingement problems – new fish return sluices at Schiller Station would have to be 170 ft long for Screen House #1 and 180 ft long for Screen House #2. However, PSNH explains that there is insufficient space between the two screen houses to accommodate 350 ft of fish return sluices. PSNH instead proposes an "acceptable" slope of ¼ ft drop per linear ft for the "slide" of the returns sections (i.e., outside the screen houses) resulting in an estimated length of 45 ft for each slide. *Id*.

PSNH did not evaluate the reduction in impingement mortality with the use of a state-of-the-art fish return system at Schiller Station because no quantitative data specific to Schiller exits. *Id*. PSNH did presume that re-impingement, hence impingement mortality would be reduced significantly if the return sluices are positioned in the most beneficial location relative to the direction of tidal flow. The total estimated capital cost to upgrade the fish return sluices is considered a CBI estimate by PSNH although no increase in maintenance compared to the current configuration is expected. *Id*. The following picture shows a segment of the Unit 4 fish return trough.

Figure 9-3: Unit 4 Fish Return Trough

Photographed during EPA site visit, February 13, 2013.

Upgraded Fish Return Troughs – EPA's Review

Schiller Station's present fish returns are unacceptable if the use of travelling screens are continued. The photograph shows a barrier in the trough and the transition from concrete to fiberglass is not smooth.[38] Another indication that there is stress to returned fish is that rubber

[38] EPA was informed that the rusted metal blockage (barrier) shown in the picture had been removed. *See* email to S. DeMeo, EPA from M. Cobb, EPA, March 5, 2013.

mats are "installed on the back wall of the screen housing to soften the impact to aquatic life during transfer from the traveling water screens to the return sluiceway." Enercon, 2008, p. 19. In addition, all troughs do not maintain a minimum water level and a segment of the Unit 4 return consists of a 90 degree turn. Further, the Screen Houses #2 return empty's too far (8 feet) above MLW elevation. *Id.* at 20.

PSNH mentions survival study results conducted for another plant, Indian Point, located on the Hudson River, in New York, providing little information about the Indian Point study, however. It did note that the Schiller Station fish return would be 25 percent shorter compared to Indian Point. Absent more information on the specifics of Indian Point's survival study, EPA cannot assess its applicability to Schiller Station, or verify PSNH's predicted survival rates. At the same time, EPA generally agrees with PSNH's description of the features of a "quality" fish return that would be part of the BTA for minimizing impingement mortality, with two concerns. First, PSNH cannot maintain the optimal slope of the sluice all the way to the water. According to the company, due to practical considerations a drop of ¼ foot per linear foot would need to be used for the slide. Enercon, 2008, p. 66. Second, PSNH indicates that a quality fish return would deliver organisms "slightly above the low water level". *Id*. EPA believes that the return sluice should discharge at a location either below the low water level or at a reasonable height above the low water level (no more than 6 feet) to reduce stress. *See* TDD, 2014, p. 6-30. *See also* EPRI, Evaluation of Factors Affecting Juvenile and Larval Fish Survival in Fish Return Systems at Cooling Water Intakes, December 2010 (Report No. 1021372).

Furthermore, an upgrade or redesign of the fish return conduits may also be necessary to minimize re-impingement. EPA requested that PSNH evaluate a combined fish return system that connects both screen houses and engineered to transport fish away from the intake structures based on the direction of tidal flow. *See* Email to A. Palmer, PSNH from M. Cobb, March 18, 2013. PSNH's response included a list of considerations and/or evaluations that would be required in order to design such a system, including an assessment of current re-impingement rates for each tidal condition. In addition, hydraulic modeling was suggested to fully understand river flow near the intakes in order to determine optimal fish return location(s). Enercon, 2013, p. 14-17.

Although Enercon points out that there are valid design considerations and potential limitations, they do not indicate that this fish return configuration is not feasible. PSNH did express concern whether a bi-directional return system was cost-effective. If the use of travelling screens were determined to be a component of BTA for Schiller Station, an effective fish return sluice would also be required that is in place and operational year round.

9.4.3 Traveling Screens and Intake Renovations – Summary

EPA has determined that PSNH's use of its existing traveling screens without additional screening technology does not satisfy the BTA standard of CWA § 316(b). The existing technology, developed in the 1950s and 1960s, does not include provisions to gently handle live impinged fish but is designed more for handling debris. Moreover, there are available technologies that have been developed since the existing traveling screens were installed that would reduce current levels of impingement mortality at Schiller Station. EPA has determined that the renovation of Unit 3's intake and the use of Ristroph coarse-mesh traveling screen technology for all the units is "available" and warrants further review as potential BTA selections for minimizing impingement mortality at Schiller Station.

In order to satisfy the BTA standard, EPA considers it a fundamental requirement for any traveling screen technology to have an effective, well designed fish return system in place. This means that the CWIS's screening system should be operational at all times when the plant is withdrawing water and impingement may be occurring, and that the system should be capable of safely catching fish on the screens, removing them from the screens, and returning them to the water body. Furthermore, chlorine dosing should occur after the screens in order to minimize exposure to impinged organisms.

9.4.4 Aquatic Microfiltration Barriers

PSNH and EPA also investigated aquatic microfiltration barriers, another type of exclusion system. This technology is composed of a custom-designed and sized filtration fabric installed in a boom-like configuration in front of a facility's CWISs to reduce or eliminate entrainment and impingement of fish eggs, larvae, and larger organisms. The filtration fabric has a very small pore size which enables it not only to block juvenile and adult fish from being drawn into the CWIS, but also, at least theoretically, to block most eggs and larvae. This technology can also be used to reduce intake volumes to 0.5 fps or less, which can prevent impingement mortality by enabling most fish species to swim away from the CWIS. Having excluded ichthyoplankton from being entrained, the question, once again, arises as to whether the organisms can be safely removed from the barriers and returned to their aquatic habitat.

One type of aquatic microfiltration barrier, a Gunderboom Marine Life Exclusion System (MLES™), has been used at a power plant on the Hudson River, in New York (Lovett Station), which closed on April 19, 2008. Although there were problems anchoring the device, the system was reported to significantly reduce entrainment at that plant, though concerns about biofouling undermining performance were also raised. *See* Taft, 2000, p.S355; but *see also* P.A. Henderson, R. M. Seaby, C. Cailes and J.R. Somes (Pisces Conservation Ltd.), "Gunderboom Fouling Studies in Bowline Pond" (July 2001).

Aquatic Microfiltration Barriers – PSNH's Review

PSNH determined that the seasonal deployment of the MLES™ to be infeasible because the length of the curtain would impair "other existing uses" of the Piscataqua River. Enercon, 2008, p. 86. Considering the maximum design intake flow, the depth of the river in front of the intake structures, and assuming the use of 20 micron mesh size, PSNH estimated that at least a 550-foot curtain would be required in order to allow the needed cooling water flow. In addition, since the MLES™ fabric is susceptible to ice formation, PSNH indicated that the curtain could only be deployed seasonally. PSNH determined that the use of an aquatic microfiltration barrier was infeasible at Schiller Station. Therefore, no further analysis was done on maintenance requirements, cost or environmental benefits. *Id*.

Aquatic Microfiltration Barriers – EPA's Review

EPA is concerned that the strong tidal currents in the Piscataqua River would cause much difficulty with anchoring the microfiltration barrier fabric to the river bottom, especially given the length that would be needed. Therefore, the feasibility of this technology at Schiller Station remains uncertain.

EPA evaluated the Gunderboom during the 2014 final 316(b) rulemaking and found the following:

> To date, the only facility where the Gunderboom was used at a full-scale level is the Lovett Generating Station along the Hudson River in New York, where pilot testing began in the mid-1990s. Initial testing at that facility showed significant potential for reducing entrainment. Entrainment reductions of up to 82 percent were observed for eggs and larvae, and these levels were maintained for extended month-to-month periods from 1999 through 2001. At Lovett, some operational difficulties affected long-term performance. These difficulties, including tearing, overtopping, and plugging/clogging, were addressed, to a large extent, through subsequent design modifications. Gunderboom, Inc. specifically has designed and installed a microburst cleaning system to remove particulates. As noted above, the Lovett Generating Station recently closed operations.
>
> Each of the challenges encountered at Lovett could be of significant concern at marine sites, as these have higher wave action and debris flows. Gunderboom systems have been successfully deployed in marine conditions to prevent migration of particulates and bacteria, including in areas with waves up to 5 feet. The Gunderboom system is being tested for potential use at the Contra Costa Plant along the San Joaquin River (a tidal river) in northern California. An additional question related to the utility of the Gunderboom and other microfiltration systems is sizing and the physical limitations and other uses of the source waterbody. With a 20-micron mesh, 144 mgd and 288 mgd intakes would require filter systems 500 and 1,000 feet long (assuming a 20-foot depth). In some locations, this may preclude the successful deployment of the system because of space limitations or conflicts with other waterbody uses.

TDD, 2014, p. 6-56. Although there has been some more recent improvement to reduce wave action and debris, EPA is not aware of the use of aquatic filtration barriers at any other existing industrial facilities. *Id.* In light of all these issues, EPA does not consider the use of a microfiltration barrier, such as the Gunderboom MLES™, as the potential BTA for Schiller Station.

9.4.5 Fish Net Barriers

PSNH's October 2008 submission briefly evaluated the possibility of installing a wide-mesh barrier net in front of the intake structures at Schiller Station. Like aquatic microfiltration barriers, PSNH rejected the use of fish net barriers due to physical limitations for net placement, size of the net required (although not provided) and possible interference with existing uses of the Piscataqua River.

PSNH re-evaluated the use of a barrier net for Schiller Station in 2014 and found that approximately 6615 ft^2 of netting would assure a through-screen velocity of 0.5 fps or lower at all times for both intake structures (245 feet in length and height of 27 feet). Enercon, 2014, p.

44.

> [T]he operations and maintenance costs associated with the barrier net system are expected to be relatively high compared to wedgewire screens. In summary, the reliability of a barrier net system would be expected to be lower than that of wedgewire screens. A pilot test or study is recommended to ensure that debris loading, the local velocity, and frequency and size distribution of ice floes do not require additional preventive measures to protect the net.

Id. at 45.

One of EPA's concerns is that a wide-mesh barrier net would provide no protection against entrainment as small aquatic organisms (e.g., eggs and larvae) would go through the net openings. The technology is, accordingly, intended only to reduce the impingement of fish against a facility's existing intake screens. Yet, even as an impingement reduction technology, there would be a number of problems with using this technology at Schiller Station given the high velocity of the river currents. In addition, this type of barrier net would likely only be able to be deployed in ice-free months and would likely be subject to significant fouling from debris during autumn and other periods with high debris loadings. Since PSNH has seen high impingement during winter months, the net would not be able to be deployed when much of the annual impingement is occurring. Given these concerns, EPA, like PSNH in its October 2008 Report, does not consider this technology a viable component of the BTA for Schiller Station.

9.4.6 Behavioral Barriers

PSNH evaluated alternative technologies such as "air bubble curtains," light and acoustic barriers, none of which effectively reduce entrainment, but which might conceivably play a role in impingement reduction as a component of an overall BTA. *See* Technical Development Document for the Final Section 316(b) Phase II Rule, Feb. 12, 2004, p. 4-19. PSNH's review of these technologies, however, identifies problems with their effectiveness in reducing impingement mortality and/or applying them to Schiller Station. Most studies of "behavioral barriers," such as bubble curtains or acoustic barriers "have been inconclusive or have shown no significant reduction in impingement or entrainment." Enercon, 2008, p. 87.

PSNH points to the successful application of acoustic fish deterrence systems at D.C. Cook Nuclear Plant in Michigan and at J.A. FitzPatrick Nuclear Plant in New York. Both plants intake water from the Great Lakes and impinge mostly Clupeiformes (Clupeid fish). The technology shows some success at these locations because some Clupeid fish are able to detect sound. Clupeid fish in the Picataqua River (e.g., Atlantic herring and Atlantic menhaden) represent less than 1% of the impinged fish at Schiller Station. Therefore, an acoustic deterrence system would not likely reduce impingement significantly. *Id*. For these reasons, EPA has eliminated the use of behavioral barrier technologies as potential BTA at Schiller Station.

9.5 CWIS Capacity Options

Under CWA § 316(b), a CWIS's "capacity," as well as its location, construction, and design, must reflect the BTA for minimizing adverse environmental impacts (such as entrainment and impingement mortality). Capacity in this sense refers to the volume of water being withdrawn by a CWIS. Reduced CWIS capacity is considered to reduce entrainment and impingement by the same proportion that the flow is reduced. In other words, a 95 percent reduction in the volume of water withdrawn achieves a 95 percent reduction in entrainment and impingement.

Indeed, intake capacity reductions have often been referred to as the most effective means of reducing entrainment, especially for existing facilities located in biologically productive environments. Similarly, impingement can be reduced through flow reductions, as well as by a reduction in the approach velocity in front of the intake structures. There are a number of different technological and operational measures that could reduce a facility's intake capacity (or water withdrawal volumes). Methods of capacity reduction evaluated here include: (1) operational (maintenance) outages; (2) reducing flow by installing and operating two-speed pumps; (3) reducing flow by installing and operating variable frequency drives; (4) reducing flow by using nearby available grey water; and (5) reducing flow by installing and operating cooling towers.

9.5.1 Maintenance Outage Scheduling

PSNH considered a scheduled operational shutdown or outage option as a means of reducing the plant's intake flow and associated impingent and entrainment. Presently, Schiller Station has maintenance outages for Units 4 and 6 every 18 months and for Unit 5 every year. Enercon, 2008, p. 100. The outages typically last approximately three to four weeks. According to PSNH, power pool demands preclude scheduled outages during peak seasons (i.e., high use winter and summer months. "If a peak season outage were allowed by ISO New England, Schiller Station would be penalized dramatically." *Id*. at 101.

When PSNH evaluated what the optimal times would be for scheduling outages based on the highest reductions in adult equivalent fish and macrocrustacean impingement and entrainment, they determined that the periods of highest fish impingement and entrainment does not coincide with the periods of highest macrocrustacean impingement and entrainment. Therefore, PSNH concluded that "the aggregate benefit of an outage shift would be minimal" and gave no more consideration to this option. *Id*. at 103.

EPA concurs that reducing flow by suspending operations during periods when early life stages of fish are present can be an effective strategy for reducing both entrainment and impingement during the outage period. At Schiller Station, however, a three-to-four-week outage each year would not cover the entire period when fish eggs and larvae as well as macrocrustaceans are present in the source water. Moreover, it also would not address the issues associated with impingement mortality during the rest of the year. PSNH has demonstrated through its impingement sampling (2006–2007) that impingement occurs year-round. Therefore, EPA does not consider scheduled outages alone to be BTA for impingement at Schiller Station.

With that said, scheduling outages to reduce entrainment during peak spawning periods could be *a component* of the overall BTA for the Facility, perhaps in combination with other technologies. For example, scheduling the annual Unit 5 maintenance outage for three weeks in June (the month with the highest concentration of eggs and larvae in the water column) could be a component of the BTA for reducing entrainment, coupled with Ristroph screens and improved fish return systems as BTA components to reduce impingement mortality. To the extent that maintenance outages for Unit 5 need to happen each year and can involve suspending cooling water withdrawals, it makes sense from the perspective of reducing adverse environmental impacts to schedule the outages during the high entrainment season.

Based on PSNH's data on entrainment of fish and macrocrustacean eggs, and larvae, June is the month of highest fish and macrocrustacean egg and larval abundance. Natural mortality of eggs and larvae are high due to predation, which shows their importance in the food chain. While PSNH determined that a scheduled outage in March for Unit 5 would yield an annual 24% reduction in adult equivalent fish entrainment, Enercon, 2008, p. 103, EPA makes control decisions based on consideration of the absolute numbers of eggs and larvae lost, not necessarily solely on adult equivalents. Basing decisions solely on adult equivalents would ignore the valuable ecological role that eggs and larvae play in the food chain.

Furthermore, operating data shows that the annual Unit 5 outage likely takes place in April when demand is lower and that Unit 5 operates at or near full capacity during June each year. *See* Excel spreadsheet titled Unit5Schiller_operatingtime.xlsx.

To calculate the environmental benefit of a scheduled outage for Unit 5 in June compared to April, EPA calculated losses for Unit 5 at design flow in April and June utilizing the Enercon, 2008 (Attachment 6) entrainment and impingement mortality rates. Then, assuming a 3 week outage, EPA calculated the number of eggs and larvae lost in each month. The environmental benefit of having the scheduled outage in June as opposed to April is simply the difference between the number of eggs and larvae lost in June minus the number of eggs and larvae lost in April.

Table 9-C: Biological Value of Shifting Unit 5 3-Week Outage from April to June

	June	April	# of Organisms Saved	Annual % Reduction[39]
Fish Entrainment (millions)	11.2	0.7	10.5	4%
Macro Entrainment (millions)	91	0	91	7%
Fish Impingement Mortality	48	105	-57	---
Macro Impingement Mortality	58	51	7	0.05%

EPA found that shifting the outage from April to June would result in a 4% reduction in fish entrainment and 7% reduction in macrocrustacean entrainment (a total of over 100,000,000 individuals saved per year). The same approach was taken for impingement resulting in 0.05% reduction in macrocrustacean impingement (7 individuals saved/year) but with a loss of approximately 57 fish from impingement.

EPA also looked at the cost of an annually scheduled maintenance outage for Unit 5 in June compared to one in April. *See* AR-167. A review of 2010 – 2014 historical wholesale electric

[39] These values are based on a total annual entrainment of approximately 255 million fish and 1342 million macrocrustaceans, as well as a total annual impingement of approximately 6050 fish and 13,828 macrocrustaceans.

prices for the New England Power Pool for the months of April and June showed a range of average price between $30 and $55 per MWh. In 2010, 2011, and 2012 the price of electricity was higher in June than in April by $13.15, $5.08, and $16.61, respectively. For 2013 and 2014, the price of electricity was higher in April than in June by $3.97 and $4.15, respectively. Based on these values, it would have been more economical to have had an outage in June during 2013 and 2014. Worse case, considering a 3 week outage for Unit 5, at full capacity, the average revenue differential between the high and low would be less than $500,000. Therefore, EPA concludes that shifting the annual outage for Unit 5 from April to June is a component of BTA for this draft permit.

9.5.2 Variable Speed Pumps

Each unit at Schiller Station has two single-speed, circulating pumps. Unit 4 has a combined design pumping capacity of about 41 MGD, Unit 5 has a combined designed pumping capacity of 42 MGD, and Unit 6 also has a capacity of approximately 42 MGD. Single speed pumps withdraw water at their design capacity.

As an alternative to single-speed pumps, variable speed pumps enable a facility to adjust the volume of water it withdraws from the source water body for cooling to better match its actual cooling needs. A facility could convert from single-speed to variable speed pumps by replacing the pump motors with motors equipped with variable frequency drives (VFD). VFDs control the speed of the motors by varying the frequency and voltage of electric power to the pumps.

Variable Speed Pumps – PSNH's Review

PSNH concluded that Schiller Station could use variable speed pumps to reduce flow, thus reducing impingement and entrainment, as long as the condenser is operated according to design limitations. These limitations include a minimum water velocity through the condensers of 3 fps. The units currently operate at 3.5 fps. A reduction of 0.5 fps amounts to a 14% reduction in flow. Therefore, the maximum reduction in impingement mortality and entrainment would be 14%, assuming a 1:1 ratio. Enercon, 2008, p. 92.

Another operational limitation is the design pressure limit for each condenser, which corresponds to a maximum inlet water temperature. Above these temperatures, the Station would increase fuel consumption and increase the risk of extensive equipment damage. The inlet water temperature limits are 61.0°F for Unit 4, 58.2°F for Unit 5, and 61.0°F for Unit 6. *Id*.

Using eight years of data collected at Schiller Station (2000-2007), PSNH determined the maximum monthly flow reduction available per unit, based on these design limitations described above. *See id*., Table 6.5, p. 93. The available flow reduction is further limited by the thermal discharge limits imposed by Schiller Station's NPDES permit, especially during the winter months. *See id*., Table 6.8, p. 100. With all other parameters unchanged, reducing cooling water flow would raise the facility's discharge temperatures. The following table presents the flow reductions that could be achieved while staying within design criteria and thermal discharge limitations.

Table 9-D: Potential Flow Reduction Without Power Loss (2000-2007) and Without Exceeding Permitted Thermal Discharge Temperatures

Month	Unit 4	Unit 5	Unit 6
January	13.4%	11.2%	11.6%
February	13.4%	11.2%	11.6%
March	13.4%	11.2%	11.6%
April	13.4%	11.2%	11.6%
May	13.3%	10.7%	11.6%
June	3.2%	0.3%	2.8%
July	0.0%	0.0%	0.0%
August	0.0%	0.0%	0.0%
September	1.4%	0.0%	1.4%
October	12.6%	6.3%	11.6%
November	13.4%	11.2%	11.6%
December	13.4%	11.2%	11.6%
Annual	9.2%	7.0%	8.1%

The new VFD motors would not likely require additional maintenance compared to the current motors. However, further reducing circulating water flow velocity through the condensers will result in increased fouling of the condensers' tubes. In order to counter this fouling, a new mechanical tube cleaning system would be needed in addition to the continued use of hypochlorite injections. The VFD themselves would require periodic inspection and minor maintenance. At the same time, the Station would save a small amount of power by using VFDs as compared to using the current pump motors. PSNH provided an estimate of the total capital and installation cost for implementing variable speed pumps for all three units. EPA is not reporting the value here because the company has claimed it to be CBI. Suffice to say, however, that EPA does not regard the amount to be very substantial for a facility like Schiller Station. *Id*. at 94.

Based on the monthly flow reduction values above and equivalent adult (EA) entrainment abundance estimates, PSNH determined that the maximum reduction in entrainment of fish from January through April would be 9.4%, 9.8%, and 9.8% for Units 4, 5, and 6, respectively. For macrocrustaceans, the highest entrainment reductions would occur in May, June, October, and November. Entrainment reduction values for these combined months are 2.2% for Unit 4, 1.2% for Unit 5, and 2.1% for Unit 6. *Id*. at 95.

Similar to entrainment, PSNH determined the monthly impingement reduction values based on maximum flow reduction with the use of variable speed pumps and EA impingement abundance data. For fish, the maximum impingement reduction would occur in April, and November through January for Unit 4, and January, April, October, and November for Units 5 and 6. The reductions in EA fish impingement for these months combined would be 9.6%, 3.8%, and 11.4% for Units 4, 5, and 6, respectively. For macrocrustaceans, the highest entrainment reductions would occur in April, May, November and December for all the units. Impingement reduction values for these combined months are 7.7% for Unit 4, 6.2% for Unit 5, and 6.5% for Unit 6. *Id*. at 96.

The following table presents PSNH's estimated potential yearly impingement and entrainment reductions based on adult equivalents.

Table 9-E: Summary of VFD Operations Annually Without Power Loss

	% EA Entrainment Reduction			% EA Impingement Reduction		
	Unit 4	Unit 5	Unit 6	Unit 4	Unit 5	Unit 6
Annual for Fish	10.7	10.9	11.1	12.0	5.7	13.0
Annual for Macrocrustaceans	2.3	1.2	2.3	10.3	7.7	8.1

Data taken from Tables 6.6 and 6.7 of Enercon, 2008.

Variable Speed Pumps – EPA's Review

PSNH indicated that if the six existing circulating water pump motors were converted to VFDs at Schiller Station, reductions in intake volumes (and corresponding reductions in impingement and entrainment) could nevertheless occur only during periods when the Piscataqua River provides a favorable thermal heat sink. In other words, if plant generation remains at peak levels, then cooling water volumes can only be reduced when the water withdrawn from the river for cooling is particularly cold. Those favorable river temperature conditions tend to occur from late fall to early spring. In colder months, less cooling water is required to remove the Facility's waste heat while maintaining the required vacuum in Schiller Station's condensers. Therefore, during such conditions, variable speed pumps could be used to reduce withdrawals.

As Table 9-D above shows, under conditions at Schiller Station, variable speed pumps are of little value during the summer months. In Section 8 of this Fact Sheet, EPA discussed that the highest entrainment rates for organisms are seen during the summer months. EPA found that the entrainment (and impingement) reduction estimates based on total number of organisms are significantly lower than PSNH estimates, which are based on adult equivalents.

Adult equivalent analyses may be useful when trying to place the loss terms of fish and macrocrustacean eggs and larvae into the context of grown fish and in order to combine entrainment and impingement losses into a single metric. When looking at the efficiencies of any control technologies, however, EPA believes that the actual numbers of eggs and larvae saved or lost provides the more appropriate metric. Eggs and larvae have their own inherent ecological value as important components of the food web. This value is ignored or hidden if losses are only considered in terms of adult equivalents. In addition, Equivalent Adult Models require additional assumptions and data manipulation to the raw data (numbers of eggs and larvae). These assumptions introduce new sources of error and variability.

Table 9-F shows EPA's percent reduction estimates based on consideration of the:

- total numbers of organisms impinged and entrained (adjusted for design flow);
- seasonal abundance of those organisms; and
- condenser design and NPDES permit limitations.

To calculate the environmental benefit of variable speed pumps, EPA used Schiller's entrainment and impingement data by unit by month and adjusted those losses to reflect design flow. The adjustment to design flow represented an approximately 7% overall increase in losses over the course of the year compared to what Schiller submitted in Normandeau, 2008. The specific % adjustment for design flow varied by unit by month, due to different historical flow rates among the units from month to month. EPA then used Schiller's estimates of monthly flow reductions that could be achieved without power loss or violations of thermal discharge limits (Table 9-D) and multiplied the monthly entrainment and impingement losses by unit. The product of this calculation divided by total annual losses results in the percent reductions in entrainment and impingement shown in Table 9-F.

Table 9-F: EPA's Summary of VSP Operations Annually without Power Loss and Without Exceeding Permitted Thermal Discharge Temperatures

	% Entrainment Reduction				% Impingement Reduction			
	Unit 4	**Unit 5**	**Unit 6**	**Total**	**Unit 4**	**Unit 5**	**Unit 6**	**Total**
Annual for Fish	5.72	4.09	4.92	**4.90**	12.40	6.15	11.25	**11.0**
Annual for Macrocrustaceans	2.59	1.52	2.34	**2.14**	10.49	6.79	7.24	**9.70**

See Excel spread sheets #1 and #2 attached to email from P. Colarusso, EPA to S. DeMeo, EPA, 7/18/14.

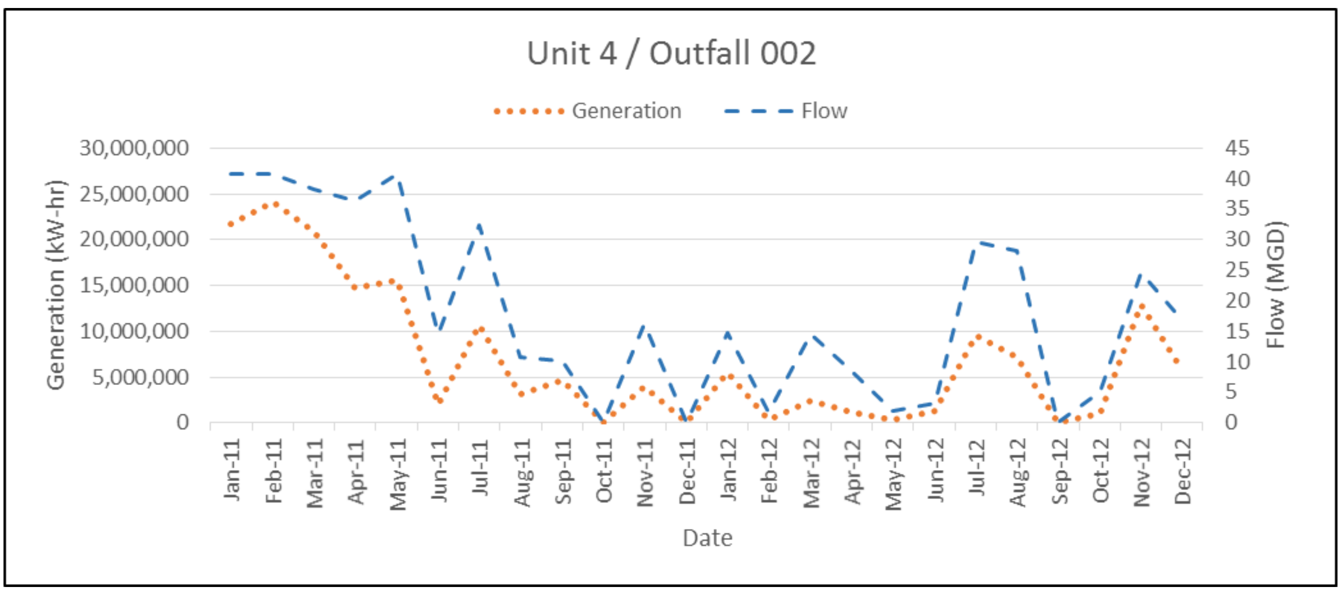
"Since the maximum flow reduction possible is 14%, the maximum power saved through this load reduction would be approximately 0.2 MWe per Unit, with the combined maximum power saved across all three Units approximately 0.6 MWe." Enercon, 2008, p. 94. Based on this amount of power saved, EPA determined that the installation of variable speed pumps would actually save the company more money over time compared to not having the pumps installed. In fact, EPA estimates that the payback or break-even period for the installation of this technology option could be between six and seven years. *See* Excel spread sheet attached to email from E. Beck, EPA to S. DeMeo, EPA, 7/28/14 (contains CBI).

In consideration of all of these factors, EPA regards modifying the circulating water pumps, at least for Units 4 and 6, to add variable frequency drives to be a step that would be likely to reduce impingement and entrainment, to some extent, without impairing Schiller Station's ability to effectively generate electricity or costing the Facility money in the long run.

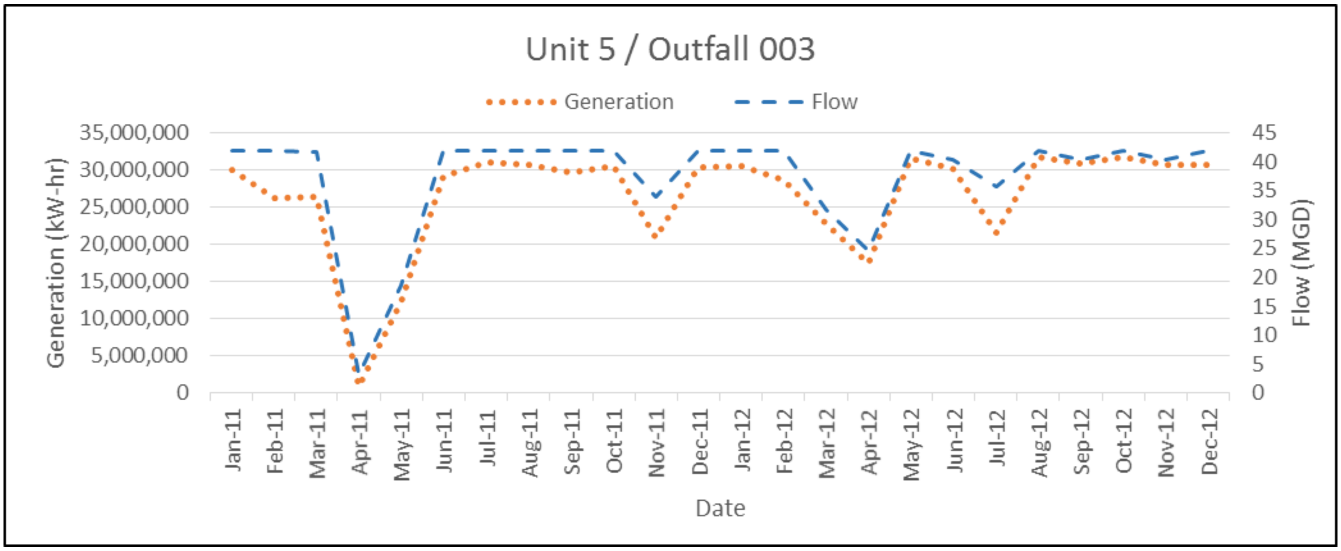
With this said, however and generally speaking, variable speed pumps are a less-promising option for base-load power plants because they are usually running at a high capacity level and provide less opportunity for reducing cooling water withdrawals. While Schiller Station has been considered a base-load electrical generating facility, with all six pumps operating continuously, except during outages (capacity factor[40] is high), this has changed. In the past few years, the capacity factors for Units 4 and 6 have been significantly lower (16.1% and 16% respectively, since the last quarter of 2011). Unit 5, however, currently operates much more consistently (80-85% capacity factor within the last year). This is because this unit burns wood, which is considered a renewable energy resource under the State's Renewable Portfolio Standard (RPS). Therefore, VSP's are unlikely to be effective at reducing flow for Unit 5 and is therefore not considered as a potential component of BTA for this Unit.

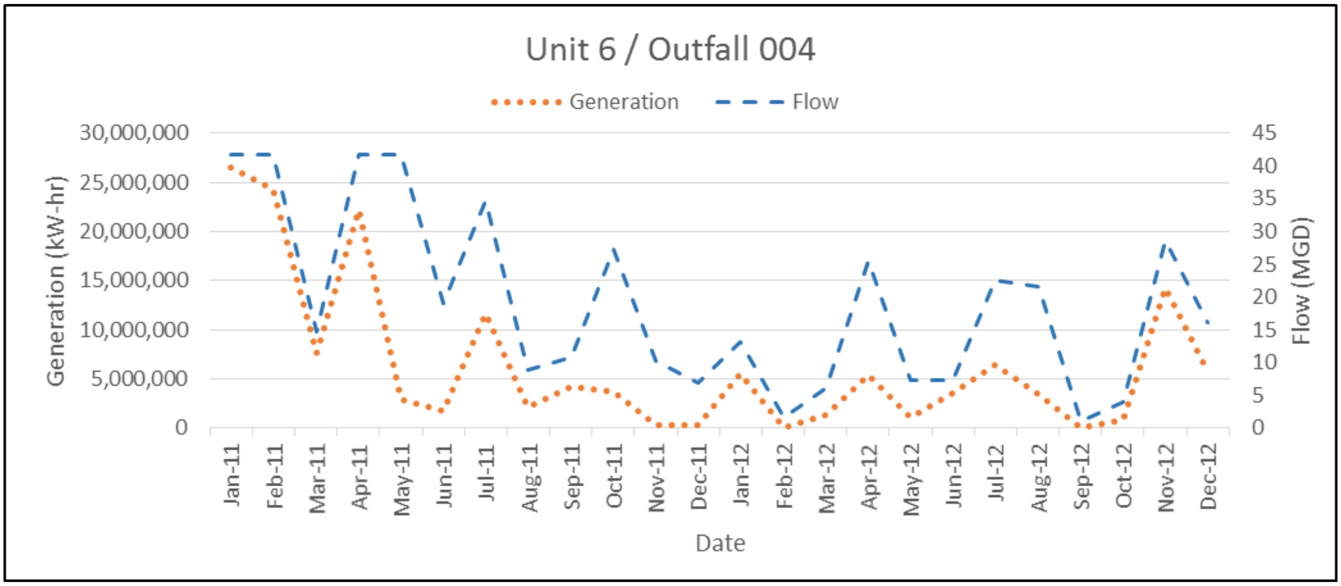
Furthermore, according to monthly average flow data from the facility's discharge monitoring reports (DMR's) and electrical generation data, the circulating cooling water intake pumps for each unit are frequently shut down when a unit is not generating electricity (*i.e.*, on stand-by). This practice results in a significant reduction in flow as well as impingement and entrainment (as well as an energy savings). During EPA's site visit in February 2013, a PSNH representative explained that the pumps may be shut down after 24 hours of non-generation. *See* Sharon DeMeo site visit notes, February 13, 2013. If energy trends continue, shutting down the intake pumps during stand-by may result in a greater reduction of flow than would result from the use of variable speed pumps. Therefore, this operating practice could be a component of BTA for Schiller Station, in place of variable speed pumps, and at little to no cost to the facility. Figure 9-4 shows the correlation between cooling water flow and generation for each of Schiller's three units during 2001 through 2012.

Figure 9-4: Correlation between Total Monthly Generation and Average Monthly Cooling Water Flow at Schiller Station (2011-2012)



[40] The net capacity factor of a power plant is the ratio of its actual output over a period of time, to its potential output if it were possible for it to operate at full nameplate capacity indefinitely.





In addition, these levels can be achieved without reductions in power generation or an exceedance of NPDES thermal discharge limits.

9.5.3 Two-Speed Pumps

In comparison to VSP, PSNH determined that the use of two-speed intake pumps at Schiller Station should not be considered a component of BTA for the following reasons:

- less effective technology;
- greater cost;
- less flow control flexibility; and
- offers no reduction in the power load necessary to operate.

EPA concurs that the use of two-speed motors need not be evaluated further.

9.5.4 Closed-Cycle Cooling

A once-through system, such as that employed at Schiller Station, removes the condensers waste heat and transfers this energy to the receiving water. Steam electric power plants can generate electricity while using substantially less water than is required for a once-through (or open-cycle) cooling system by using a "closed-cycle" cooling system. Generally, steam electric power plants employ one of four basic types of circulating water systems to reject waste heat. These systems are:

- once-through cooling;
- once-through cooling with supplemental cooling of the heated discharge;
- entirely closed-cycle or recirculating cooling; and
- combinations of these three systems.

In a once-through (or open-cycle or non-recirculating) system, the entire amount of waste heat is discharged to the receiving water body (unless some portion of the waste heat is dissipated to the atmosphere in a thermal discharge canal).

Closed-cycle or recirculating cooling water systems employ a cooling device that enables the plant's waste energy to be emitted from the cooling water directly to the atmosphere. As a result the temperature of the cooling water is brought back down and the facility is then able to recirculate and reuse the previously heated water for additional cooling. This enables the facility not only to reduce discharges of heat, but also to reduce withdrawals of water for cooling. As a result, entrainment and impingement mortality are substantially reduced. For example, converting an open-cycle cooling system to closed-cycle technology can enable water withdrawals to be reduced by up to 95% or more, depending on certain site-specific factors. As with other flow reduction technologies, closed-cycle cooling is regarded to reduce the number of organisms entrained by the CWIS by the same amount that it reduces intake flows.

There are two basic methods of heat rejection for closed-cycle recirculating cooling water systems. The first is to use wet (or evaporative) cooling towers.[41] The second uses cooling ponds or lakes. These two methods dramatically reduce cooling water use, though they do require a small amount of "makeup" water. The makeup water is required to replace cooling water lost to evaporation, leaks and periodic cooling tower blowdown discharges.

A third type of closed-cycle cooling system does not use cooling water at all and, instead, employs "dry cooling towers" ("or air-cooled condensers"). This method eliminates the use of cooling water and rejects heat directly to the atmosphere from the surface of the condenser. No evaporation of water is involved.

Another type of closed system worthy of note is the "hybrid" (or "wet/dry") system which combines elements of both wet and dry tower operations. The advantage of this type of cooling

[41] *See, e.g.,* 66 Fed. Reg. at 65,282; EPA, Economic and Engineering Analysis of the Proposed 316(b) New Facility Rule, August 2000, EPA-821-R-00-019EPA (hereinafter EPA Economic and Engineering Analysis), App. A at 14.

system is that it can be used to reduce and/or eliminate any problematic water vapor plumes from mechanical draft cooling towers.[42] This technology would be less expensive than dry cooling but more expensive than a wet cooling tower system.[43]

As a general matter wet, dry, and wet/dry cooling towers are all practicable, available technologies for power plants. Wet cooling towers have been widely used at power plants for many years.[44] Dry cooling is also clearly a viable technology as dry cooling systems have been installed or proposed for installation at a number of facilities in the United States, including new units at the Mystic Station and the Fore River Station in Massachusetts.[45] In addition, wet/dry cooling towers are also a practicable technology used at a number of plants.[46]

Finally, a single power plant could use both open-cycle and closed-cycle cooling technologies. For example, different types of cooling systems could be provided for different generating units. Alternatively, closed-cycle cooling equipment could be installed for an entire facility but only used during certain parts of the year, while open-cycle cooling would be used at other times. This approach has been taken at various power plants, such as the Vermont Yankee nuclear facility when it was operating. Such “combination options” or “partially closed-cycle cooling options” could be selected for a variety of reasons, such as to address seasonally-focused environmental issues, to reduce overall plant flows and/or thermal discharges to some predetermined level, to deal with a facility’s space constraints, or to stay below some specified cost threshold.[47]

In the context of permitting for an existing facility, such as Schiller Station, EPA must assess whether one or more of the above cooling technologies is capable of being retrofitted to the facility. EPA research has identified a number of existing power plants with open-cycle cooling systems that have been converted to closed-cycle cooling by retrofitting wet cooling towers at the facilities. *See, e.g., Draft Permit Determinations Document for Brayton Point Station NPDES Permit,* at 7-37 to 7-38; *Responses to Comments for Brayton Point Station NPDES Permit,* at IV-

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[42] *See* 65 Fed. Reg. at 49,081 (discussion of wet/dry tower); 39 Fed. Reg. at 36,192; EPA Economic and Engineering Analysis, App. A at 14.

[43] *See* 65 Fed. Reg. at 49,081 (discussion of wet/dry tower); Science Applications International Corporation (SAIC) Report (Mar. 15, 2002), Table 5.

[44] *See, e.g., id.*; 65 Fed. Reg. at 49,080-81; 1996 EPA Suppl. to Background Paper No. 3, at A-3; 41 Fed. Reg. at 17,388; 1976 Draft EPA CWA §316(b) Guidance at 13; EPA 1976 Development Document at 149–57, 191; 39 Fed. Reg. at 36,192.

[45] *See also* 65 Fed. Reg. at 49,080–81; Letter from Vernon Lang, USFWS to EPA Proposed Rule Comment Clerk at 3 (Nov. 6, 2000) (comments on EPA’s proposed regulations under CWA § 316(b) for new power plants listing a number of facilities currently operating, under construction, or recently approved for dry cooling); EPA Economic and Engineering Analysis, App. A at 14.

[46] *See, e.g.,* 65 Fed. Reg. at 49,080–81; EPA Economic and Engineering Analysis, App. A at 14–15; 39 Fed. Reg. at 36,192; Literature from Marley Cooling Tower Company; Pub. Serv. Comm’n of Wis./Wisc. Dep’t of Natural Res., Final Environmental Impact Statement, Badger Generating Company, LLC, Electric Generation and Transmission Facilities (Jun. 2000, 9340-CE-100), Exec. Sum.

[47] *See* 1994 EPA Background Paper No. 3, at 2–3.

115.[48]

EPA has not, however, found a single example of an existing power plant converting from open-cycle cooling to closed-cycle cooling by retrofitting a dry cooling system at the facility. Dry cooling is generally considered to be more expensive, and to require more space for installation, than wet cooling.[49] Therefore, converting to dry cooling would tend to pose greater difficulty than a conversion to wet cooling. Of course, none of this establishes that such a retrofit would be impracticable in all cases and it seems, theoretically, that a retrofit of dry cooling should be possible. Nevertheless, in the absence of a single example of such a conversion ever having taken place, EPA is unable to draw a firm conclusion at this time about the practicability of such a conversion in the future. Retrofits have typically involved wet mechanical draft cooling towers, though the Brayton Point Station facility in Somerset, Massachusetts, chose to retrofit natural draft towers to its formerly open-cycle facility. All of this establishes that converting an existing open-cycle facility to a closed-cycle operation using wet cooling towers is practicable as a general matter.

Beyond the issue of a technology's practicability (or "availability"), EPA also considers other issues pertaining to the effects of using a particular technology that may be pertinent in determining whether the capacity reductions from a particular closed-cycle cooling technology should be determined to reflect the BTA at a specific plant. Such considerations may include the secondary environmental effects, direct and indirect, of using cooling towers (e.g., sound emissions, air emissions of water vapor, mist, or other substances, visual or "aesthetic" effects). Moreover, if such effects require mitigation measures, additional project costs may need to be considered. Finally, use of any closed-cycle cooling technology will also likely result in a marginal loss of electrical output to the power grid by the power plant due to marginally reduced electric generation efficiency ("efficiency penalty") and the need to use some of the plant's output to power cooling tower fans and pumps ("auxiliary energy penalty"). This reduced output has an associated economic cost to the power plant and in an extreme set of circumstances could conceivably affect the adequacy of local energy supplies. Moreover, it could result in the facility, or another facility, burning additional fossil fuel and emitting more air pollution to provide "replacement power" to offset the lost output to the grid. These kinds of issues are discussed further below.

Moving beyond this general discussion, it is necessary to determine whether the above closed-cycle cooling technologies are available specifically for retrofitting at Schiller Station.

"Air" or "Dry" Cooling Towers at Schiller Station

As discussed above, using air (or dry) cooling towers would yield the maximum reduction in flow of any cooling technology by essentially eliminating the use of water for cooling. Thus, this option would essentially eliminate both the heat load to the Piscataqua River and the losses to

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[48] In the Phase I CWA § 316(b) Rule, EPA determined that entrainment and impingement mortality reductions commensurate with the use of closed-cycle cooling reflect the BTA for *new* facilities with CWISs. *See* 40 C.F.R. Part 125, Subpart I (Phase I CWA § 316(b) Rule).

[49] *See, e.g.,* 66 Fed. Reg. at 65,282–83.

aquatic life resulting from impingement and entrainment associated with cooling water withdrawals.

"Air" or "Dry" Cooling Towers at Schiller Station – PSNH's Review

PSNH's analysis concluded that retrofitting air cooling at Schiller Station would be impracticable. Specifically, PSNH concluded that dry cooling towers would require far greater surface area for construction than is available at Schiller Station. Dry cooling towers are less efficient than wet or hybrid cooling towers using evaporative cooling and this contributes to their greater space requirements. PSNH also stated that lower efficiency of dry cooling towers is such that they "…are not capable of supporting condenser temperatures and associated backpressures necessary to be compatible with the Station's turbine design…" Enercon, 2008, p. 39.

"Air" or "Dry" Cooling Towers at Schiller Station – EPA's Review

EPA has decided based on current information to eliminate dry cooling towers from further consideration for retrofitting at Schiller Station. In PSNH's view, dry cooling would be impracticable because of space constraints. *Id*. While EPA has not independently verified this conclusion, we have previously noted that dry cooling requires more space, and is likely to have greater feasibility problems as a result, than wet cooling towers. Furthermore, as stated above, EPA has not identified a single case of a facility retrofitting from open-cycle cooling to dry cooling. Dry cooling would also be more expensive and create larger marginal energy penalties, while likely achieving only a small marginal additional reduction over the high end of the reduction range for wet cooling towers. In light of the above considerations, including the absence of a single example of an open-cycle plant converting to dry cooling, EPA has determined based on current information that converting to dry cooling is not the BTA for Schiller Station. *See also Riverkeeper, Inc. v. U.S. Environmental Protection Agency,* 358 F.3d 174, 194-196 (2d Cir. 2004) ("Riverkeeper I") (upholding EPA's rejection of dry cooling as the BTA for the Phase I § 316(b) Rule addressing new facilities).

Wet Cooling Towers at Schiller Station

There are two principal types of wet cooling towers that are used in closed cycle systems: natural draft and mechanical draft towers. "Natural draft towers have no mechanical device to create air flow through the tower and are usually applied in either very small or very large applications." EPA, Preliminary Regulatory Development Section 316(b) of the Clean Water Act Background Paper No. 3: Cooling Water Intake Technologies, April 4, 1994, p. 2-4. Mechanical draft towers use fans in the cooling process. *See id.*; EPA, Economic and Engineering Analysis of the Proposed 316(b) New Facility Rule, August 2000, EPA-821-R-00-019, p. 11-2 to 11-3 and App. A, at 14. A third type of cooling tower combines elements of both wet and dry cooling and is referred to, alternatively, either as "wet/dry" cooling towers, "hybrid" cooling towers or "plume abated" cooling towers.

Natural Draft Wet Cooling Towers – PSNH's Review

PSNH evaluated natural draft cooling towers and concluded that this technology should be eliminated as the potential BTA. Natural draft cooling towers function because a "chimney effect" within the tower produces an air flow which provides the cooling medium to cool the heated non-contact cooling water discharged by the condenser. PSNH concluded that the volume of cooling water (i.e., circulation flow) at Schiller Station would not provide an adequate heat load "to fuel the thermal differential required to create and sustain the "chimney effect." Enercon, 2008, p. 39.

Natural Draft Wet Cooling Towers – EPA's Review

EPA has not independently verified that natural draft cooling towers are infeasible at Schiller and is not prepared, without further justification, to agree that it would be infeasible to use natural draft towers in a closed-cycle configuration at Schiller Station given the widespread use of this technology.

At the same time, given PSNH's expressed position and given the undisputed availability of other cooling tower technologies equally effective at reducing impingement mortality and entrainment, EPA considers it unnecessary to further investigate natural draft wet cooling tower technology as the potential BTA for Schiller Station. Furthermore, EPA notes that mechanical draft cooling towers have been used much more frequently in the United States in more recent years, including for retrofits (with the notable exception of the Brayton Point Station facility, as mentioned above), and are expected to be less expensive than natural draft towers. At the same time, PSNH may use any lawful technology, including natural draft cooling towers, to meet NPDES permit limits.

Mechanical Draft Wet Cooling Towers – PSNH's Review

According to PSNH, it would be feasible to convert Schiller Station from open-cycle to closed-cycle cooling by retrofitting mechanical draft cooling towers at the facility. The company estimates that this approach would reduce intake flow, and associated entrainment and impingement, by 96.9 to 100%. PSNH also indicates that mechanical draft towers at Schiller Station would require a maximum 3.8 MGD makeup water for all three units combined. This make-up water would be needed to replace: (1) blow-down; (2) evaporation losses; and (3) drift (water particles carried out by the tower plume).

As EPA requested, PSNH evaluated the use of treated recycled water (e.g., grey water) to augment the use of seawater in the plant's open-cycle cooling systems. If all of the wastewater generated in the Rockingham County area (12 municipal wastewater treatment plants) was routed to Schiller Station, it would only amount to 18.91% of the cooling water flow needed by the Station for condenser cooling. Enercon, 2008, p. 90. Therefore this option was rejected as potential BTA.

However, the Pierce Island Wastewater Treatment Plant would be able to provide sufficient grey water as make-up if the cooling system were converted to closed cycle.[50] Although additional investigations and arrangements would be necessary to determine the feasibility of this option, PSNH noted potential significant advantages of this option. Therefore, EPA considers using grey

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[50] If grey water is used instead of sea water, the cycles of concentration in the towers could increase, thereby reducing the amount of makeup water needed to 2.3 MGD.

water for make-up water to be a potential BTA for minimizing impingement and entrainment if cooling towers are installed.

PSNH notes concern about the possibility of water vapor plumes causing fogging and/or icing problems to nearby roads and commercial areas in cold weather. As a result, PSNH considered that the use of hybrid (or wet/dry) mechanical draft cooling towers would be necessary at Schiller Station for plume abatement. PSNH also concluded that noise abatement features would be needed considering that the cooling towers would be located directly across the river from residential areas.

The permittee provided an estimate of the total capital cost of this conversion (including using grey water versus sea water), as well as the total operation and maintenance costs. PSNH has claimed these cost estimates to be CBI, however, and, as a result, the figure is not reported here. Suffice to say, PSNH estimates substantial costs to convert Schiller Station to closed-cycle cooling with wet mechanical draft cooling towers. PSNH's estimate includes the parasitic energy demand of the cooling tower fans and booster pumps (requiring a new dedicated substation), as well as efficiency losses due to higher condenser cooling water inlet temperatures and increased water treatment and maintenance costs.

Mechanical Draft Wet Cooling Towers – EPA's Review

Mechanical draft wet and hybrid wet-dry cooling tower technologies are widely used at steam-electric power plants. These technologies are often used in closed-cycle configurations and have been retrofitted in closed-cycle configurations at a number of plants. *See, e.g.,* Clean Water Act NPDES Permitting Determinations for Thermal Discharge and Cooling Water Intake from Brayton Point Station in Somerset, MA (NPDES Permit No. MA0003654) (Draft Permit) at 7-37 to 7-38 (Jul. 22, 2002); Responses to Comments, Public Review of Brayton Point Station NPDES Permit No. MA0003654, at IV-114 to 115 (Oct. 3, 2003). *See also* US EPA, Technical Development Document for the Final Section 316(b) Existing Facilities Rule (EPA-821-R-14-002, May 2014), § 6.1.1.5.

With regard to Schiller Station specifically, PSNH concluded that converting Schiller Station from open-cycle to closed-cycle cooling by retrofitting mechanical draft wet cooling towers at the facility would be feasible. EPA agrees that such a conversion is a feasible option and concluded it should be further evaluated as a potential BTA for the Facility under CWA § 316(b).

As previously discussed, EPA considers a variety of factors in evaluating technological options for the BTA on a BPJ basis. Based on the intake flow reductions that converting closed-cycle cooling could achieve, this technology could reduce entrainment and impingement by approximately 95 percent, and by as much as 100 percent if gray water was used for make-up water. As indicated above, such a conversion would be feasible in terms of available space at the Facility and engineering considerations. EPA notes that PSNH has expressed concern about possible adverse effects to local neighbors across the river from cooling tower sound emissions, but also has also indicated that steps can and should be taken to mitigate any such effects. EPA agrees that technologies are available to mitigate sound emissions – e.g., low noise fans, sound baffling structures – if they are identified to be a problem. PSNH has also identified a concern about the potential for water vapor plumes from the cooling towers freezing on local roadways during winter weather and causing an icing hazard, but has also identified hybrid (wet/dry) cooling tower technology as a method of mitigating that concern. EPA agrees that such icing concerns can be addressed by using hybrid cooling towers. EPA has not conducted an independent analysis to verify the concerns about sound emissions or icing, but does not regard the concerns to be unreasonable given the local geography and weather conditions at Schiller Station. Moreover, EPA agrees that mitigating technologies are available to address these issues, albeit at some extra modicum of cost.

Converting to closed-cycle cooling would impose a small marginal “energy penalty” on generation by Schiller Station – approximately 2-4 percent less generation due to efficiency and auxiliary energy penalties – but this would not have significant effects on the local or regional power grid because the amount is small, Schiller is not a large generator and the coal units have a relatively low capacity factor in the first place. While some additional air emissions might result from additional power generation by other facilities to replace reduced Schiller Station generation, this is not likely to be significant both because the amount of lost generation is so small and because other cleaner sources might replace the electricity. Finally, EPA also notes that closed-cycle cooling would have the added benefit of reducing thermal discharges by approximately 95 percent. This is not considered to be a major benefit in this case, however, as Schiller Station’s thermal discharge is not considered to be particularly problematic. *See* Section 6.4, above.

When making a BTA determination under the CWA § 316(b), one aspect of determining whether a technology is *available* that EPA evaluates is whether the technology is affordable for the permittee. PSNH has submitted initial information regarding its estimates of the capital, operation and maintenance (O&M), and other direct and indirect costs of retrofitting mechanical draft hybrid wet-dry cooling tower technology in a closed-cycle configuration at Schiller Station. Installation of cooling towers, regardless of the type of tower and the specific cooling system configuration, would involve both one-time costs and annually recurring costs. One-time costs include the initial capital investment to procure equipment and construct the facilities, as well as lost profits from any otherwise unnecessary outage period in which one or both units must cease generation in order to allow construction to proceed. Annually recurring costs include incremental costs to operate and maintain the new facilities and costs associated with any reduction in generation efficiency. As stated above, PSNH’s cost estimates as well as EPA’s assessment of those estimates is considered CBI.

EPA agrees with PSNH that converting Schiller Station from open-cycle to closed-cycle cooling by retrofitting mechanical draft wet cooling towers (using either river water or grey water as make-up) at the facility is a feasible option that should be further considered as the potential BTA under CWA § 316(b). Closed-cycle cooling would also satisfy the impingement mortality reduction standard of the New CWA § 316(b) Regulations. 40 C.F.R. § 125.94(c)(1). As a result, it is an option open to Schiller Station for reducing impingement mortality in compliance with CWA § 316(b). EPA must further evaluate closed-cycle cooling for entrainment mortality reductions under the New CWA § 316(b) Regulations. See 40 C.F.R. §§ 125.94(d), 125.98(f) and 125.98(g). This further evaluation is presented in Section 10 of this Fact Sheet.

9.6 EPA's Conclusions on Alternative Technologies

From the above evaluation, EPA concludes that fine-mesh wedgewire screens, mechanical draft wet closed-cycle cooling towers, variable speed pumps and scheduled maintenance outages should be further evaluated as potential BTA options because they are available technologies that appear capable of appreciably reducing the Facility's entrainment of aquatic organisms. EPA also concludes that impingement mortality could potentially be reduced at Schiller Station by closed-cycle cooling, fine-mesh wedgewire screens, variable speed pumps, scheduled maintenance outages, fish return system improvements and/or the replacement of the Facility's existing traveling screens with Ristroph screens (including the renovation of the abandoned Unit 3 intake). Accordingly, EPA concludes that these BTA options for reducing impingement mortality should also be evaluated. A detailed discussion of EPA's BTA determination and decision process, as an ongoing permitting action, follows in Section 10, including a comparison of the cost-effectiveness of the various options.

10. Consideration of BTA Option Costs, Cost-Effectiveness, and Comparison of Relative Costs and Benefits

In the text above, EPA concluded that the current location, design, construction, and capacity of Schiller Station's CWISs no longer reflect the BTA for minimizing adverse environmental impact (AEI). In addition, EPA evaluated options for technological or operational modification of the Facility's CWISs to reduce impingement and entrainment in order to meet the BTA standard of CWA § 316(b). Based on this analysis, EPA "screened out" certain technological approaches from further evaluation as potential BTA options for Schiller Station's CWISs. Specifically, EPA rejected certain traveling screen technologies (fine-mesh, WIP, MultiDisc®, dual flow), coarse-mesh wedgewire screens, aquatic microfiltration barriers, fish net barriers, two speed pumps, behavioral barriers, open-cycle cooling using grey water, and certain closed cycled cooling options (dry cooling, natural draft).

Below EPA considers the remaining technologies, including their respective costs, cost-effectiveness and relative costs and benefits as part of its determination of the proposed BTA for Schiller Station's CWISs. As described in the preceding discussion of technologies, EPA determined that four general technology options stood out for further consideration, either alone or in combination, as a means for minimizing both impingement and entrainment caused by Schiller Station's CWIS:

- converting to closed-cycle cooling using wet mechanical draft cooling towers;
- installing fine-mesh wedgewire screens;
- installing variable speed pumps or requiring intake pump shutdown when practicable; and
- scheduling maintenance outages to minimize entrainment.

In addition, the following options for reducing impingement mortality (but not entrainment) were also retained for further evaluation:

- upgrading the traveling screens with Ristroph screens;

- renovating the abandoned Unit 3 intake;
- operating the new screens continuously;
- relocating chlorine dosing to downstream side of screens; and
- installing new fish return systems.

Based on information provided by PSNH, EPA further determined that these "impingement only" options could all be instituted concurrently. In fact, PSNH's construction cost estimate includes all of these as line items, except for the cost of operating the screens continuously, though new Ristroph screens are designed to operate continuously and typically are operated in this manner. *See* AR-187, 316(b) BTA Modified Ristroph Fish Handling Traveling Water Screen. *See also* S. Rajagopal, H. Jenner, V. Venugopalan (editors), Operational and Environmental Consequences of Large Industrial Cooling Water Systems, 2012, p. 373. Therefore, this combination of "impingement-only options" is grouped together and labeled the "Ristroph Screen Option."

Furthermore, EPA found that shutting down the intake pumps when a unit is on stand-by could significantly reduce Schiller Station's water withdrawals, and associated impingement and entrainment, if the capacity factor for that unit is low for a given time period. Although there is no way to predict with certainty the seasonal or annual capacity factor for each unit, this option's cost is low compared to the potential benefit. In fact, recent operating experience shows that Units 4 and 6 have not been operating much outside the peak winter and summer seasons and that this status is expected to continue. Therefore, as a component of the BTA for Schiller Station, EPA determined that PSNH should continue its current practice of shutting down intake pumps to reduce intake flow as much as practicable when a unit is not generating electricity.

Using the biological data and cost information, EPA evaluated the cost-effectiveness of the BTA options for reducing impingement mortality separately from the cost-effectiveness of the BTA options for reducing entrainment. EPA also evaluated how certain combinations of the available options would compare, in terms of cost-effectiveness, to each option alone. This discussion is presented below.

10.1 Method of Estimating Cost of BTA Options

All cost values used in the cost-effectiveness comparisons below were derived from the 2008 Enercon report. The relative costs (normalized) of the available technologies are presented in Tables 10-A and 10-B below, except for requiring intake pump shutdown when practicable and scheduling maintenance outages to minimize entrainment (these two options are considered to either save revenue or to cost relatively little in comparison to the environmental benefit and therefore are considered as components of BTA for this permit.) All values cited are in 2013 dollars. These values were provided to EPA in 2008 dollars, but EPA converted them to 2013 dollars using the Construction Cost Index (CCI). *See* http://enr.construction.com/economics/ for details.

For this Fact Sheet, EPA calculated the net present value (NPV) cost of each option, including all up-front expenses and periodic operation and maintenance costs. In this case, EPA finds that the NPV is the appropriate cost metric because it factors in the time value of money.

NPVs were calculated using Excel 2013's built-in function, as documented on Microsoft's website (http://office.microsoft.com/en-us/excel-help/go-with-the-cash-flow-calculate-npv-and-irr-in-excel-HA102753229.aspx?CTT=1). The function was run utilizing a weighted after-tax average cost of capital (5.3% as the discount factor, *See* letter from Michael Fisher and Lisa Tarquinio, Abt Associates, to Kelly Meadows, Tetra Tech, Subject: Cost and Affordability Analysis of Cooling Water System Technology Options at Merrimack Station, Bow, NH – with revised assessment of electricity rate effects, December 7, 2012). NPVs were adjusted to an after-tax basis using an estimate of PSNH's combined federal and New Hampshire state marginal tax rate of 40.5 percent for Merrimack Station. *See* December 7, 2012, Letter from Abt Associates to EPA. This adjustment was applied to capital costs only, not to lost revenue or O&M costs, since the benefits of tax write-offs are generally only available for capital expenses.

NPVs were calculated based on a 30-year time horizon for all options. The useful life of the cooling tower option is estimated to be 30 years. In the case of wedgewire and Ristroph screens, where the technology's useful life is judged to be less than 30 years, adjustments were made to put it on a 30-year basis. Therefore, since the lifetime of a wedgewire screen is understood to be 15 years, the screens would have to be replaced once over the 30 year time frame. The capital costs of the two sets of screens were then "chained" together to construct a 30-year cost basis for deriving net present values. In the case of the Ristroph screens, where the life of the equipment is assumed to be 20 years, a similar approach was taken, except that because the second set of Ristroph screens still has 10 years of life left at the end of the 30-year period of comparison, salvage value for the equipment was estimated via straight-line depreciation and deducted from the 30-year NPV.

The spreadsheet used to make all these calculations has not been made available in the public portion of the administrative record because PSNH has designated the technology cost information to be confidential business information (CBI). EPA cannot release such information to the public under 40 C.F.R. Part 2, Subpart B, unless PSNH withdraws its claim of CBI or EPA determines, after undertaking the CBI review and substantiation process (including any appeals and judicial review), that the material is not properly considered CBI. *See* 40 C.F.R. §§ 2.205 and 2.211.

Further, because of the claim of CBI, EPA cannot put the actual cost estimates derived into this fact sheet. Instead, in the table immediately below (Table 10-A), EPA has computed a ratio of the various costs, essentially setting an index relative to Ristroph screens. This is accomplished by dividing the cost of a technology, in NPV, by the NPV cost of installing Ristroph screens.

10.2 Comparison of Options for Reducing Impingement Mortality

Estimates of the costs and quantitative impingement mortality reduction benefits of the available technologies evaluated in this case are presented in Table 10-A.

Table 10-A Comparison of Cost and Degree of Impingement Mortality Reduction for Schiller Station's Existing CWIS and the BTA Technological Options

	Normalized Net Present Value Cost Ratio[1 *]	Annual Fish And Macrocrustacean Impingement Mortality[2]	Estimated % Reduction In Fish Impingement Mortality[3]	Estimated % Reduction In Macrocrustacean Impingement Mortality[3]	Estimated Annual Number Of Fish Saved[2]	Estimated Annual Number Of Macrocrustacean Saved[2]
Current Operation/ Technology	0.00	19,877	0.0	0.0	0	0
Mechanical Draft Cooling Towers	56.47	616	96.9	96.9	5862	13,399
Wedgewire Screen 1.0 mm	1.25	2,485	87.5	87.5	5293	12,099
Wedgewire Screen 0.8 mm	1.30	2,485	87.5	87.5	5293	12,099
Wedgewire Screen 0.69 mm	1.34	2,485	87.5	87.5	5293	12,099
Wedgewire Screen 0.6 mm	1.37	2,485	87.5	87.5	5293	12,099
Ristroph Screens	1.00	5,009	74.8	74.8	4525	10,343

[1]See cost derivation discussion above.
[2]Based on study as discussed in Section 8.2. For wedgewire screen options, *see* Excel spreadsheet #5 attached to email from P. Colarusso, EPA to S. DeMeo, EPA, 7/18/14.
[3]Basis for these values discussed in Sections 9.3 through 9.5 for each technology option. For wedgewire screen, *see* Excel spread sheet #6 attached to email from P. Colarusso, EPA to S. DeMeo, EPA, 7/18/14

* Note: This is a ratio of control technology cost to the cost of installing Ristroph screens. By definition, the ratio, or index, for Ristroph screens is 1.0, and these figures are dimensionless.

Wedgewire screens are expected to be highly effective for reducing impingement due to the low through-screen velocity that they produce, coupled with the strong sweeping currents present in the Piscataqua River. EPA determined that the wedgewire screen options are among the most cost-effective options evaluated for reducing impingement mortality.

Renovating the abandoned Unit 3 intake and installing Ristroph screens and new fish return systems for each of the three intake structures at the Station would be marginally less costly than wedgewire screens, but also would achieve an estimated reduction in impingement mortality of only 75% (by improving survival following impingement on the screens), as compared to an 87% reduction in impingement mortality with wedgewire screens. Wedgewire screens are predicted to achieve superior impingement mortality reductions because they prevent impingement and do not remove fish and other organisms from the water, whereas the Ristroph Screen Option allows organisms to come into contact with the screens, spray wash and fish return systems, which causes immediate mortality for some fish species, as discussed in Section

9.4.2 of this Fact Sheet.

In other words, the Ristroph Screen Option focuses on trying to improve fish survival after impingement, rather than preventing impingement in the first place, as wedgewire screens are likely to do. Preventing impingement would be particularly beneficial for Schiller Station because some of the species of fish impinged by Schiller Station have poor survival rates once impinged, regardless of the technology used (*e.g.* alewife, Atlantic herring, Atlantic menhaden and rainbow smelt). *See* Taft, E.P., *Fish protection technologies: a status report*, 2000, Environmental Science & Policy, Volume 3, September 1, 2000 (hereinafter Taft, 2000), pp. 349-359. These are "fragile species" when it comes to their ability to survive impingement. *See* New CWA § 316(b) Regulations, 40 C.F.R. § 125.92(m) (definition of "fragile species"). *See also* 40 C.F.R. § 125.94(c)(9) and 125.98(d). Moreover, American shad, river herring and rainbow smelt have experienced declining populations in recent years, and minimizing adverse impacts to these populations is fundamental to their recovery.

It appears that both the wedgewire screen option and the Ristroph Screen Option could potentially meet one or another of the generally applicable impingement mortality reduction criteria in the New CWA § 316(b) Regulations. *See* 40 C.F.R. § 125.94(c)(2) and (5). As discussed above, however, approximately 24% of the fish impinged by Schiller Station are fragile species. These fish would still suffer mortality with the Ristroph Screen Option, whereas they are less likely to with the wedgewire screen option.

It also appears that the two options are roughly equivalent in terms of cost-effectiveness for reducing impingement mortality at Schiller Station given how close the cost and effectiveness estimates are for the two options, and given the uncertainty inherent in these estimates. Nevertheless, EPA concludes that the wedgewire screen option should be favored because it would be likely to provide a larger reduction in impingement mortality because the above-discussed fragile species are likely to fare better with wedgewire screens than the Ristroph Screen Option. Moreover, as discussed below, the wedgewire screen option would also provide entrainment reduction benefits, while the Ristroph Screen Option would not. Furthermore, EPA concludes that the 1.0 mm slot-size wedgewire screen option could satisfy 40 C.F.R. § 125.94(c)(2) but, as discussed elsewhere in this analysis, it would not perform nearly as well as the other options for reducing entrainment mortality. Therefore, EPA rejects the 1.0 mm slot-size wedgewire screen option as a potential BTA option under 40 C.F.R. §§ 125.94(d), 125.98(f) and 125.98(g).

The closed-cycle cooling option is estimated to be the most effective, but also the most expensive, option for reducing impingement mortality. Cooling towers are expected to be able to reduce impingement mortality by about 10 percent more than wedgewire screens (a 97% reduction versus an 87% reduction), but at a cost nearly 40 times higher. While this option would satisfy 40 C.F.R. § 125.94(c)(1), and Schiller Station is free to select and implement it, EPA is not mandating it because the wedgewire screen options with slot sizes of 0.8 mm or less will satisfy 40 C.F.R. § 125.94(c)(2) at far less cost.

Finally, combining one of the wedgewire screen mesh size options with PSNH's current practice of shutting down the intake pumps when the units are on stand-by (*see* Figure 9-4 above) will further reduce impingement at no cost. Currently, Units 4 and 6 have not been operating regularly (i.e., having low capacity factors) and this status is not expected to change in the near future. Given current energy trends, EPA believes that the current practice of shutting down the pumps is achieving a higher level of reduction in impingement for Units 4 and 6 than the installation of VSP's. Unit 5, on the other hand, operates more consistently and reductions in cost and impingement may more likely be realized if variable speed pumps are installed for this unit.

10.3 Comparison of Options for Reducing Entrainment Mortality

The estimated costs and entrainment mortality reduction percentages of the available technologies are presented in Table 10-B.

Table 10-B Comparison of Cost and Degree of Entrainment Mortality Reduction for Schiller Station's Existing CWIS and the BTA Technological Options

	Normalized Net Present Value Cost Ratio[1]	Annual Fish And Macrocrustacean Entrainment Mortality[2]	Estimated % Reduction In Fish Entrainment Mortality [3]	Estimated % Reduction In Macrocrustacean Entrainment Mortality [3]	Estimated Annual Number Of Fish Eggs And Larvae Saved[2]	Estimated Annual Number Of Macrocrustacean Eggs And Larvae Saved[2]
Current Operation/ Technology	0.00	1,596,747,579	0	0	0	0
Mechanical Draft Cooling Towers	56.47	49,499,175	96.9	96.9	246,694,739	1,300,553,665
Wedgewire Screen 1.0 mm	1.25	239,311,718	6	100	15,275,216	1,342,160,645
Wedgewire Screen 0.8 mm	1.30	160,389,768	37	100	94,197,166	1,342,160,645
Wedgewire Screen 0.69 mm	1.34	142,568,683	44	100	112,018,251	1,342,160,645
Wedgewire Screen 0.6 mm	1.37	129,839,336	49	100	124,747,598	1,342,160,645
Ristroph Screens	1.00	1,596,747,579	0	0	0	

[1]See cost derivation discussion above.
[2]Based on study as discussed in Section 8.2. Also note that 100% mortality is assumed for entrained organisms
[3]The basis for these values is discussed in Sections 9.3 through 9.5 for each technology option.

As discussed above, fine-mesh wedgewire screens can significantly reduce entrainment mortality under certain circumstances. This technology works through a combination of mechanisms. By utilizing screen slot sizes smaller than the local aquatic organisms, fine-mesh wedgewire screens can prevent entrainment by excluding the organisms from the CWIS. As discussed above, this would reduce entrainment but would not reduce mortality if the organisms are killed by contacting the screens. In addition, however, wedgewire screens operate with low through-screen velocities which may enable later stage larvae with swimming ability to avoid contact with the wedgewire screens. Furthermore, low through-screen velocity combined with strong sweeping currents in the source water body, and the design of the wedgewire screens, may cause organisms to be swept past the screens without contacting them. *See, e.g.,* 79 Fed. Reg. 48331 ("Limited evidence also suggests that extremely low intake velocities can allow some egg and larval life stages to avoid the intake because of hydrodynamic influences of the crossflow.”); EPRI (2003). To the extent that this occurs, it would obviously reduce entrainment mortality.

There is no way, however, for EPA to estimate with any precision whether, or how many, more eggs and larvae would avoid contact with the proposed wedgewire screens than currently avoid contact with the existing CWISs. While low intake velocity (0.5 fps or less) and strong sweeping flows might make it more likely for eggs and larvae to be swept past the screens, the larger area of screens in the water body associated with the proposed installation of multiple wedgewire screens might be a countervailing factor that would make it more likely for organisms to contact the screens. In addition, if and when passing currents are *too* strong, they may cause relatively more organisms to contact the screens. *See* EPRI, 2005, pp. 5-4 to 5-5.

In the face of these uncertainties, EPA’s (and PSNH’s) quantitative analysis focuses on the extent to which the numbers of eggs and larvae currently entrained by the Facility can be reduced by using fine-mesh wedgewire screens to exclude them from entering the CWIS. EPA believes this is likely a conservative approach at this site because it does not reflect any increased avoidance of the CWIS, though EPA expects that some enhanced avoidance of the screens may occur. EPA determined how many organisms would be excluded by comparing the predicted size of the eggs and larvae expected to be present with the different screen slot size options under consideration.

EPA also estimated the degree to which entrainment *mortality* would be reduced by estimating the degree to which organisms excluded by the screens would survive contact with the screens. EPA based this assessment on relevant information from the literature related to determining such survival, including information about the heartiness of the organisms involved. There is unavoidably significant uncertainty regarding these estimated survival rates because there is a dearth of such information for fine-mesh wedgewire screens generally, and no information specifically for the proposed installation of such screens at Schiller Station. Based on EPA’s review of various EPRI reports (2003, 2005, 2007), EPA’s TDD for the 316(b) rule and our site specific knowledge of the Piscataqua River, EPA estimated egg survival to be 80% and larval survival to be 12%. The high ambient velocity in the Piscataqua produces a substantial sweeping flow that should minimize egg and larvae contact time with the screens. Obviously, complete avoidance of the screens would produce the lowest mortality rates for larvae and eggs, but EPA believes that reducing contact time with the screen is an important factor is reducing egg and larval mortality.

Screen slot sizes of 1.0 mm, 0.8 mm, 0.69 mm and 0.6 mm were evaluated. All of the options were deemed to achieve the same 100% reduction in macrocrustacean egg and larvae entrainment due to the relatively large size of these organisms. Furthermore, EPA estimates a 100% reduction in macrocrustacean entrainment mortality on the grounds that these organisms are hearty enough to survive contact with the wedgewire screens.

With regard to fish eggs and larvae, however, performance varied due to the range in the relative size of these organisms. The 1.0 mm slot size screen option was estimated to achieve substantially lower reduction in fish egg and larvae entrainment (only 11.5% vs. 79.2%, 85% and 94.4%, respectively, for the other slot sizes) and lower reduction in entrainment mortality (only 6% vs. 37%, 44% or 49%, respectively, for the other slot sizes). As a result, and given that the

1.0 mm slot size option is only slightly less expensive than the other options, EPA rejects the 1.0 mm slot size as a BTA option for reducing entrainment at Schiller Station.

The other slot size options (0.8 mm, 0.69 mm and 0.6 mm) have only slightly different estimated costs and their estimated levels of entrainment and entrainment mortality reduction are fairly close together. All things being equal, EPA would favor the smallest slot size because it would achieve the greatest reduction in entrainment (and entrainment mortality), but EPA understands that PSNH has indicated that if wedgewire screens are to be installed, it would want to do some pilot testing to determine whether there are important differences among these options with regard to potential screen clogging and other maintenance issues. EPA regards this approach to be reasonable under the facts of this case.

Each of the wedgewire screen options is projected to be more effective for reducing entrainment than the Ristroph Screen Option, which does not reduce entrainment. The wedgewire screen options, however, are expected to be less effective than closed-cycle cooling. Nevertheless, the comparison between the wedgewire screen and closed-cycle cooling options for entrainment reduction is complicated.

EPA estimates that converting Schiller Station to closed-cycle cooling could reduce entrainment mortality by as much as 97% for both macrocrustaceans and fish eggs and larvae. Because this improvement is achieved by reducing intake flow, it is considered to be the most certain way of reducing entrainment mortality. The wedgewire screen options are all projected to achieve a similar, actually slightly better (100%), reduction in macrocrustacean entrainment mortality. This is because the screens should exclude all the macrocrustaceans and they should be hardy enough to survive any contact with the screens.

There are significant differences, however, between the two technologies' ability to reduce entrainment and entrainment mortality for fish eggs and larvae. Region 1 estimates that closed-cycle cooling can reduce entrainment mortality for fish eggs and larvae by as much as 97%, whereas the wedgewire screen options with the three smallest slot sizes are estimated to reduce such entrainment mortality by 37%, 44% or 49%, respectively. The closed-cycle cooling option, however, is estimated to cost nearly 40 times more than any of the wedgewire screen options. *See* Table 10-B above (normalized net present value ratios). Thus, closed-cycle cooling is the best performing technology for reducing entrainment mortality, but the wedgewire screen options will also achieve substantial entrainment mortality reductions and will do so at far lower cost.

Finally, combining one of the wedgewire screen mesh size options with PSNH's current practice of shutting down the intake pumps when the units are on stand-by (*see* Figure 9-4 above) will further reduce entrainment at no additional cost. As discussed above for impingement, Units 4 and 6 have not been operating regularly in recent years and this is not expected to change in the near future. Given current energy trends, EPA believes that the current practice of shutting down the pumps is achieving a higher level of reduction in flow and entrainment for Units 4 and 6 than would the installation and operation of VSP's. Of course, this could change during the permit cycle but EPA is not prepared to mandate the use of VSP's at this time. If the capacity factor of these two units rises for an extended period of time, EPA can revisit the BTA determination as a permit modification. Unit 5, on the other hand, operates as more of a baseload generator and appreciable reductions in impingement and entrainment would be unlikely from installing variable speed pumps for this unit.

10.4 Conclusions

As explained above, the permit proceeding for Schiller Station is considered an "ongoing permit proceeding" under 40 C.F.R. § 125.98(g) of the New CWA § 316(b) Regulations. For such ongoing permit proceedings, the BTA determination for reducing impingement mortality "may be based on the BTA standards for impingement mortality at § 125.95(c)" and the site-specific BTA determination for reducing entrainment mortality may be based on some or all of the factors specified in 40 C.F.R. §§ 125.98(f)(2) and (3). 40 C.F.R. § 125.98(g). Of course, if the permitting authority decides not to consider these factors from the regulations, the BTA determination must still have a rational basis, be consistent with applicable law and not be arbitrary or capricious. In this case, EPA *did* consider the factors and standards specified in the New CWA § 316(b) Regulations, in addition to other appropriate factors, as explained below.

When setting permit limits under CWA §316(b) for controlling entrainment and impingement mortality, there is a relationship or interaction between the technologies selected as the BTA for each of these two problems (*i.e.*, entrainment vs. impingement). In some cases, the same technologies will address both (*e.g.*, closed-cycle cooling), whereas in other cases, different technologies might address the two issues (*e.g.*, flow reductions with variable speed pumps and outages to address entrainment vs. modified screen and fish return systems to address impingement). The New CWA § 316(b) Regulations address the possibility of conflicts between the technologies for addressing entrainment and impingement in 40 C.F.R. § 125.94(b)(1) and (2), essentially by providing that compliance with new impingement mortality requirements must be complied with after a determination of entrainment control requirements. This draft permit addresses BTA determinations for both entrainment mortality reduction and impingement mortality reduction. The discussion below addresses entrainment first and then impingement.

BTA for Entrainment Mortality Reduction

The BTA standard for reduction entrainment mortality under the New CWA § 316(b) Regulations states (in pertinent part) that:

> [t]he Director must establish BTA standards for entrainment for each intake on a site-specific basis. These standards must reflect the Director's determination of the maximum reduction in entrainment warranted after consideration of the relevant factors as specified in § 125.98.

40 C.F.R. § 125.94(d). As explained above, however, for an ongoing permit proceeding such as this one, the permitting authority has the discretion whether or not to consider "some or all of the factors in paragraphs (f)(2) and (3) …." 40 C.F.R. § 122.98(g). In addition, 40 C.F.R. § 125.98(f)(introductory paragraph) provides (in pertinent part) that:

> [t]he Director must establish site-specific requirements for entrainment … [that] reflect the Director's determination of the maximum reduction in entrainment

> warranted after consideration of factors relevant for determining the best technology available for minimizing adverse environmental impact at each facility.

Furthermore, the New CWA § 316(b) Regulations provide that:

> [t]he Director must provide a written explanation of the proposed entrainment determination in the fact sheet or statement of basis for the proposed permit [which] … must describe why the Director has rejected any entrainment control technologies or measures that perform better than the selected technologies or measures, and must reflect consideration of all reasonable attempts to mitigate any adverse impacts of otherwise available better performing entrainment technologies.

40 C.F.R. § 125.98(f)(1). In the discussion above, EPA has explained in writing much of its assessment and comparison of the relevant technologies. The Agency's conclusions are described and summarized below.

Closed-cycle cooling is an entrainment mortality reduction option open to Schiller Station. It is both technically and financially feasible. (As discussed farther below, closed-cycle cooling would also satisfy 40 C.F.R. § 125.94(c)(1) with regard to reducing impingement mortality.) Closed-cycle cooling would also be the most effective and most certain technology option for reducing entrainment mortality due to the substantial year-round flow reductions that it could achieve.

Nevertheless, EPA is not proposing to mandate this technology as the site-specific BTA for entrainment mortality reduction at Schiller Station primarily because the Agency concludes that under the facts of this case its far greater costs, as compared to the fine-mesh wedgewire screen option, are not warranted by the additional margin of reduction in adverse environmental effects that it could achieve. Further, the added benefit of reducing thermal discharges by approximately 95% with closed cycle cooling is not a significant factor because the facility's thermal discharge is not considered particularly problematic. This is a site-specific decision and closed-cycle cooling might be the BTA at another site under different facts.

Although the benefits will not be as great or as certain as the benefits that closed-cycle cooling would achieve, the fine-mesh wedgewire screen options, with the exception of the 1.0 mm slot size option, can also achieve substantial entrainment mortality benefits at far less expense. EPA estimates that closed-cycle cooling could reduce entrainment mortality of fish eggs and larvae and macrocrustaceans by approximately 97%, while the 0.6, 0.69 and 0.90 mm wedgewire screen options are conservatively estimated to be capable of reducing entrainment mortality of fish eggs and larvae by approximately 49%, 44% and 37%, respectively, and of macrocrustaceans by 100%. EPA finds that closed-cycle cooling would cost 40 times more than the wedgewire screen option. EPA concludes that such costs are not in this case warranted for the additional margin of entrainment mortality reduction that closed-cycle cooling could achieve.

EPA reaches this conclusion in light of the moderate size of Schiller Station's water withdrawal and its relatively small withdrawal relative to the flow in the Piscataqua River. In addition, EPA's judgment is influenced by the fact that while the Facility's entrainment of eggs and larvae is significant, it has not been associated with higher level impacts, such as major effects on local populations of impacted species or the overall community of organisms in the river, or with impacts to endangered species. In addition, Schiller Station's Units 4 and 6 have been operating at a relatively low capacity factors in recent years and this trend is currently expected to continue (although such trends can change over time).

EPA clearly is *not* concluding that nothing needs to be done about Schiller Station's entrainment. To the contrary, EPA regards it to be important to reduce entrainment mortality (and impingement mortality) caused by Schiller Station's CWISs. EPA finds that current entrainment and impingement losses at Schiller Station represent avoidable mortality to aquatic organisms in a productive river of public importance that is subject to cumulative stresses from, among other sources, municipal storm water runoff, industrial discharges, land use changes, upstream flow alterations and other power plant water withdrawals. These losses are avoidable in the sense that available technology could be added to the Facility at an appropriate cost that would enable Schiller Station to continue generating electricity while harming far fewer aquatic organisms.

That said, the Agency also finds that in this case, the cost of the closed-cycle cooling option is not warranted by the benefits it would obtain. At the same time, EPA finds that the cost of the fine-mesh wedgewire screen options (along with the specified BMPs) will make improvements at a low seven-figure cost that *is* warranted by the benefits.

Based on the evaluation herein, EPA has also determined that shutting down pumps to reduce flow to the maximum amount practicable when an associated generating unit is not generating electricity, and water is not needed for fire-fighting or other emergencies, is also a component of the BTA for reducing impingement mortality and entrainment at Schiller Station. This step should actually save the company money over time due to the reduced energy costs associated with shutting off the pumps.

EPA has discussed the benefits of reducing mortality from entrainment (and impingement) above. From a quantitative standpoint, the proposed BTA is estimated to save approximately more than 1.4 billion eggs and larvae of various fish and macrocrustacean species each year. The closed-cycle cooling option would save more fish eggs and larvae and a slightly smaller number of macrocrustaceans. All things being equal, the greater the reduction in mortality from entrainment and impingement, the greater the benefits that will be achieved.

At the same time, it should also be understood that, as mentioned above, EPA has no evidence that entrainment and/or impingement losses at Schiller Station are causing or significantly contributing to declines in local populations of the affected species of aquatic organisms or to disruptions in the local community or assemblage of organisms in the Piscataqua River. This is not surprising given that Schiller Station's withdrawal of 125 MGD is only 0.5% of the tidal prism of the Piscataqua River Estuary (approximately 25,000 MGD). In addition, as discussed elsewhere in this Fact Sheet, EPA expects that the proposed permit conditions will satisfy the requirements of the Endangered Species Act, the Magnuson-Stevens Act, and the Coastal Zone Management Act. That said, some of the species affected by entrainment and impingement at Schiller Station are not doing well on a regional basis (e.g., rainbow smelt, herring) and taking reasonable steps to reduce mortality is appropriate. The proposed permit conditions will require such reasonable steps.

As discussed earlier in this document, the CWA does not *require* EPA to compare the costs and benefits of the options being considered as the possible BTA under CWA § 316(b). *Entergy,* 556 U.S. at 222-226. The statute does, however, give EPA the *discretion* to consider such cost/benefit comparisons in the process of determining the BTA, and EPA has done so for many years as part of its consideration of cost. *Id.* Consistent with the law and the Agency's practice, EPA's New CWA § 316(b) Regulations direct permitting authorities making BTA determinations for the reduction of entrainment mortality to consider the relationship of social costs and social benefits of technological options if the available information is of "sufficient rigor." 40 C.F.R. § 125.98(f)(2)(v). *See also* 40 C.F.R. §§ 125.92(x) and (y) (definitions of "social benefits" and "social costs").[51] The regulations then give the permitting authority the discretion to determine how much weight to give to this consideration of costs and benefits in making its BTA determination. 40 C.F.R. § 125.98(f)(2).

Neither statute, nor regulations, nor guidance document dictate precisely how such cost/benefit evaluations should be conducted. The regulations do, however, indicate that *social* costs and benefits should be considered and that costs and benefits should be considered both qualitatively and, if possible, quantitatively. *See also* 40 C.F.R. §§ 125.92(x) and (y) 122.21(r)(11). EPA makes reasonable efforts to make as complete an assessment as it can of the costs and benefits at issue, so that it can factor them into its evaluation. As part of a qualitative evaluation, EPA seeks to compare the cost of BTA options with "the magnitude of the estimated environmental gains (including attainment of the objectives of the Act and § 316(b)) to be derived from the modifications." *Id.* at 225 (quoting, *Central Hudson,* Decision of the General Counsel, No. 63, at p. 381). The relevant "objectives of the Act and § 316(b)," as referred to in *Central Hudson,* include minimizing adverse environmental impacts resulting from the operation of CWISs, restoring and maintaining the physical and biological integrity of the Nation's waters, and achieving, wherever attainable, water quality providing for the protection and propagation of fish, shellfish and wildlife, and providing for recreation, in and on the water. 33 U.S.C. §§ 1251(a)(1) and (2), 1326(b).

Reducing mortality from entrainment (and impingement) by Schiller Station's CWIS will directly increase the number of recreational and forage fish (eggs, larvae, juveniles and adults), as well as other types of aquatic organisms (*e.g.*, macrocrustaceans such as rock crabs, oysters and lobsters) found in the Piscataqua River, which is part of the Great Bay Estuary. The greater the reductions, the more likely it is that they will contribute to increased populations of juvenile and adult fish. In addition, regardless of population-level effects, reducing the loss of eggs and larvae due to entrainment is valuable in and of itself because of the role these organisms play at the base of the food web and the other benefits that they may provide, such as contributing to species' compensatory reserve. (Reducing impingement losses also directly contributes to increased abundance of adult fish, which are also important to the food web and provide a commercial and recreational resource in the Piscataqua River and other connected water bodies that make up the Great Bay Estuary.) Finfishing, lobstering and shellfishing are all important activities in the Great Bay Estuary. "Anglers seek striped bass, bluefish, smelt, river herring,

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[51] Of course, as explained previously, 40 C.F.R. § 125.98(g) gives the permitting authority discretion in an "ongoing permit proceeding" whether or not to consider the factors in § 125.98(f), including the cost/benefit factor in § 125.98(f)(2)(v).

flounder, and a variety of other species in the estuary. In winter, smelt fishermen set up bobhouses, drill holes in the ice and wait patiently for smelt to nibble their lines." Mills, Kathy, Great Bay National Estuarine Research Reserve, Ecological Trends in the Great Bay Estuary, 20 Year Anniversary Report, 2009 (hereinafter 2009 Great Bay 20th Report)(AR-186). Several recreationally important species are among the species commonly impinged and/or entrained by Schiller Station, including rainbow smelt, winter flounder, blueback herring, pollock, hake species alewife, and Atlantic cod. Moreover, regional populations of American shad, river herring and rainbow smelt have all declined in the relatively recent past which supports the appropriateness of taking steps to help preserve these species.

Beyond these direct benefits to aquatic life, reducing entrainment (and impingement) is also likely to result in additional indirect benefits to the ecosystem and the public's use and enjoyment of it. Examples of such potential indirect benefits include increasing recreational and educational opportunities, increasing or maintaining biological diversity, and contributing to healthier populations of resident and migratory birds and other terrestrial wildlife reliant on the river's aquatic organisms for food.

In addition to these direct and indirect benefits of protecting fish in the Piscataqua River ecosystem, fish populations also generate a multitude of ecosystem services. Many of these ecosystem services have no direct market value and occur at regional spatial scales over the long term, making them difficult to monetize or even quantify. However, the potential benefits of increasing fish populations in terms of their functional role in natural ecosystems cannot be overlooked and, at a minimum, these ecosystem services should be considered qualitatively.

Thus, in addition to food production, fish populations can control the growth of algae and macrophytes, supply recreational opportunities, regulate food web dynamics, recycle nutrients, serve as active and passive links between ecosystems, and maintain species and genetic biodiversity. *See* C.M. Holmlund and M. Hammer, Ecosystem services generated by fish populations, Ecological Economics 29: 253-268, 1999. Within the Piscataqua River and Great Bay Estuary, nitrogen has shown a long term increasing trend, concurrent with a decrease in eelgrass and a possible increase in drift macroalgae.

Biodiversity has recently emerged as a critical measure of ecosystem resilience. Systems with high biodiversity tend to be more stable and have enhanced primary and secondary productivity, as well as lower rates of collapse of commercially important fish and invertebrate taxa over time. *See* Worm B., et al., Impacts of Biodiversity Loss on Ocean Ecosystem Services, Science 314: 787-790, November 2006. Low phenotypic diversity (i.e., the physical expression of a fish genotype), which can be a result of loss of a percentage of the population (such as through mortality associated with a CWIS), can decrease equilibrium catch and effort levels used by regulatory agencies to set quotas for commercial fishing stocks (e.g., through fishery management plans). Overestimating the maximum sustainable yield based on a conventional growth model in populations with low levels of phenotypic variance may lead to overharvesting and potentially collapse the stock. *See* Akpalu, W., Economics of biodiversity and sustainable fisheries management, Ecological Economics 68: 2729-2733, 2009.

The predominant economic benefits to be obtained in this case include non-market (*e.g.*, recreational opportunities), indirect (*e.g.*, ecosystem services), and non-use benefits (*e.g.*, "existence values," "bequest values"). EPA did not attempt to develop a monetized estimate of the full benefits that would accrue to society from the above-discussed impingement mortality and entrainment reductions from the preferred BTA – such as by undertaking a stated preference study or a benefits transfer analysis to estimate non-use benefits for this case – because EPA decided that doing so would be prohibitively difficult, time-consuming and expensive for this permit.[52] No such complete monetized estimate is readily available and it would take many months and substantial cost to attempt to develop such an estimate.[53] *See Entergy*, 556 U.S. at 232-235 (J. Breyer concurring opinion).

A complete monetized assessment of benefits would consider commercial use values, recreational use values, non-use values and ecological benefits. While estimating the commercial use value of lobsters and river herring that would be saved by a particular option could potentially be fairly straightforward in this case, estimating recreational use values can be complex, costly and time-consuming. Moreover, the largest component of the total benefit of saving fish in this case, is likely to be found in the ecological benefits and non-use values arising from saving those organisms. Yet, attempting to develop a monetized estimate of such ecological and non-use values is even more challenging than addressing recreational use values. In both cases, specialized expertise in natural resource economics and modeling would be needed that EPA Region 1 does not have on staff to apply on a permit-by-permit basis. It could take many months or even years to develop this type of complete monetized benefits estimate, and it could cost hundreds of thousands of dollars or more in contractor support. EPA does not have such resources to apply to this permit.

Moreover, in EPA's view, it would be unreasonable to spend those kinds of public resources, even if they could be found, in this case. This decision involves a permit for only a single, relatively small facility, Schiller Station, and Units 4 and 6 at the plant have been operating less and less in recent years. Moreover, as stated above, Schiller Station withdraws only a very small portion of the tidal flux of the Piscataqua River.

As a result, EPA has considered the benefits of reducing entrainment (and impingement) mortality *quantitatively* simply in terms of the number of organisms saved by the various options, and then has assessed the overall benefit of saving these organisms on a qualitative basis. Considering benefits qualitatively may be appropriate when monetized estimates of the full benefits of an action are not available. *See,* 40 C.F.R. §§ 125.92(x), 125.98(f)(2)(v). *See also*

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[52] EPA also notes that efforts by the Agency to develop monetized estimates of these sorts of non-use values have proven highly controversial. *See, e.g.,* Logan, Lee, "Power Sector Seeks Host Of Late Changes to Delayed Cooling Water Rule," *Inside EPA* (Jan. 23, 2014). This is not to say that EPA would not or should not undertake such an analysis in appropriate cases just because it would likely be met with opposition from some interested parties. Rather, it is to underscore both the potential difficulties and likely expense of pursuing such an analysis and the fact that completing such an analysis would be unlikely to resolve all controversies over the value of reducing entrainment and impingement. Instead, the analysis itself would likely become a new bone of contention.

[53] To the best of EPA's knowledge, the Agency has yet to conduct a stated-preference survey in the context of an individual permit in an effort to develop a monetized estimate of non-use values from entrainment and impingement reductions. EPA is aware of one case in which the Agency developed a benefits transfer-based estimate of monetized non-use values to be considered in conjunction with a qualitative assessment. *See In re Dominion Energy Brayton Point, LLC (Formerly USGen New England, Inc.) Brayton Point Station*, 12 E.A.D. 490, 675-691(EAB 2006). This effort to generate a monetized estimate was, however, time-consuming and controversial. *See id.* It was also expensive because it required outside contractor expertise to develop.

Entergy, 556 U.S. at 224; *EPA Guidelines for Preparing Economic Analyses* (EPA 2000a). This is a better approach than entirely ignoring those benefits and only considering the cost of more protective technology. Just as EPA considers the cost of technological options, it is important that the Agency also assess and consider the benefits of these options in as complete a way as possible.

Therefore, in this case, EPA has quantitatively considered the number of organisms that would be saved by the reduced entrainment (and impingement) that could be achieved by the various options. As indicated above, installing the wedgewire screens appear capable of saving a significant, though difficult to quantify, segment of the nearly 1.6 billion eggs and larvae that are estimated to be entrained by the Facility annually. More specifically, as indicated above, *see* Table 10-B, EPA estimates that the fine-mesh wedgewire screen options still under consideration could save approximately 100 million fish eggs and larvae (around 40-50% of those lost to entrainment) and approximately 1.3 billion macrocrustacean eggs and larvae (virtually all of those currently lost to entrainment). The wedgewire screen options also can save more than 17,000 fish and crustaceans per year by largely eliminating impingement mortality at the Facility.

EPA also qualitatively considered the value of the Piscataqua River's aquatic organisms that the BTA options will protect from entrainment and impingement. Minimizing impingement and entrainment by the Schiller Station CWIS would have ecological benefits for the Great Bay Estuary ecosystem. The Piscataqua River is a 12 mile long tidal estuary that spans part of the boundary between New Hampshire and Maine before reaching the Atlantic Ocean east of Portsmouth, New Hampshire. As mentioned, the Piscataqua River is part of the Great Bay Estuary, which is an area of major public conservation efforts that continue to protect and preserve the estuary and its aquatic organisms. "The New Hampshire Fish and Game Department manages the Great Bay Reserve, which was designated in 1989. The Reserve is also supported by the Great Bay Stewards, a non-profit friends group." *See* http://www.greatbay.org/.

> The Partnership includes *Principal, Associate and Community Partners* representing regional, state and federal agencies, municipalities, and land trusts serving the region. The Partnership's *Principal Partners* include:
>
> Ducks Unlimited, Inc.
> Great Bay National Estuarine Research Reserve
> New Hampshire Audubon
> New Hampshire Fish and Game Department
> Society for the Protection of New Hampshire Forests
> The Nature Conservancy, New Hampshire Chapter
> U.S. Environmental Protection Agency
> U.S. Fish and Wildlife Service, Great Bay National Wildlife Refuge
> U.S.D.A. Natural Resources Conservation Service

http://www.greatbaypartnership.org/. Overall costs are not easily calculated for fish restoration efforts in the Great Bay Estuary. "Since 1995, the Partnership has invested over $65 million in land protection within the Great Bay watershed, including $56 million in funds from NOAA. Funding sources are diverse and include federal and state grants, municipal sources, foundation grants, and private donations." 2009 Great Bay 20th Report (AR-186). The Great Bay National Estuarine Research Reserve (NERR) is part of a national network of 27 protected coastal areas that was created for long-term research, education and stewardship. Established under the Coastal Zone Management Act of 1972, the NERR "partnership program between the National Oceanic and Atmospheric Administration (NOAA) and the coastal states protects more than one million acres of the nation's most important coastal resources." http://www.greatbay.org/ *See also* 2009 Great Bay 20th Report (AR-186).

Particular efforts have been made to protect and restore fish, such as the anadromous species river herring (alewife and blueback herring) and rainbow smelt, as well as others, through the construction and monitoring of fish ladders and the institution of fish stocking programs. Increases in forage fish and invertebrate populations may also benefit recreationally and ecologically important fish species, as well as resident and migratory birds and other terrestrial wildlife (including State-listed threatened and endangered species), by increasing prey abundance. As mentioned above, American shad, river herring and rainbow smelt have experienced declining populations in recent years, and minimizing adverse impacts to these populations is fundamental to their recovery. In fact, rainbow smelt is listed as a Species of Concern by the National Marine Fisheries Service. (In addition, juvenile and adult life stages of the federally protected Atlantic sturgeon inhabit the river and could potentially be at risk for impingement, though none were found to have been impinged during the two-year impingement data collection efforts described farther above in this document. The wedgewire screens would address this risk.)

NHDES has designated the relevant segment of the Piscataqua River a Class B water. Class B waters are "considered as being acceptable for fishing, swimming and other recreational purposes and, after adequate treatment, for use as water supplies." (RSA 485-A:8, II) Though the standard for Class B waters does not include any specific numeric criteria that apply to cooling water intakes, it is nevertheless clear that permits must include any conditions necessary to protect the designated uses of the river, including that it provide good quality habitat for fish and other aquatic life and a recreational fishing resource.

In light of the public importance attributed to these ecological resources, it would be anomalous for the NPDES permit to allow Schiller Station to kill large numbers of the river's fish, at various life stages, through entrainment and impingement by CWISs that essentially have no effective means of preventing such mortality. Furthermore, these CWISs have been allowed to operate essentially without modification or limitation for approximately 50 years despite the existence of technological and/or operational restrictions that could reduce these entrainment and impingement losses.

In summary, achieving substantial reductions in impingement and entrainment by Schiller Station's CWIS will increase the number of recreational and forage fish (eggs, larvae, juveniles and adults), as well as invertebrate species in the affected segment of the Piscataqua River. These improvements are also likely to contribute to increased populations of these organisms. In turn, reducing adverse impacts from impingement and entrainment could provide a number of direct, indirect, and non-use benefits both within the river and the estuary. Benefits may also include, for example, preservation or enhancement of habitat for migratory birds and other terrestrial animals dependent on the estuary's aquatic organisms, and enhanced recreational opportunities, including bird watching, fishing, and boating. While EPA has not developed a monetized estimate of these benefits, the importance to the public of the Piscataqua River and Great Bay ecosystem and its natural resources is evident from the federal, state and public efforts to protect these public natural resources. Moreover, substantially reducing entrainment and impingement will contribute to "attainment of the objectives of the Act and § 316(b)," including (a) minimizing adverse environmental impacts from cooling water intake structures, (b) restoring and maintaining the physical and biological integrity of the Nation's waters, (c) achieving, wherever attainable, water quality providing for the protection and propagation of fish, shellfish and wildlife, and (d) providing for recreation, in and on the water.

Compliance with the BTA measures for minimizing entrainment and impingement by Schiller Station will substantially reduce avoidable mortality to millions of aquatic organisms in the affected segment of the Piscataqua River. This mortality is avoidable in that Schiller Station can reduce these adverse effects by implementing the selected BTA measures while continuing to generate electricity. There is nothing inherent in Schiller Station's process for generating electricity that requires this mortality. It is a function of the way that the facility operates and the limitations of its existing technology. The Station's CWIS and fish return system have not been significantly upgraded since their original installation some 50 years ago. Making the proposed upgrades would also be consistent with the New Hampshire WQS, as discussed above. Furthermore, implementing the proposed BTA measures could potentially prevent Schiller Station from killing individual members of a number of particularly important species, such as the federally protected Atlantic sturgeon, and would reduce losses of other important species such as rainbow smelt, winter flounder, Atlantic cod and river herring. Protecting other species may also have important ecological significance for the food web in the river.

EPA evaluated using wedgewire screens at Schiller Station based on a variety of other factors discussed in Section 7.3 above. The age of the Schiller Station or CWIS equipment would not preclude installing new wedgewire screens. New wedgewire screens would essentially take the place of the existing traveling screens, which are original to the facility. Upgrading such old equipment would be entirely appropriate.

Furthermore, PSNH indicates that it has no plans to close Schiller Station or any of its currently operating generating units. In particular, PSNH converted Unit 5 to a wood-burning unit fairly recently and that unit runs at a high capacity factor. Thus, the facility appears to have sufficient remaining useful life to justify the expenditures necessitated for the wedgewire screen option.

Using wedgewire screens would not change the process of generating electricity, but there could be a small period of "down time" during installation of the equipment when the facility might need to forego revenue from electricity generation from one or more units. Yet, there is no reason to expect that any such downtime would be at all lengthy given that the work would not affect the electrical generation equipment itself. Furthermore, any necessary brief downtime could be scheduled during expected downtime due to low demand or scheduled maintenance in order to avoid any significant interference with electrical generation.

In addition, EPA considered the non-water quality environmental impacts associated with the installation and use of wedgewire screens. EPA does not expect any impacts in energy consumption, water quantities in the affected water bodies, air emissions, noise, and visual impacts with these technologies. EPA recognizes that, unlike closed-cycle cooling, wedgewire screen technology will not reduce Schiller Station's thermal discharges, but as discussed in this Fact Sheet, the Facility's thermal discharges, as is, can meet CWA standards.[54] Thus, this option would have no effect on energy supply for New Hampshire or New England.

As EPA explained above, for an ongoing permit proceeding, such as this one, the New CWA § 316(b) Regulations indicate that a permitting authority may consider some or all of the factors specified in 40 C.F.R. §§ 125.98(f)(2) and (3) in making its site-specific BTA determination under 40 C.F.R. § 125.98(g). Although not required to, EPA did consider the factors in 40 C.F.R. §§ 125.98(f)(2) and (3). With regard to the factors in § 125.94(f)(2), EPA considered the "numbers and types of organisms entrained," "impact of changes in particulate emissions or other pollutants associated with entrainment technologies," "land availability," and "quantified and qualitative social benefits and costs of available entrainment technologies when such information on both benefits and costs is of sufficient rigor to make a decision." 79 Fed. Reg. 48438 (40 C.F.R. § 125.98(f)(2)(i), (ii), (iii), and (v)). Using cooling towers at Schiller Station would not, in EPA's view based on existing information, pose significant issues regarding the emission of particulates or other pollutants in light of the relatively small size of the power plant and its location.

Furthermore, the BTA selected by EPA, which entails a combination of steps including the use of wedgewire screens and a BMP designed to minimize unnecessary water withdrawals, rather than cooling towers, does not raise issues concerning the emission of particulates or other pollutants. EPA has also considered the issue of the remaining useful plant life, *id.* (40 C.F.R. § 125.98(f)(iv)). Although the plant is more than 50 years old, there is no indication that PSNH has any present intention or plan to close the generating units that use the cooling water intake structures because they have a limited remaining useful life. Moreover, PSNH has not made any significant recent improvements to the cooling water intake structures that EPA ought to consider before requiring new technology. In addition, based on the discussion above, EPA concludes that the relatively modest costs of the wedgewire screen option, as presented above, are warranted by the benefits that they would produce. For the closed-cycle cooling option, EPA reached a different conclusion and, instead, found that the far greater costs were not warranted by the additional benefits that they would provide. *See* Table 10-B above. EPA regards the available information to be of sufficient rigor to support the largely qualitative benefits analysis that factored into the comparison of costs and benefits.

Turning to the factors in the new 40 C.F.R. § 125.98(f)(3), EPA again considered the substance of these factors, including "(i) entrainment impacts on the water body; (ii) thermal discharge impacts; (iii) credit for reductions in flow associated with the retirement of units occurring within the ten years preceding October 14, 2014; (iv) impacts on the reliability of energy delivery within the immediate area; (v) impacts on water consumption; and (vi) availability of process water, gray water, waste water, reclaimed water, or other waters of appropriate quantity and quality for reuse as cooling water." 79 Fed. Reg. 48438. In particular EPA notes here that it does not expect any significant impact on energy delivery from making improvements to Schiller Station's CWISs because the cooling system changes under consideration will not preclude or

[54] Although EPA has rejected the closed-cycle cooling option for Schiller Station, it is should be noted that that option would pose additional issues to be assessed with regard to energy effects, air emission effects, sound emissions, visual effects, icing, etc.

substantially restrict future energy production. Moreover, installation of any new equipment (*e.g.*, wedgewire screens, VFDs, or cooling towers) should be feasible without outages of any significance. Any outages needed to allow new equipment installation could be scheduled during regular maintenance outages or periods of low electricity demand, and Schiller Station is not a large generator, in any event. In addition, no units have been retired in the last 10 years at the Facility, but EPA's analysis has considered the diminished operations of Units 4 and 6 in recent years.

Finally, EPA does not regard consumptive water use concerns to be a significant issue for this BTA determination. Although the cooling tower option could result in a small amount of evaporative water loss, any such losses would be inconsequential in the tidal environment around Schiller Station. Moreover, EPA is not proposing closed-cycle cooling as the BTA and the preferred wedgewire screed option will not affect water quantities in the river.

BTA for Reducing Impingement Mortality

The BTA standard for reducing impingement mortality under the New CWA § 316(b) Regulations states that:

> [t]he owner or operator of an existing facility must comply with one of the alternatives in paragraphs (c)(1) through (7) of this section, except as provided in paragraphs (c)(11) or (12) of this section, when approved by the Director. In addition, a facility may also be subject to the requirements of paragraphs (c)(8), (c)(9), or (g) of this section if the Director requires such additional measures.

40 C.F.R. § 125.94(c)(introductory paragraph). As explained above, for an ongoing permit proceeding such as this one, the permitting authority has the discretion whether or not to base the BTA determination for reducing impingement mortality on the BTA standards for impingement mortality at § 125.94(c). 40 C.F.R. § 122.98(g). For this draft permit, EPA did look to the BTA standards in 40 C.F.R. § 125.94(c).

All of the fine-mesh wedgewire screen options would satisfy the BTA standard specified in 40 C.F.R. § 125.94(c)(2), because they each has a design through-screen velocity of 0.5 fps or less. EPA has ruled out the 1.0 mm slot-size option, however, because, as discussed above, it would be inadequate for reducing entrainment mortality. Therefore, as also discussed above, EPA is drafting permit requirements that will allow Schiller Station to conduct pilot testing to determine the optimal screen slot-size from the three remaining options (0.6 mm; 0.69 mm; and 0.80 mm). EPA also notes that closed-cycle cooling is an option open to the Facility, as that technology would satisfy 40 C.F.R. § 125.94(c)(1).

EPA considers reducing impingement mortality at Schiller Station to be an important objective. From a quantitative standpoint, the proposed BTA is estimated to save approximately 17,500 adult and juvenile aquatic organisms (fish and macrocrustaceans) from impingement mortality While the wedgewire screen and closed-cycle cooling options would achieve roughly equivalent benefits in terms of reduced impingement mortality at Schiller Station, the wedgewire screen option would be far less costly.

The Ristroph Screen Option would also reduce impingement mortality sufficiently to satisfy one part of the BTA standard for impingement mortality in the New CWA § 316(b) Regulations, 40 C.F.R. § 125.94(c)(5) (concerning "modified traveling screens"), but EPA is authorized to impose additional measures to protect fragile species under 40 C.F.R. §§ 125.4(c)(9) and 125.98(d). As discussed above, a substantial number of such fragile species are present at Schiller Station and would not be protected from impingement mortality by the Ristroph Screen Option. Therefore, EPA has determined that if a screening option is to be implemented by Schiller Station for impingement mortality reduction, it must address fragile species and be one of the preferred wedgewire screen options. This also makes sense because the wedgewire screen options also reduce entrainment mortality, but the Ristroph Screen Option would not.

Conclusion

In light of the analysis presented above, EPA is proposing for this draft permit that the BTA for Schiller Station includes the following:

1) Wedgewire screens with a mesh or slot size of 0.80 mm or less operated and maintained to maintain an intake through-screen velocity of 0.5 fps or less and equipped with an air burst system. The actual screen slot size selected will be subject to EPA approval and based upon the results of the Facility's pilot testing and demonstration report submitted to the agencies. The demonstration report will provide a justification for 1) the proposed screen slot size based on consideration of each option's ability to reduce entrainment mortality, avoid screen clogging, fouling or other maintenance issues, and any other relevant considerations; and 2) the proposed material alloy choice for the equipment in order to reduce bio-fouling; and 3) the proposed optimal screen orientation in the river (i.e., parallel or perpendicular to the flow) in order to reduce entrainment and impingement mortality;

2) A best management practice (BMP) of shutting down the intake pumps associated with a particular generating unit to the extent practicable when that generating unit is not operating and water is not needed for fire prevention or other emergency conditions; and

3) The annual outage of Unit 5 during June to maximize the reduction in entrainment mortality.

10.5 BTA Permit Requirements

After an initial pilot study is conducted, the permittee is required to install, operate, and maintain wedgewire screens and achieve a through-screen velocity of 0.5 fps to reduce the impingement and entrainment of all life stages of fish to the maximum extent practicable, consistent with the requirements described below.

The wedgewire screen units[55] shall have a maximum slot size of 0.8 millimeters and a design

[55] EPA is aware that the permittee will need to evaluate certain design and construction variables for the use of wedgewire screens at Schiller Station. These considerations may include but not limited to the use of high grade

through-slot intake velocity of 0.5 fps or less under all facility operating conditions and all flow conditions, including during periods of minimum ambient source water surface elevation and periods of maximum head loss across the units. The actual screen slot size selected will be subject to EPA approval and based upon the results of the Facility's pilot testing and demonstration report submitted to the agencies. The wedgewire screen units shall employ a pressurized air burst system to periodically clear debris from the screens. Periodic manual cleaning will also be required. The permittee shall verify that the through slot velocity at the wedgewire screen intake is 0.5 fps or less through measurement or calculation.

The wedgewire screen units must be positioned as close to the west bank of the Piscataqua River and the CWIS as possible, while meeting all operational specifications required by this permit, the conditions of any other permits for the equipment, and assuring that the equipment performs as designed. The screen orientation in the river will also be subject to EPA approval and based upon the results of the Facility's pilot testing and demonstration report. Deflecting structures, such as debris-deflecting nose cones, are strongly recommended to eliminate the damage risk associated with free-floating debris from contacting the screen assembly.

Regarding the wedgewire screens, the permittee shall address all necessary permitting or other approvals with the National Marine Fisheries Service (NMFS) and the Army Corps of Engineers (ACOE) to schedule a favorable time for installation and to minimize environmental and navigational impacts during construction and installation. In addition, EPA will work with Schiller Station and, as appropriate, the ISO to schedule any necessary downtime of the power plant that will minimize or eliminate any effects on the adequacy of the region's supply of electricity.

Furthermore, the permittee is required to schedule the annual Unit 5 outage during June to maximize the reduction in entrainment mortality. If the permittee has a three year capacity supply obligation that would result in a penalty, the permittee is required to reconfigure the obligation within the next year to allow an outage in June without a penalty. The rescheduled outage would not be required until the obligation is reconfigured.

Moreover, as a best management practice (BMP) requirement, the permittee shall to the extent practicable not operate intake water pumps for each electrical generating unit except for when water must be withdrawn to generate electricity, or for firefighting or other emergency events. Thus, when generating units 4, 5 and/or 6 are not generating electricity and water is not needed for firefighting or other emergency conditions, the intake water pumps for that unit would be shut down to the extent practicable.

Compliance Schedule

With regard to fine-mesh wedge-wire screens, PSNH states that "[t]his technology is one of the highest ranked of the alternative CWIS technologies evaluated for this Report in terms of biological benefits … [and i]ts annual operational costs are comparable to the costs of operating

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stainless steel, hydrodynamic load, hydrostatic load, wave load, impact load, weight of the structures and the stability of the bedrock underneath, marine construction methodologies, potential concerns of having lower water levels in the intake bays and increased hydraulic head across the circulating water pumps, as well as debris and river bed saltation and the potential need for dredging and/or the use of Johnson Screens Model T-78HC half-screens.

the Station's existing traveling screens." Enercon, 2008, p. 107. However, PSNH also suggests that "[a] site specific study would be required to determine the appropriate wedgewire screen material and slot size to ensure that the screens would be able to withstand the aggressive marine environment." *Id*. With the caveat that EPA has rejected the 1.0 mm slot size option, as discussed above, EPA agrees that a one year site-specific study is a sensible idea to pin down the optimal slot size and construction materials to use. Since it has already been determined that wedgewire screen technology is feasible at Schiller Station, the study should only be used to evaluate the performance of the system and final design specifications (*i.e.*, slot size for maximum entrainment reduction while minimizing any debris loading issues).

Beyond the issue of a site-specific study, Schiller Station plainly will also need a period of time to install the new CWIS equipment. In the past EPA did not include compliance schedules for BTA requirements in NPDES permits; rather, compliance schedules for BTA requirements were included in administrative compliance orders issued in conjunction with the new NPDES permit. EPA's approach to compliance schedules, however, has changed.

EPA has long understood that when new permit conditions are issued that require new equipment that will reasonably take some time to install, a compliance schedule of some kind will typically be appropriate to provide a clear, enforceable timeline for achieving permit compliance. EPA has made this clear in many permit proceedings over the years. *See, e.g.*, EPA Region 1, "Responses to Comments, Public Review of Brayton Point Station NPDES Permit MA0003654" (Oct. 3, 2003), p. I-6 (AR-183). The question that remains, however, is whether the compliance schedule should be included in the permit itself or in a separate enforceable instrument, such as an administrative compliance order under CWA § 309(a) (*i.e.*, a non-penalty scheduling order), or a consent decree.

Under 40 C.F.R. § 122.47(a)(1), a schedule for attaining future compliance with technology-based effluent limits whose statutory compliance deadline has already passed cannot be included in an NPDES permit. The deadline for compliance with BAT, BPT and BCT technology standards is 1989. *See* 40 C.F.R. § 125.3 (deadline for compliance with BAT, BPT and BCT technology standards is 1989); 33 U.S.C. § 1311(b)(2). Therefore, a schedule for attaining compliance with these standards would be included in an instrument outside of the permit. By the same token, EPA cannot put a compliance schedule in a permit for achieving compliance with water quality-based effluent requirements, unless the applicable state standards themselves provide for such future compliance. Otherwise, the statutory deadline of 1977 for achieving water quality standards compliance has already passed and cannot be extended by a permit action. *See* 33 U.S.C. § 1311(b)(1)(C). Thus, compliance schedules for meeting water quality-based effluent limits would also be handled outside the permit unless the state water quality standards at issue expressly provide for achieving compliance at some time in the future. *See In the Matter of Star-Kist Caribe, Inc.*, 4 E.A.D. 33, 34-36 (EAB 1992).

The situation with regard to cooling water intake structure requirements under CWA § 316(b) is somewhat more complicated. The new Draft Permit for Schiller Station does require certain improvements to the Facility's CWISs which will require some time to plan and install in order to achieve compliance. In the past, EPA interpreted CWA § 316(b) to incorporate the compliance deadlines from CWA § 301(b)(2) and, as a result, any compliance schedule would have been handled outside an NPDES permit. *See, e.g., Cronin v. Browner*, 898 F.Supp. 1052 (S.D.N.Y.

1995); *EPA General Counsel's Opinion No. 41* (1976). *See also* EPA Region 1, "Responses to Comments, Public Review of Brayton Point Station NPDES Permit MA0003654" (Oct. 3, 2003), p. I-6 (AR-183). EPA has more recently changed its legal interpretation, however, and has now determined that because there is no stated compliance deadline within the "four corners" of CWA § 316(b), compliance with the BTA standard is due *as soon as practicable*. *See* 79 Fed. Reg. 48359.

As a result, a compliance schedule may be, but does not necessarily have to be, included in an NPDES permit to govern attainment of compliance with CWA § 316(b) requirements. *See* 79 Fed. Reg. 48433, 48438 (40 C.F.R. §§ 125.94(b)(1) and (2) ("The Director may establish interim compliance milestones in the permit."), and 125.98(c)). In this case, EPA has included a reasonable compliance schedule in the Draft Permit by which the permittee is to achieve compliance with the Final Permit's requirements under CWA § 316(b). The time provided for evaluation and selection of the final wedgewire screen option is consistent with PSNH's own suggestion regarding a schedule for studying wedgewire screen slot size options. Furthermore, the timeline provided for installing the wedgewire screens is based on EPA's knowledge of the wedgewire screen installation schedule for the GE Lynn facility, as well as the schedule to install cooling towers at Brayton Point Station. The Draft Permit includes the following compliance schedule at Part I.A.14.b:

1. Design

   i. The permittee shall complete pilot testing of wedgewire screens no later than twelve (12) months from the effective date of this permit.

   ii. A demonstration report documenting the results of the pilot testing shall be submitted to EPA and NHDES within two (2) months of the completion of the pilot testing. The demonstration report shall include a preliminary design of the wedgewire screens at Schiller Station and include justifications for 1) the proposed screen slot size based on consideration of each option's ability to reduce entrainment mortality, avoid screen clogging, fouling or other maintenance issues, and any other relevant considerations; 2) the proposed material alloy choice for the equipment in order to reduce bio-fouling; and 3) the proposed optimal screen orientation in the river (i.e., parallel or perpendicular to the flow) in order to reduce entrainment and impingement mortality. The screen slot size and orientation selected will be subject to EPA approval and based upon the results of the pilot testing and demonstration report.

   iii. Data collection, including but not limited to topographic and bathymetric surveys, geotechnical exploration, and other design and marine construction variables that need to be evaluated shall be completed no later than sixteen (16) months from the effective date of the permit.

iv. Within four (4) months of the completion of pilot testing and after correspondence from EPA, the permittee shall submit a final design for the wedgewire screens at Schiller Station.

2. Permitting

i. Within four (4) months of the completion of the pilot testing, the permittee shall commence the process to obtain all necessary permits and approvals for installation and construction of the wedgewire screens, including those required by U.S. Army Corps of Engineers (ACOE), National Marine Fisheries Service (NMFS), NHDES, New Hampshire Division of Coastal Zone Management, local conservation commissions, and others as necessary. This shall include the engineering to support the permitting, the permit applications, and all necessary supplementary data.

ii. From the commencement of the permitting process and until all permits and approvals are issued, the permittee shall provide timely and complete responses to all requests from each permitting and approval authority.

iii. Within eight (8) months from the commencement of the permitting process, the permittee shall complete submission of all necessary permit applications and notices necessary to install wedgewire screens at the Units 4, 5, and 6 CWISs.

3. Construction

i. Within twelve (12) months of the completion of the pilot testing, the permittee shall enter into an Engineering, Procurement and Construction agreement with the permittee's contractor.

ii. No later than nine (9) months after obtaining all permits and approvals, the permittee shall complete site preparation for the installation of wedgewire screens for the Units 4, 5 and 6 CWISs. The permittee shall minimize environmental and navigational impacts during construction and installation. In addition, EPA will work with representatives of Schiller Station and, as appropriate, the ISO to schedule any necessary downtime of the power plant that will minimize or eliminate any effects on the adequacy of the region's supply of electricity.

iii. The permittee shall complete installation, operational modifications, test, startup and commissioning of the wedgewire screens for the CWIS's of Units 4, 5 and 6 no later than twenty (20) months from obtaining all permits and approvals.

Compliance with New Hampshire Water Quality Standards

As explained above, New Hampshire's WQS apply to effects of Schiller Station's water withdrawals through its CWISs. As also discussed above, New Hampshire's WQS seek to protect and preserve the biological integrity of the State's waters. The NPDES permit's new requirements based on the BTA proposed herein should substantially reduce mortality to aquatic organisms from impingement and entrainment by Schiller Station's CWISs. As a result, these permit conditions should satisfy New Hampshire WQS and EPA expects that the NHDES would certify these permit conditions under CWA § 401(a)(1).

11. Stormwater Pollution Prevention Plan

On September 25, 1992, EPA promulgated through its General Permit for Stormwater Discharge Associated with Industrial Activity, that the minimum BAT/BCT requirement for stormwater discharges associated with industrial activity is a Stormwater Pollution Prevention Plan (SWPPP) [57 FR, 44438]. EPA has included SWPPP requirements in the draft permit because a significant amount of wastewater discharged from the Facility consists of stormwater and the Facility engages in activities that could result in the discharge of pollutants to waters of the United States either directly or indirectly through stormwater runoff. These operations include at least one of the following in an area potentially exposed to precipitation or stormwater: material storage, in-facility transfer, material processing, material handling, or loading and unloading. Specifically, at this Facility, the two parking lot chemical loading zones and the two on-site tank farms are examples of material storage, processing and handling operations that must be included in the SWPPP.

To control activities/operations that could contribute pollutants to waters of the United States and potentially violate New Hampshire's WQSs, the draft permit requires the Facility to continue to implement, and maintain a SWPPP. This process involves the following four main steps:

- Forming a team of qualified Facility personnel who will be responsible for developing and updating the SWPPP and assisting the Facility manager in its implementation;
- Assessing the potential stormwater pollution sources;
- Selecting and implementing appropriate management practices and controls for these potential pollution sources; and
- Periodically re-evaluating the effectiveness of the SWPPP in preventing stormwater contamination and overall compliance with the various terms and conditions of the draft permit.

The goal of the SWPPP is to reduce, or prevent, the discharge of pollutants through the stormwater system. The SWPPP serves to document the selection, design and installation of control measures, including BMPs. Additionally, the SWPPP requirements in the draft permit are intended to facilitate a systematic approach for the permittee to properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used to achieve compliance with the conditions of this permit. The SWPPP shall be prepared in accordance with good engineering practices and identify potential sources of pollutants, which may reasonably be expected to affect the quality of stormwater discharges associated with industrial activity from the Facility. The SWPPP documents measures implemented at the

Facility to satisfy the non-numeric technology-based effluent limitations included in the draft permit. These non-numeric effluent limitations support, and are equally enforceable as, the numeric effluent limitations included in the draft permit.

Pursuant to Section 304(a) of the Act and 40 CFR 125.103(b), BMPs may be expressly incorporated into a permit on a case-by-case basis where it is determined they are necessary to carry out the provision of the CWA under Section 402(a)(1). These conditions apply to the Facility because PSNH stores and handles products containing pollutants listed as toxic under Section 307(a)(1) of the CWA or pollutants listed as hazardous under Section 311 of the CWA and have ancillary operations that could result in significant amounts of these pollutants reaching waters of the United States. BMPs have been selected based on those appropriate for this specific facility (*see* Sections 304(e) and 402(a)(1) of the CWA and 40 CFR §122.44(k)).

In essence, the SWPPP requirement directs the permittee to review the physical equipment, the operational procedures, and the operator training for the Facility. The objective of this review is to protect the local waterway by minimizing the pollutants discharged through inadequate facility design, through human error, or through equipment malfunction.

The draft permit directs the permittee to incorporate BMPs directly into the SWPPP. BMPs become enforceable elements of the permit upon submittal of a SWPPP certification within 90 days of the effective date of the permit. Therefore, BMPs are permit conditions comparable to the numerical effluent limitations and are required to minimize the discharge of any pollutants through the proper operation of the generating facility.

12. Essential Fish Habitat

Under the 1996 Amendments (PL 104-267) to the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. §1801 et seq. (1998)), EPA is required to consult with the National Marine Fisheries Services (NMFS) if EPA's action or proposed action that it funds, permits, or undertakes, "may adversely impact any essential fish habitat." 16 U.S.C. § 1855(b). Adversely impact means any impact which reduces the quality and/or quantity of EFH (50 C.F.R. § 600.910 (a)). Adverse impacts may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey, reduction in species' fecundity), site-specific or habitat wide impacts, including individual, cumulative, or synergistic consequences of actions. The Amendments broadly define essential fish habitat as: waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (16 U.S.C. §1802 (10))

Essential fish habitat is only designated for species for which federal fisheries management plans exist (16 U.S.C. § 1855(b) (1) (A)). EFH designations for New England were approved by the U.S. Department of Commerce on March 3, 1999 and are identified on the NMFS website at http://www.nero.noaa.gov/hcd/webintro.html. In some cases, a narrative identifies rivers and other waterways that should be considered EFH due to present or historic use by federally managed species.

The federal action being considered in this case is the proposed NPDES permit reissuance for Schiller Station. EPA believes that the conditions and limitations contained within the Draft Permit adequately protects all aquatic life, including those with designated EFH in the receiving water, and that further mitigation is not warranted.

Attachment D provides the complete discussion of EPA's Essential Fish Habitat assessment as it relates to the renewal of Schiller Station's NPDES permit. All documents supporting the EFH assessment, including a letter under separate cover, will be made available to the NMFS Habitat Division.

Should adverse impacts to EFH be detected as a result of this permit action, or if new information is received that changes the basis for EPA's conclusions, NMFS will be contacted and an EFH consultation will be reinitiated.

13. Endangered Species Act

Section 7(a) of the Endangered Species Act of 1973, as amended (ESA) grants authority to and imposes requirements upon Federal agencies regarding endangered or threatened species of fish, wildlife, or plants ("listed species") and habitat of such species that has been designated as critical (a "critical habitat"). The ESA requires every Federal agency, in consultation with and with the assistance of the Secretary of Interior, to ensure that any action it authorizes, funds, or carries out, in the United States or upon the high seas, is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat.

EPA has reviewed the federal endangered or threatened species of fish, wildlife, or plants to determine if any listed species might potentially be impacted by the re-issuance of this NPDES permit. The two listed species that have the potential to be present in the vicinity of Schiller Station are the shortnose sturgeon (*Acipenser brevirostrum*) and the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*).

Based on the expected distribution of the species, EPA has determined that there are no shortnose sturgeon in the action area and that the reissuance of the permit will have no effect on the species. Therefore, consultation under Section 7 of the ESA with NMFS for shortnose sturgeon is not required.

Based on the analysis of potential impacts to Atlantic sturgeon presented in Attachment E to this Fact Sheet, EPA has made the preliminary determination that impacts to Atlantic sturgeon from the intake and discharges at Schiller Station, if any, will be insignificant or discountable. The attachment provides the complete discussion of EPA's Endangered Species Act assessment as it relates to the renewal of Schiller's NPDES permit.

Therefore, EPA has judged that a formal consultation pursuant to Section 7 of the ESA is not required. EPA is seeking concurrence from NMFS with the preliminary determination through the supporting information in this Fact Sheet, Attachment E to the Fact Sheet and the Draft Permit. A letter under separate cover will also be submitted to NMFS Protected Resources requesting concurrence.

Reinitiation of consultation will take place: (a) if new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in the consultation; (b) if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the consultation; or (c) if a new species is listed or critical habitat is designated that may be affected by the identified action.

14. Monitoring and Reporting

The effluent monitoring requirements have been established to yield data representative of the discharge under authority of Section 308 (a) of the CWA in accordance with 40 CFR §§122.41 (j), 122.44 (l), and 122.48.

The draft permit requires the permittee to report monitoring results obtained during each calendar month in the Discharge Monitoring Reports (DMRs) no later than the 15th day of the month following the completed reporting period.

The draft permit includes new provisions related to electronic DMR submittals to EPA and the State. The draft Permit requires that, no later than six months after the effective date of the permit, the permittee submit all DMRs to EPA using NetDMR, unless the permittee is able to demonstrate a reasonable basis, such as technical or administrative infeasibility, that precludes the use of NetDMR for submitting DMRs and reports ("opt-out request").

In the interim (until six months from the effective date of the permit), the permittee may either submit monitoring data to EPA in hard copy form, or report electronically using NetDMR.

NetDMR is a national web-based tool for regulated Clean Water Act permittees to submit DMRs electronically via a secure Internet application to U.S. EPA through the Environmental Information Exchange Network. NetDMR allows participants to discontinue mailing in hard copy forms under 40 CFR § 122.41 and § 403.12. NetDMR is accessed from the following url: http://www.epa.gov/netdmr. Further information about NetDMR can be found on the EPA Region 1 NetDMR website located at http://www.epa.gov/region1/npdes/netdmr/index.html.

EPA currently conducts free training on the use of NetDMR, and anticipates that the availability of this training will continue to assist permittees with the transition to use of NetDMR. To learn more about upcoming trainings, please visit the EPA Region 1 NetDMR website http://www.epa.gov/region1/npdes/netdmr/index.html .

The draft permit also includes an "opt-out" request process. Permittees who believe they cannot use NetDMR due to technical or administrative infeasibilities, or other logical reasons, must demonstrate the reasonable basis that precludes the use of NetDMR. These permittees must submit the justification, in writing, to EPA at least sixty (60) days prior to the date the facility would otherwise be required to begin using NetDMR. Opt-outs become effective upon the date of written approval by EPA and are valid for twelve (12) months from the date of EPA approval. The opt-outs expire at the end of this twelve (12) month period. Upon expiration, the permittee must submit DMRs to EPA using NetDMR, unless the permittee submits a renewed opt-out request sixty (60) days prior to expiration of its opt-out, and such a request is approved by EPA.

In most cases, reports required under the permit shall be submitted to EPA as an electronic attachment through NetDMR, subject to the same six month time frame and opt-out provisions as identified for NetDMR. Certain exceptions are provided in the permit such as for providing written notifications required under the Part II Standard Permit Conditions. Once a permittee begins submitting reports to EPA using NetDMR, it will no longer be required to submit hard copies of DMRs or other reports to EPA and the NHDES. Until electronic reporting using NetDMR begins, or for those permittees that receive written approval from EPA to continue to submit hard copies of DMRs, the Draft Permit requires that submittal of DMRs and other reports required by the permit continue in hard copy format. Hard copies of DMRs must be postmarked no later than the 15th day of the month following the completed reporting period.

15. Antidegradation

This draft permit is being reissued with some changes in permit requirements. EPA has determined that the changes, as described in this fact sheet, will not cause lowering of water quality or loss of existing water uses and that no additional antidegradation review is warranted.

16. State Certification Requirements

EPA may not issue a permit unless either the State Water Pollution Control Agency with jurisdiction over the receiving water(s) certifies that the effluent limitations and/or conditions contained in the permit are stringent enough to assure, among other things, that the discharge will not cause the receiving water to violate State's Surface Water Quality Regulations or the certification is deemed to be waived as set forth in 40 CFR §124.53. The NHDES is the certifying authority within the State of New Hampshire.

Upon public noticing of the Draft Permit, EPA is formally requesting that the State's certifying authority make a written determination concerning certification. The State will be deemed to have waived its right to certify unless certification is received within 60 days of receipt of this request.

The State's certification should include the specific conditions necessary to assure compliance with applicable provisions of the Clean Water Act, Sections 208(e), 301, 302, 303, 306 and 307 and with appropriate requirements of State law. In addition, the State should provide a statement of the extent to which each condition of the Draft Permit can be made less stringent without violating the requirements of State law. Since certification is provided prior to permit issuance, failure to provide this statement for any condition waives the right to certify or object to any less stringent condition which may be established by EPA during the permit issuance process following public noticing as a result of information received during that noticing. If the State believes that any conditions more stringent than those contained in the draft permit are necessary to meet the requirements of either the CWA or State law, the State should include such conditions and, in each case, cite the CWA or State law reference upon which that condition is based. Failure to provide such a citation waives the right to certify as to that condition. The sludge conditions implementing section 405(d) of the CWA are not subject to the 401 certification requirements.

Reviews and appeals of limitations and conditions attributable to State certification shall be made through the applicable procedures of the State and may not be made through the applicable procedures of 40 CFR § 124.

The New Hampshire Department of Environmental Services, Water Division is the certifying authority. EPA has discussed this Draft Permit with the Staff of the Wastewater Engineering Bureau and expects that the Draft Permit will be certified. Regulations governing state certification are set forth in 40 CFR §§ 124.53 and 124.55.

17. Comment Period, Hearing Requests, and Procedures for Final Decisions

All persons, including applicants, who believe any condition of the draft permit is inappropriate must raise all issues and submit all available arguments and all supporting material for their arguments in full by the close of the public comment period, to Michael Cobb, U.S. EPA, Office of Ecosystem Protection, Municipal Permits Branch, 5 Post Office Square, Suite 100, Boston, Massachusetts 02109-3912. Any person, prior to such date, may submit a request in writing for a public hearing to consider the draft permit to EPA and the State Agency. Such requests shall state the nature of the issues proposed to be raised in the hearing. A public meeting may be held if the criteria stated in 40 C.F.R. § 124.12 are satisfied. In reaching a final decision on the draft permit, the EPA will respond to all significant comments and make these responses available to the public at EPA's Boston office.

Following the close of the comment period, and after any public hearings, if such hearings are held, the EPA will issue a final permit decision and forward a copy of the final decision to the applicant and each person who has submitted written comments or requested notice. Within 30 days following the notice of the final permit decision, any interested person may submit a petition for review of the permit to EPA's Environmental Appeals Board consistent with 40 C.F.R. § 124.19.

18. EPA Contact

Additional information concerning the draft permit may be obtained between the hours of 9:00 A.M. and 5:00 P.M., Monday through Friday, excluding holidays from:

Mr. Michael Cobb, Environmental Engineer
U.S. Environmental Protection Agency
Office of Ecosystem Protection
5 Post Office Square, Suite 100 (OEP06-1)
Boston, Massachusetts 02109-3912
Telephone: (617) 918-1369
FAX No.: (617) 918-0995

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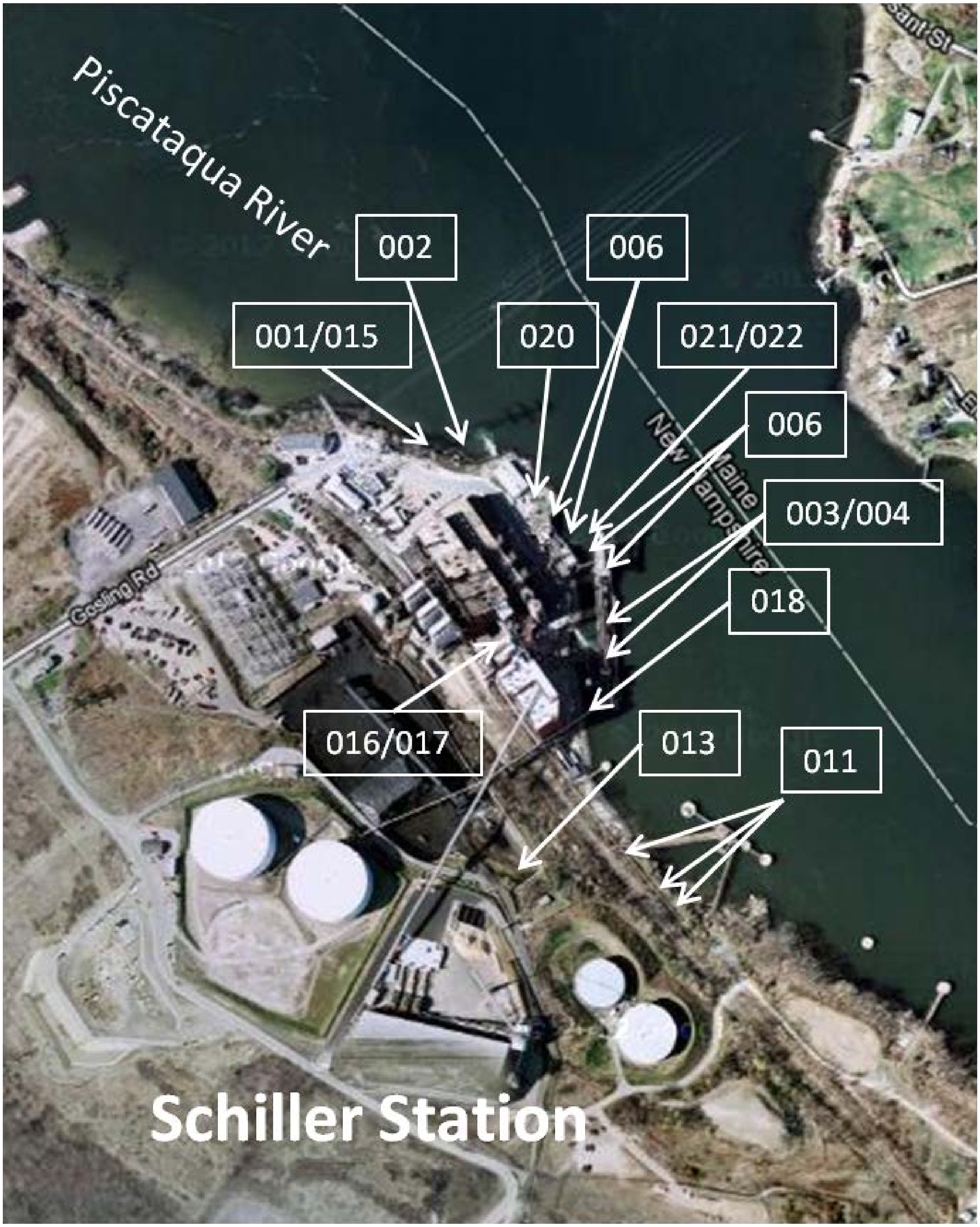
Date:

Ken Moraff, Director
Office of Ecosystem Protection
U.S. Environmental Protection Agency

ATTACHMENT A – AERIAL MAP WITH OUTFALL LOCATIONS



*Aerial image obtained from maps.google.com
**See Section 6.2 of this fact sheet for a description of each outfall

ATTACHMENT B – DMR SUMMARY

The following tables are a quantitative summary of the discharge from each outfall during the period from November 1990 through April 2014.

Outfall 001A, Monthly Reporting								
Monitoring Period End Date	Total Residual Chlorine	Ferrous Sulfate	Flow		Oil & Grease		Temperature	
	mg/L		MGD		mg/L		degree F	
	Daily Max	Daily Max	Monthly Average	Daily Max	Monthly Average	Daily Max	Difference between Intake and Discharge	Water Temp
Existing Permit Limit	0.2	0.5	40	40	15	20	25	95
Minimum	0	0	0.01	0.01	0	0	16	55.5
Maximum	0	0	39	39	13.2	16	22	89
Average	---	---	3.48	4.63	1.4	1.4	19	73
Standard Deviation	---	---	9.38	10.64	2.5	2.7	2	13
# of Measurements	2	0	188	188	306	306	11	11
# of Exceedances	0	0	0	0	0	0	0	0

Outfall 002A, Monthly Reporting						
Monitoring Period End Date	Total Residual Chlorine	Ferrous Sulfate	Flow		Temperature	
	mg/L		MGD		degree F	
	Daily Max	Daily Max	Monthly Average	Daily Max	Difference between Intake and Discharge	Water Temp
Existing Permit Limit	0.2	0.5	43.5	52.2	25	95
Minimum	0.02	0.42	0.1	4.6	0	52
Maximum	0.2	0.55	43.5	43.5	26	95
Average	0.15	0.45	32.3	40.93	23	77
Standard Deviation	0.05	0.02	11.39	3.2	3	11.5

Outfall 002A, Monthly Reporting						
Monitoring Period End Date	Total Residual Chlorine	Ferrous Sulfate	Flow		Temperature	
	mg/L		MGD		degree F	
	Daily Max	Daily Max	Monthly Average	Daily Max	Difference between Intake and Discharge	Water Temp
# of Measurements	270	112	277	277	277	277
# of Exceedances	0	1	0	0	1	0

Outfall 003A, Monthly Reporting						
Monitoring Period End Date	Total Residual Chlorine	Ferrous Sulfate	Flow		Temperature	
	mg/L		MGD		degree F	
	Daily Max	Daily Max	Monthly Average	Daily Max	Difference between Intake and Discharge	Water Temp
Existing Permit Limit	0.2	0.5	50.2	50.2	25	95
Minimum	0.01	0.4	1.3	24.4	10	22
Maximum	0.2	0.48	41.8	43.5	31	95
Average	0.17	0.45	35.4	41.52	23	77.6
Standard Deviation	0.04	0.02	9.41	1.7	2	11.4
# of Measurements	273	113	280	280	280	280
# of Exceedances	0	0	0	0	13	0

Outfall 004A, Monthly Reporting						
Monitoring Period End Date	Total Residual Chlorine	Ferrous Sulfate	Flow		Temperature	
	mg/L		MGD		degree F	
	Daily Max	Daily Max	Monthly Average	Daily Max	Difference between Intake and Discharge	Water Temp
Existing Permit Limit	0.2	0.5	50.2	50.2	25	95
Minimum	0	0.39	0.6	20.9	8	25
Maximum	0.2	0.49	41.8	41.8	28	97
Average	0.14	0.45	33.98	41.53	22.94	76.91
Standard Deviation	0.05	0.02	11.39	1.84	2.61	11.71
# of Measurements	266	113	281	281	279	281
# of Exceedances	0	0	0	0	12	1

Outfall 006A, Monthly Reporting			
Monitoring Period End Date	Total Flow	pH	
	GPD	SU	
	Daily Max	Daily Min	Daily Max
Existing Permit Limit	Report	6.5	8
Minimum	3	6	6
Maximum	15000	10	10
Average	1509	9	9
Standard Deviation	3738	1.2	1.2
# of Measurements	23	23	23

Outfall 006A, Monthly Reporting			
Monitoring Period End Date	Total Flow	pH	
	GPD	SU	
	Daily Max	Daily Min	Daily Max
# of Exceedances	N/A	1	18

Outfall 0011A, Monthly Reporting								
Monitoring Period End Date	Flow		Oil & Grease		pH		Rain pH	
	GPD		mg/L		SU			
	Monthly Average	Daily Max	Monthly Average	Daily Max	Daily Min	Daily Max	Daily Min	Daily Max
Existing Permit Limit	115,000	230,000	15	20	6.5	8	Report	Report
Minimum	1349	8542	0	0	6.5	6.5	2.8	4.2
Maximum	108959	238801	19	19	7.7	7.7	5.8	7.8
Average	44039	74903	2	2	7	7	4	5
Standard Deviation	30698	32098	3	3	0	0	1	1
# of Measurements	278	278	198	198	278	278	279	279
# of Exceedances	4	0	0	0	0	0	N/A	N/A

Outfall 013A - Monthly Reporting					
	Flow	pH		Rain pH	
	GPD	SU			
Monitoring Period End Date	Daily Max	Daily Max	Monthly Average	Daily Max	Monthly Average
Existing Permit Limit	Report	Report	Report	Report	Report
Minimum	4800	4.9	5.1	4.3	4.4
Maximum	60000	7	7.3	5.9	6.1
Average	23363	5.8	6	5.2	5.4

Outfall 013A - Monthly Reporting					
	Flow	pH		Rain pH	
	GPD	SU			
Monitoring Period End Date	Daily Max	Daily Max	Monthly Average	Daily Max	Monthly Average
Standard Deviation	22210	0.7	0.8	0.5	0.5
# of Measurements	9	9	9	9	9
# of Exceedances	N/A	N/A	N/A	N/A	N/A

Outfall 015A, Monthly Reporting						
Monitoring Period End Date	Flow		Oil & Grease		pH	
	GPD		mg/L		SU	
	Monthly Average	Daily Max	Monthly Average	Daily Max	Daily Min	Daily Max
Existing Permit Limit	61800	85300	15	20	6.5	8
Minimum	304	9120	5.2	5.2	6.5	7.8
Maximum	43540	43540	5.2	5.2	7	8
Average	21922	26330	N/A	N/A	6.75	7.9
Standard Deviation	30572	24339	N/A	N/A	0	0
# of Measurements	2	2	1	1	2	2
# of Exceedances	0	0	0	0	0	0

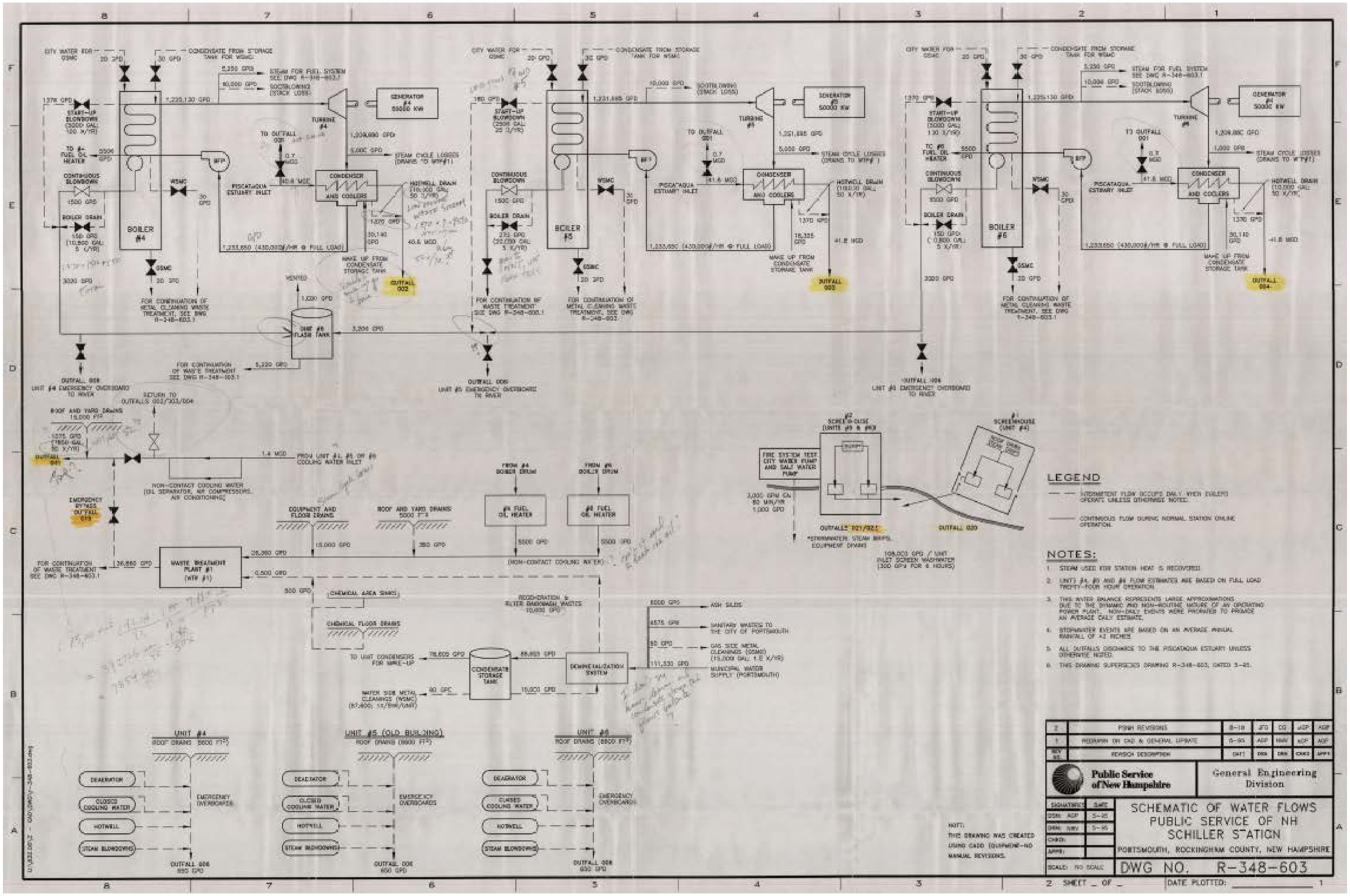
Outfall 016A, Monthly Reporting										
Monitoring Period End Date	Total Copper	Flow		Total Iron	Oil & Grease		pH		TSS	
	mg/L	GPD		mg/L			SU		mg/L	
	Daily Max	Monthly Average	Daily Max	Daily Max	Monthly Average	Daily Max	Daily Min	Daily Max	Monthly Average	Daily Max
Existing Permit Limit	1	216000	360000	1	15	20	6.5	8	30	100
Minimum	0	33270	65614	0.03	0	0	6.5	7.3	0	1.4
Maximum	0.4	100155	194532	1.3	10.6	17	6.8	8	14.5	52.8
Average	0.06	65413	115038	0.5	1.5	3.24	6.5	8	4.75	8.42
Standard Deviation	0.05	14025	19225	0.2	2	3.59	0.1	0.1	2.43	6.09
# of Measurements	305	282	282	282	428	403	282	282	286	282
# of Exceedances	0	0	0	1	0	0	0	0	0	0

Outfall 017A, Monthly Reporting									
Monitoring Period End Date	Total Copper	Flow	Total Iron	Oil & Grease		pH		TSS	
	mg/L	GPD	mg/L			SU		mg/L	
	Daily Max	Daily Max	Daily Max	Monthly Average	Daily Max	Daily Min	Daily Max	Monthly Average	Daily Max
Existing Permit Limit	1	360000	1	15	20	6.5	8	30	100
# of Measurements	1	1	1	1	1	1	1	1	1
# of Exceedances	0	0	0	0	0	0	0	0	0

Outfall 018A, Monthly Reporting								
Monitoring Period End Date	Flow		Oil & Grease		pH		pH of Rain	
	GPD		mg/L		SU		SU	
	Monthly Average	Daily Max	Monthly Average	Daily Max	Daily Min	Daily Max	Daily Min	Daily Max
Existing Permit Limit	300000	600000	15	20	6.5	8	Report	Report
Minimum	400	56	0	0	5.7	5.9	2.8	4.2
Maximum	19430549	432154	12.4	12.4	7.8	7.9	5.8	7.8
Average	82858	77332	1	1	7	7	4	5
Standard Deviation	1164632	53806	2	2	0	0	1	1
# of Measurements	278	278	265	265	265	265	278	278
# of Exceedances	1	0	0	0	6	0	N/A	N/A

Outfall 019A, 020A, 021A, 022A - Monthly Reporting				
Monitoring Period End Date	Flow 019A	Flow 020A	Flow 021A	Flow 022A
	GPD			
	Daily Max			
Existing Permit Limit	108000	108000	108000	108000
Minimum	8400	24	2688	8400
Maximum	16800	106960	100800	26880
Average	12600	14099	26747	13439
Standard Deviation	4277	16794	24439	8304
# of Measurements	28	274	279	55
# of Exceedances	0	0	0	0

ATTACHMENT C – FLOW SCHEMATIC



ATTACHMENT D – EFH ASSESSMENT

Under the 1996 Amendments (PL 104-297) to the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. § 1801 et seq. (1998)), EPA is required to consult with the National Marine Fisheries Service (NOAA Fisheries) if EPA's actions, or proposed actions that EPA funds, permits, or undertakes, "may adversely impact any essential fish habitat." 16 U.S.C. § 1855(b). The Amendments broadly define essential fish habitat (EFH) as, "... those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." 16 U.S.C. § 1802(10). Adverse effect means any impact which reduces the quality and/or quantity of EFH. 50 C.F.R. § 600.910(a). Adverse effects may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey, reduction in species' fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions. Id.

EFH is only designated for species for which federal Fishery Management Plans exist (16 U.S.C. § 1855(b)(1)(A)). EFH designations were approved for New England by the U.S. Department of Commerce on March 3, 1999.

Schiller Station withdraws water from and discharges effluent to the lower Piscataqua River. The Piscataqua River is a high value habitat for a variety of marine and estuarine species, and serves as the only conduit between the Gulf of Maine and Great Bay Estuary. While some fish species permanently reside in the river, most use it to either access spawning or nursery habitats in the Great Bay Estuary and associated rivers, or to migrate from these areas to marine habitats in the Gulf of Maine and beyond. Still others are seasonally present, preying on the concentrated but temporal influx of migrating forage species. The table below lists the 17 EFH fish species located in the vicinity of Schiller Station (NMFS Habitat Division).

EFH Species Located in the Vicinity of Schiller Station

Species	Eggs	Larvae	Juveniles	Adults	Spawning Adults
Atlantic salmon *(Salmo salar)*			F,M		
Atlantic cod *(Gadus morhua)*	S	S			
haddock *(Melanogrammus aeglefinus)*	S	S			
pollock *(Pollachius virens)*	S	S	S		
red hake *(Urophycis chuss)*			S	S	
white hake *(Urophycis tenuis)*	S		S	S	
redfish *(Sebastes fasciatus)*	n/a				
winter flounder *(Pleuronectes americanus)*	M,S	M,S	M,S	M,S	M,S
yellowtail flounder *(Pleuronectes ferruginea)*	S	S			

Species	Eggs	Larvae	Juveniles	Adults	Spawning Adults
windowpane flounder *(Scopthalmus aquosus)*	S	S	S	S	S
Atlantic halibut *(Hippoglossus hippoglossus)*	S	S	S	S	S
Atlantic sea herring *(Clupea harengus)*		M,S	M,S		
bluefish *(Pomatomus saltatrix)*			M,S	M,S	
long finned squid *(Loligo pealei)*	n/a	n/a			
short finned squid *(Illex illecebrosus)*	n/a	n/a			
Atlantic mackerel *(Scomber scombrus)*	M,S	M,S	S		
spiny dogfish *(Squalus acanthias)*	n/a	n/a			

S = The EFH designation for this species includes the seawater salinity zone of this bay or estuary (salinity > or = 25.0%).

M = The EFH designation for this species includes the mixing water/ brackish salinity zone of this bay or estuary (0.5% < salinity < 25.0%).

F = The EFH designation for this species includes the tidal freshwater salinity zone of this bay or estuary (0.0% < or = salinity < or = 0.5%).

n/a = These species do not have this lifestage in its life history (dogfish/ redfish), or has no EFH designation for this lifestage (squids). With regard to the squids, juvenile corresponds with pre-recruits, and adult corresponds with recruits in these species' life histories.

These EFH designations of estuaries and embayments are based on the NOAA Estuarine Living Marine Resources (ELMR) program (Jury et al. 1994; Stone et al. 1994).

Facility Description

Schiller Station, located on the southwestern bank of the Piscataqua River in Portsmouth, New Hampshire, is a four-unit, 163 megawatt (MW) steam electric generating facility. The three main generators are designated as 4, 5, and 6; all rated at 48 MW each. Units 4 and 6 are equipped with dual fuel boilers capable of firing both pulverized bituminous coal and #6 fuel oil. Unit 5 was converted to a dual fuel fluidized bed boiler that is capable of burning both wood and coal, with wood being its primary fuel. The remaining unit, designated CT-1, is a 19 MW combustion turbine fired with #1 fuel oil that is typically operated during periods of highest seasonal peak demand. Schiller Station is a base load plant and generates upwards of 1 million MW-hrs annually, with a third of the power being provided by a renewable energy resource. Schiller Station produces enough energy to supply 65,000 New Hampshire homes. However, operations over the past few years have been significantly reduced in the 2 coal-burning units (Units 4 and 6).

Schiller Station's current National Pollutant Discharge Elimination System (NPDES) Permit allows the withdrawal of cooling water from and the discharge of pollutants to the Piscataqua

River. See Attachment A of the fact sheet, showing a map of the facility including outfall locations. The Station is permitted to discharge non-contact cooling water, operational plant wastewater, process water, and runoff. The majority of stormwater runoff on the site is commingled with other non-stormwater waters, so much of the runoff is regulated under the individual permit. For any stormwater that is directly discharged, a Stormwater Prevention Pollution Plan has been drafted and a NOI will be filed to cover these outfalls under a Multi-Sector General Storm Water Permit.

Schiller Station operates two intake structures that withdraw water directly from the Piscataqua River. Each intake structure has two openings which provide cooling water to the two circulation pumps. Unit 4 has a submerged offshore intake pipe that is 6.5 feet in diameter. The opening is located 32 feet out into the river and is equipped with a course mesh (12 inch by 12 inch grating) stationary bar rack to prevent large debris from entering the intake. In addition, there is another fixed screen at the bottom of the tunnel entrance to divert lobsters from crawling into the intake. PSNH reports that the through-screen velocity is 1.38 fps at mean low water (MLW). However, the intake velocity at the tunnel entrance is 1.97 fps. Enercon, 2013, p.6.

The four screen openings used for Units 5 and 6 are approximately 5.5-feet wide each. The openings are protected by bar racks with 4 3/8-inch by 4 inch gratings. Enercon, 2008, p. 5. Furthermore, the through-screen velocities of these two units is 0.68 feet per second (ft/sec or fps). *Id*., p. 12.

Schiller Station still utilizes the same traveling screen design and technology that was originally installed with each unit: Unit 4 in 1952, Unit 5 in 1955, and Unit 6 in 1957. The mesh size of the traveling screens is 3/8-inch square, which is a size commonly used in the industry for CWIS screens. This mesh size should be small enough to prevent the entrainment of adult fish and most juvenile fish through the plant's cooling water system, but not younger and smaller lifestages (*i.e.*, eggs and larvae). In addition, narrow shelves (2–3 inches wide) are attached to the screens which carry debris and fish up as the screen rotates. These shelves are designed primarily for moving debris, not fish. Since there are no buckets or troughs used to carry fish safely to the fish return trough, fish can fall off the screen shelves as the screens emerge from the water. Consequently, fish can suffer injury or exhaustion from being dropped and re-impinged as the screens rotate.

Schiller Station maintains 16 permitted outfalls. A detailed description of each discharge is found in Section 6.3 of the Fact Sheet.

Potential Impacts to EFH Species from Schiller Station Effluent

The Schiller Station Facility, like all facilities that utilize a natural waterbody for cooling purposes, can impact aquatic resources in three major ways:

- *Entrainment* of small organisms into and through the cooling water system;
- *Impingement* of larger organisms on the intake screens; and
- *Discharge of effluent* creating adverse conditions in receiving waters.

The following discusses these three potential impacts.

Entrainment

The potential to impact aquatic organisms by entrainment largely depends on the presence and abundance of organisms that are vulnerable to entrainment, and the flow required for cooling. The EFH resources (including forage species) most vulnerable to entrainment in the vicinity of Schiller Station are species that have positively buoyant eggs, and/or pelagic larvae. Other important considerations include the location and design of the intake structure. According to Section 316(b) of the Clean Water Act, any point source that uses a cooling water intake structure must ensure that its location, design, construction, and capacity reflects the best technology available (BTA) for minimizing adverse environmental impact.

Entrainment monitoring was conducted at Schiller Station for 41 weeks over a 13-month period with the following frequency. Samples were collected 1 day a week from January 2007 to March 2007 and June 2007 to September 2007. From September 2006 to December 2006 and from April to May 2007, samples were collected every other week.

Sorting, species and life stage identification and enumeration were all completed to generate entrainment rates (# of eggs or larvae per volume of water). Entrainment losses were calculated by multiplying the entrainment rate by the weekly plant cooling water flow.

At Schiller Station, entrainment losses of ichthyoplankton peaked in July, with a much smaller peak in the winter (January-March). Cunner eggs accounted for a large percentage of the losses in the July period (Normandeau, 2008). The peak in entrainment losses in the winter was comprised of winter spawners, such as American sand lance and rock gunnel (Normandeau, 2008). Macrocrustacean entrainment losses also peaked in July and were essentially almost non-existent during spring, fall and winter.

The table below presents entrainment losses by species (adjusted raw numbers at design flow);

Estimated Annual Entrainment Losses for Fish from Schiller Station

Common Name	Eggs & Larvae
Alligator fish	134,305
American eel	8,420
American plaice	1,061,867
American sand lance	13,677,174
Atlantic cod*****	329,888
Atlantic cod*****/haddock*****	161,177
Atlantic cod*****/haddock*****/witch flounder	344,498
Atlantic herring*****	1,921,628
Atlantic mackerel*****	5,846,389
Atlantic menhaden	633,228
Atlantic seasnail	389,677
Atlantic tomcod	53,043
Cunner	32,539,552
Cunner/yellowtail flounder	72,955,812

Common Name	Eggs & Larvae
Fourbeard rockling	1,723,189
Fourbeard rockling/hake	6,394,256
Goosefish	135,665
Grubby	3,393,233
Gulf snailfish	21,770
Haddock*	7,072
Hake family*	1,397,166
Longhorn sculpin	424,745
Northern pipefish	716,836
Pollock*	661,273
Radiated shanny	201,269
Rainbow smelt	1,752,755
Rock gunnel	7,634,337
Sculpin family	59,139
Sea raven	13,329
Sea robin family	71,494
Shorthorn sculpin	93,113
Silver hake	275,997
Striped killifish	8,420
Summer flounder	11,904
Tautog	56,294
Unidentified	246,244
Windowpane*	547,224
Winter flounder*	372,846
Witch flounder	17,617
Wrymouth	5,790
Total Entrainment	**156,179,633**

*Indicates EFH species

According to entrainment monitoring at Schiller Station, the early life stages (ELS) of eight (8) EFH species were entrained at the facility.

Section 8.2.3 of the Fact Sheet contains a complete discussion of entrainment mortality impacts from Schiller Station operation.

Finfish Entrainment Mitigation

As part of the proposed permit Best Technology Available (BTA) requirements, EPA has identified the following technology to further mitigate ELS finfish losses, including EFH species, from current expected entrainment mortality levels at the cooling water intake structure (CWIS).

EPA proposes the installation of wedgewire screen intake structures with a mesh or slot size of 0.80 mm, 0.69 mm, or 0.60 mm to maintain an intake through-screen velocity of 0.5 fps or less. These slot sizes are estimated to reduce finfish ELS entrainment by approximately 37%, 44%

and 49% from current levels, respectively. The actual screen slot size selected will be subject to EPA approval and based upon the results of the Facility's pilot testing and demonstration report submitted to the agencies.

In addition, EPA proposes that the annual maintenance outage at Unit 5, when no water is withdrawn, take place in June. This is estimated to reduce finfish ELS entrainment mortality by another 4% from current levels.

The proposed BTA will also reduce the entrainment levels of macrocrustacean ELS, which are a food source for EFH species. Section 10 of the fact sheet includes a full discussion of a number of potential mitigation measures and their expected reduction of finfish as well as macrocrustacean ELS entrainment mortality.

In summary, EPA proposes permit requirements that are estimated to reduce finfish ELS entrainment, including the eight EFH species, by approximately 41% to 53%, depending on the slot size selected.

Impingement

Organisms that have grown to a size too large to pass through intake screens are still vulnerable to being impinged on these screens. Juvenile lifestages are particularly vulnerable to impingement, but adults of certain species are also at risk. As with entrainment, the intake location, design and cooling water flow requirements are major factors in assessing impingement potential.

Fish species that are especially vulnerable to impingement tend to have one or more of the following characteristics:

- pass intake structure in large, dense schools as juveniles or adults;
- are actively pursued as major forage species;
- are attracted to the intake structure as a source of forage or refuge;
- are slow moving or are otherwise unable to escape intake current; and
- are structurally delicate, and likely to die if impinged.

Fish for impingement sampling were collected in the fish and debris return sluice coming off of the traveling screens for each unit. Impingement sampling was conducted from August 31, 2006, through September 27, 2007. Impingement samples were collected over a continuous 24 hour period, once a week for 57 consecutive weeks. Each individual sample represented a six hour collection period. Impingement sampling was only conducted when the plant was operational. Operational is defined as having at least 1 circulating pump running at the time of sampling.

Schiller Station conducted an impingement collection efficiency study to determine what percentage of impinged fish on the screens they were able to collect within the fish return sluice as well as an impingement survival study.

Fish impingement losses peaked in April, with secondary peaks in the fall and early winter.

White hake, Atlantic herring and cunner were fish exhibiting the highest impingement losses in April (Normandeau, 2008). In the fall, rainbow smelt, grubby and white hake were the species with the highest impingement losses (Normandeau, 2008).

The table below presents entrainment losses by species (adjusted raw numbers at design flow);

Estimated Annual Fish Impingement Losses from Schiller Station

Common Name	Fish Impinged
Alewife	25
American sand lance	9
Atlantic cod*	38
Atlantic herring*	297
Atlantic menhaden	328
Atlantic silverside	122
Atlantic tomcod	50
Blueback herring	68
Bluegill	64
Cunner	668
Emerald shiner	33
Grubby	491
Herring family*	9
Inland silverside	16
Lumpfish	357
Ninespine stickleback	149
Northern pipefish	621
Pollock*	25
Pumpkinseed	9
Rainbow smelt	622
Red hake*	9
Roch gunnel	26
Sea raven	16
Shorthorn sculpin	8
Silver hake	9
Skate family	17
Striped bass	25
Tautog	9
Threespine stickleback	53
Unidentifiable	0
White hake*	736
White perch	198
Windowpane*	75
Winter flounder*	573
Total Impingement	**5,557**

*Indicates EFH species

According to impingement monitoring at Schiller Station, adult and juvenile life stages of seven (7) EFH species were impinged at the facility.

Section 8.2.3 of the Fact Sheet contains a complete discussion of impingement mortality impacts from Schiller Station operation.

Finfish Impingement Mitigation

As part of the proposed permit Best Technology Available (BTA) requirements, EPA has identified the following technology to further mitigate adult and juvenile finfish losses, including EFH species, from current expected impingement mortality levels at the cooling water intake structure (CWIS).

EPA proposes the installation of wedgewire screen intake structures with a mesh or slot size of 0.80 mm, 0.69 mm, or 0.60 mm to maintain an intake through-screen velocity of 0.5 fps or less. These slot sizes are estimated to reduce adult and juvenile finfish impingement by approximately 87% from current levels.

Discharge of Heated Effluent

The discharge of heated effluent may kill or impair organisms outright, or create intolerable conditions in otherwise high value habitats, and interfere with spawning. Thermal impacts associated with the discharge are related primarily to the dilution capacity of the receiving water, the rate of discharge, and the change in temperature (delta-T or ΔT) of the effluent compared to ambient water temperatures. Another important consideration is the presence of temperature-sensitive organisms and vegetated habitats.

As discussed in detail in Section 6.4 of the Fact Sheet, Schiller Station's existing permit's thermal discharge requirements are based on a CWA § 316(a) variance. The Facility initially requested that its new permit retain the same thermal discharge limits based on a renewal of its CWA § 316(a) variance. Schiller's request maintains, in essence, that the Facility's existing thermal discharge has not caused appreciable harm to the BIP and, indeed, could not have caused such harm given how small it is relative to the large volume and cold temperatures of the waters of the Piscataqua River estuary.

Based on the analysis of thermal plume monitoring and mapping data collected in the summer and fall of 2010, along with other supporting information (see Section 6.4.4. of the Fact Sheet), EPA concludes that Schiller Station's existing thermal discharge has not caused appreciable harm to the BIP. Moreover, EPA concludes that the record provides reasonable assurance that with the same thermal discharge limits in place, the Facility's thermal discharge will not cause such harm to the BIP in the future – in other words, will allow for the protection and propagation of the BIP. Indeed, the Facility's declining capacity factors indicate that, if anything, Schiller Station's thermal discharges will decrease overall in the future, though EPA cannot be sure of whether or when such reductions may occur.

Thus, EPA's new draft permit for Schiller Station proposes to retain the thermal discharge limits from the existing permit.

- A daily maximum discharge temperature limit (Max-T) of 95ºF;

- A daily maximum temperature differential between the intake and discharge temperatures (Delta-T) of 25ºF (this limit is increased to 30ºF for a two-hour period during condenser maintenance); and

- A prohibition of discharges that cause the receiving water to exceed a maximum temperature of 84°F at any point beyond a distance of 200 feet in any direction from the point of discharge.

Consistent with the Facility's request, EPA is proposing to issue these permit limits pursuant to a variance under CWA § 316(a).

Proposed Limits on Other Pollutants

The Draft Permit also proposes limits on the following pollutants:

Effluent Characteristic	Average Monthly	Maximum Daily
Total Residual Chlorine	---	0.2 mg/L
Oil and Grease	15 mg/L	20 mg/L
Total Suspended Solids (TSS)	30 mg/L	100 mg/L
Total Copper	1.0 mg/L	1.0 mg/L
Total Iron	1.0 mg/L	1.0 mg/L
pH	6.5 – 8.0 S.U. (range)	

These limits are calculated to meet water quality standards and protect all aquatic organisms in the receiving water, including EFH species.

EPA's Finding of all Potential Impacts to EFH Species

- This Draft Permit action does not constitute a new source of pollutants. It is the reissuance of an existing NPDES permit;
- The BTA requirements of the CWIS are estimated to reduce entrainment impacts by 41 to 53% and reduce impingement impacts by 87%;
- Thermal discharge from the facility is limited to 95°F and satisfies a CWA § 316(a) variance with a limited mixing zone;
- Effluent is discharged into the Piscataqua River, with rapid mixing characteristics from the high energy tidal exchange;
- Chlorine, oil and grease, TSS, total copper, total iron and pH are regulated by the Draft Permit to meet water quality standards;
- The Draft Permit prohibits the discharge of pollutants or combination of pollutants in toxic amounts;
- The effluent limitations and conditions in the Draft Permit were developed to be protective of all aquatic life; and
- The Draft Permit prohibits violations of the state water quality standards.

EPA believes that the conditions and limitations contained within the Schiller Station Draft Permit adequately protects all aquatic life, including those with designated EFH in the receiving water, and that further mitigation is not warranted. Should adverse impacts to EFH be detected as a result of this permit action, or if new information is received that changes the basis for EPA's conclusions, NMFS will be contacted and an EFH consultation will be re-initiated.
As part of the renewal of the NPDES permit for this facility, EPA has made the Draft Permit and the Fact Sheet available to NMFS. In addition, a letter will be sent under separate cover to NMFS Habitat Division to satisfy EPA's notification responsibility regarding EFH.

ATTACHMENT E – ESA ASSESSMENT

Section 7(a) of the Endangered Species Act of 1973, as amended (ESA) grants authority to and imposes requirements upon Federal agencies regarding endangered or threatened species of fish, wildlife, or plants ("listed species") and habitat of such species that has been designated as critical (a "critical habitat"). The ESA requires every Federal agency, in consultation with and with the assistance of the Secretary of Interior, to insure that any action it authorizes, funds, or carries out, in the United States or upon the high seas, is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. The United States Fish and Wildlife Service (USFWS) administers Section 7 consultations for freshwater species. The National Marine Fisheries Service (NMFS) administers Section 7 consultations for marine species and anadromous fish.

EPA has reviewed the federal endangered or threatened species of fish, wildlife, or plants to determine if any listed species might potentially be impacted by the re-issuance of the Schiller Station NPDES permit. The two listed species that have the potential to be present in the vicinity of Schiller Station (the Facility) are the shortnose sturgeon (*Acipenser brevirostrum*) and the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*).

Shortnose sturgeon

The shortnose sturgeon was placed on the original endangered species list in 1967 [32 Fed. Reg. 4001 (1967)] by the USFWS. Currently, NMFS has authority over this species under Section 4(a) (2) of the ESA, 16 U.S.C. Section 1533 (a) (2). At present, there are 19 recognized distinct population segments (Shortnose Sturgeon Recovery Plan, NMFS, 1998), which all remain listed as endangered.

The Shortnose Sturgeon Recovery Plan states that “There are no known shortnose sturgeon populations in the rivers between the Androscoggin and Merrimack rivers.” However, information contained in the NMFS Protected Resources website at http://www.nmfs.noaa.gov/pr/species/fish/shortnosesturgeon.htm lists the shortnose sturgeon as occurring in the Piscataqua River. In addition, the Atlantic States Marine Fisheries Commission, *Atlantic Sturgeon Stock Assessment*, *Peer Review Report*, March 1998, reported that “… two captures of shortnose sturgeon have been documented [in the Piscataqua River] (New Hampshire Fish & Game, 1989).”

In order to obtain the most up-to-date assessment regarding the occurrence of shortnose sturgeon in the Piscataqua River, EPA contacted NMFS directly. As part of a communication with NMFS for the Dover Wastewater Treatment Facility (WWTF), NMFS reported that shortnose sturgeon are not known to utilize the portion of the Piscataqua River in the vicinity of the Dover WWTF (e-mail from C. Vaccaro, NMFS to D. Arsenault, EPA, September 12, 2011). Since Schiller Station is approximately five and a half miles downstream of the Dover WWTF, shortnose sturgeon are not expected to be present in the vicinity of this facility either.

Based on this evaluation and the expected distribution of the species, EPA has determined that there are no shortnose sturgeons in the action area and that the reissuance of the permit will have no effect on the species. Therefore, consultation under Section 7 of the ESA with NMFS for shortnose sturgeon is not required.

Atlantic Sturgeon

On February 6, 2012, NOAA's Fisheries Service published in the federal register a final decision to list five distinct population segments of Atlantic sturgeon under the Endangered Species Act. The Chesapeake Bay, New York Bight, Carolina, and South Atlantic populations of Atlantic sturgeon were listed as endangered, while the Gulf of Maine population was listed as threatened. The decision became effective on April 6, 2012. Atlantic sturgeon found in the Piscataqua River are part of the Gulf of Maine population and therefore listed as threatened. The Atlantic States Marine Fisheries Commission, *Atlantic Sturgeon Stock Assessment*, *Peer Review Report*, March 1998, reported that, "An occasional Atlantic sturgeon (Hoff 1980) has been captured in the Piscataqua River…" However, since 1990, NH F&G has not observed or received any reports of Atlantic sturgeon of any age-class being captured in the Great Bay Estuary and its tributaries (B. Smith, NH F&G, Pers. Comm. to the Atlantic Sturgeon Status Review Team, 2006). The Atlantic Sturgeon Status Review Team and NH F&G biologists concluded that the Great Bay Atlantic sturgeon population is likely extirpated. *See* Atlantic Sturgeon Status Review Team. 2007. Status Review of Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus). Report to National Marine Fisheries Service, Northeast Regional Office. February 23, 2007. 174 pp.

As part of a more recent communication with NMFS for the Dover WWTF, NMFS reported that Atlantic sturgeon do in fact use the portion of the Piscataqua River in the vicinity of the Dover WWTF (E-mail from C. Vaccaro, NMFS to D. Arsenault, EPA, September 12, 2011). Since Schiller Station is approximately five and a half miles downstream of the Dover WWTF, Atlantic sturgeon are expected to be present in the vicinity of this facility as well.

Based on this information and the expected distribution of the species, EPA has determined that Atlantic sturgeon may be present in the action area and this species may be affected by the discharges authorized by the proposed permit. EPA must consult with NMFS under Section 7 of the ESA. EPA has evaluated the potential impacts of the permit action on Atlantic sturgeon. On the basis of this evaluation, which is discussed below, EPA's determination is that this action "is not likely to adversely affect listed species or critical habitat." [56] 16 C.F.R. § 402.13(a). As a result, based on the justification contained in this attachment and a letter sent to NMFS under separate cover, request NMFS's written concurrence with EPA's determination in order to complete the consultation with NMFS on an "informal" basis. *See* 16 C.F.R. § 402.13(a). If NMFS does not concur, then a "formal consultation" will be necessary.

Receiving Water Description

Schiller Station withdraws water from and discharges effluent to the lower Piscataqua River.

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[56] A project can be considered "unlikely to adversely affect" a listed species "when direct or indirect effects of the proposed project on listed species are expected to be discountable, insignificant or completely beneficial." August 20, 2009, Letter from Patricia A. Kurkul, Regional Administrator, NOAA, National Marine Fisheries Service, Northeast Region, to Melville P. Cote, EPA Region 1 ("NOAA's August 20, 2009, Rockport Consultation Letter") (addressing ESA issues concerning EPA's proposed NPDES permit for the Rockport, MA, POTW).

The Piscataqua River is high value habitat for a variety of marine and estuarine species, and serves as the only conduit between the Gulf of Maine and Great Bay Estuary. While some fish species permanently reside in the river, most use it to either access spawning or nursery habitats in the Great Bay Estuary and associated rivers, or to migrate from these areas to marine habitats in the Gulf of Maine and beyond. Still others are seasonally present, preying on the concentrated but temporal influx of migrating forage species.

The Piscataqua is a tidal river approximately 13 miles long, which empties into Portsmouth Harbor/ Atlantic Ocean. The tide in this river is semi-diurnal with an average period of 12.4 hours. The lower portion of the Piscataqua River has been characterized as a well-mixed estuary. Tidal flushing requires six to 12 tidal cycles (3 to 6 days) and tidal mixing forces cause the water column to be vertically well mixed.

The Piscataqua River is classified as a Class B water body pursuant to the State of New Hampshire Surface Water Quality Regulations (N.H. Code of Administrative Rules, PART Env-Wq 1703.01) and N.H. RSA 485-A:8. Class B waters are "considered as being acceptable for fishing, swimming and other recreational purposes and, after adequate treatment, for use as water supplies." (RSA 485-A:8, II)

Section 303(d) of the Federal Clean Water Act (CWA) requires states to identify those water-bodies that are not expected to meet surface water quality standards after the implementation of technology-based controls and, as such require the development of total maximum daily loads (TMDL). The section of the Piscataqua River that Schiller Station discharges into is on the 2010, CWA 303(d) list for polychlorinated biphenyls (PCB's), mercury and dioxin.

Facility Description

Schiller Station, located on the southwestern bank of the Piscataqua River in Portsmouth, New Hampshire, is a four-unit, 163 megawatt (MW) steam electric generating facility. The three main generators are designated as 4, 5, and 6; all rated at 48 MW each. Units 4 and 6 are equipped with dual fuel boilers capable of firing both pulverized bituminous coal and #6 fuel oil. Unit 5 was converted to a dual fuel fluidized bed boiler that is capable of burning both wood and coal, with wood being its primary fuel. The remaining unit, designated CT-1, is a 19 MW combustion turbine fired with #1 fuel oil that is typically operated during periods of highest seasonal peak demand. Schiller Station is a base load plant and generates upwards of 1 million MW-hrs annually, with a third of the power being provided by a renewable energy resource. Schiller Station produces enough energy to supply 65,000 New Hampshire homes. However, operations over the past few years have been significantly reduced in the 2 coal-burning units (Units 4 and 6).

Schiller Station's current National Pollutant Discharge Elimination System (NPDES) Permit allows the withdrawal of cooling water from and the discharge of pollutants to the Piscataqua River. See Attachment A of the fact sheet, showing a map of the facility including outfall locations. The Station is permitted to discharge non-contact cooling water, operational plant wastewater, process water, and runoff. The majority of stormwater runoff on the site is commingled with other non-stormwater waters, so much of the runoff is regulated under the individual permit. For any stormwater that is directly discharged, a Stormwater Prevention Pollution Plan has been drafted and a NOI will be filed to cover these outfalls under a Multi-Sector General Storm Water Permit.

Schiller Station operates two intake structures that withdraw water directly from the Piscataqua River. Each intake structure has two openings which provide cooling water to the two circulation pumps. Unit 4 has a submerged offshore intake pipe that is 6.5 feet in diameter. The opening is located 32 feet out into the river and is equipped with a course mesh (12 inch by 12 inch grating) stationary bar rack to prevent large debris from entering the intake. In addition, there is another fixed screen at the bottom of the tunnel entrance to divert lobsters from crawling into the intake. PSNH reports that the through-screen velocity is 1.38 fps at mean low water (MLW). However, the intake velocity at the tunnel entrance is 1.97 fps. Enercon, 2013, p.6.

The four screen openings used for Units 5 and 6 are approximately 5.5-feet wide each. The openings are protected by bar racks with 4 3/8-inch by 4 inch gratings. Enercon, 2008, p. 5. Furthermore, the through-screen velocities of these two units is 0.68 feet per second (ft/sec or fps). *Id*., p. 12.

Schiller Station still utilizes the same traveling screen design and technology that was originally installed with each unit: Unit 4 in 1952, Unit 5 in 1955, and Unit 6 in 1957. The mesh size of the traveling screens is 3/8-inch square, which is a size commonly used in the industry for CWIS screens. This mesh size should be small enough to prevent the entrainment of adult fish and most juvenile fish through the plant's cooling water system, but not younger and smaller lifestages (*i.e.*, eggs and larvae). In addition, narrow shelves (2–3 inches wide) are attached to the screens which carry debris and fish up as the screen rotates. These shelves are designed primarily for moving debris, not fish. Since there are no buckets or troughs used to carry fish safely to the fish return trough, fish can fall off the screen shelves as the screens emerge from the water. Consequently, fish can suffer injury or exhaustion from being dropped and re-impinged as the screens rotate.

Schiller Station maintains 16 permitted outfalls. A detailed description of each discharge is found in Section 6.3 of the Fact Sheet.

Action Area of Schiller Station Effluent

As described in detail in Section 6.4.4. of the Schiller Station Fact Sheet, EPA performed an analysis to determine the volume and configuration of the thermal plume that is discharged from outfalls 001, 002, 003 and 004. EPA used temperature data collected in the summer and fall of 2010 from eleven fixed monitoring stations placed approximately 200 feet from the four thermal discharge outfalls. Each station collected continuous river temperature data at near-surface, mid-depth and near- bottom positions in the water column. Two monitoring stations were placed well outside the influence of the station discharge (one upstream and one downstream) to collect ambient river temperature data (see Figure 6.1 of the Fact Sheet).

In addition, on August 31, 2010, an EPA field crew recorded river temperatures by conducting multiple transects through the Station's discharge plume while towing a boat mounted temperature sonde. A pressure transducer on the temperature sonde recorded its exact depth as it recorded the temperature measurements. Temperature, depth and GPS positioning data were recorded and stored every 10 seconds during a transect run. Multiple bank-to-bank transects, perpendicular to the flow of the river, as well as down river and up river, were conducted within and outside of the Station's thermal plume. This one-day monitoring effort was designed to be a "snap shot" of thermal plume conditions over a brief time period. Late August was selected for the monitoring effort to capture seasonally high ambient river temperatures along with expected high electric generation by the facility, which would result in near maximum permitted discharge flows and temperatures. This constituted approximate "worst-case" conditions for the receiving water (see Figure 6.2 of the Fact Sheet).

Based on these data sets, EPA confirmed that the receiving water did not exceed a maximum temperature of 84°F at any point beyond a distance of 200 feet in any direction from the thermal discharge outfalls. The selection of 84°F as defining the edge of the mixing zone of the thermal discharge was established in this site-specific case in consultation with the New Hampshire Department of Environmental Services (NHDES) and the New Hampshire Fish and Game Department (NHF&G) to meet state water quality standards. In fact, during the entire three month study (see Table 6-B of the Fact Sheet), temperature data from the fixed monitoring stations did not record a temperature within 5°F of the mixing zone limit. The highest instantaneous maximum temperature recorded during the study was 78.8°F, at one surface station (Station A7). This station was approximately 200 feet directly offshore from outfalls 003 and 004 (see Figure 6.1 of the Fact Sheet). This monitoring station consistently recorded the highest relative temperatures throughout the study. In general, the temperatures recorded at Station A7 were approximately 3.6°F to 5.4°F above ambient river temperatures in most cases, with highs briefly reaching a difference of approximately 7.2°F, likely during slack tide events. The near ambient temperatures recorded throughout the study at the mid-depth and near bottom fixed monitors confirmed that the thermal plume from Schiller Station is a surface feature in the receiving water.

In addition, during the one-day thermal mapping field event, the highest temperature recorded was a surface reading of 82.4°F, noted as a small "hot spot" well within the 200 foot mixing zone. The thermal mapping results (see Figure 6.2), along with the fixed temperature monitoring station data, confirm that the high energy tidal exchange and volume of the Piscataqua River in the vicinity of Schiller Station results in an action area that is confined to the near-surface of the river and encompasses an area approximately 200 feet in all directions from the discharge. While this limited action area is based on an analysis of the thermal component of the Schiller Station's effluent, other pollutants in the draft permit are regulated to meet water quality standards at the point of discharge (unlike the CWA § 316(a) thermal variance). Also, other regulated pollutants at Schiller Station, including total suspended solids and heavy metals, are discharged at much lower flows than the thermal effluent (360,000 gallons per day as opposed to 40 million gallons per day), further reducing the action area of these pollutants before mixing with the Piscataqua River makes their presence in the receiving water insignificant or discountable to protected species.

Potential Impacts to Atlantic Sturgeon from Facility Operation

Schiller Station, like all facilities that utilize a natural waterbody for cooling purposes, can impact aquatic resources in three major ways: (1) by the impingement of larger organisms on the intake screens and the entrainment of small organisms into and through the cooling water system; (2) by creating adverse conditions in the receiving waters from the discharge of heated effluent; and (3) by creating adverse conditions in the receiving waters from the discharge of pollutants. The following information details these three potential impacts.

Impingement

Organisms that have grown to a size too large to pass through intake screens are still vulnerable to being impinged on these screens. Juvenile lifestages are particularly vulnerable to impingement, but adults of certain species are also at risk. As with entrainment, the intake location, design and cooling water flow requirements are major factors in assessing impingement potential.

Fish species that are especially vulnerable to impingement tend to have one or more of the following characteristics:

- pass intake structure in large, dense schools as juveniles or adults;
- are actively pursued as major forage species;
- are attracted to the intake structure as a source of forage or refuge;
- are slow moving or are otherwise unable to escape intake current; and
- are structurally delicate, and likely to die if impinged.

Fish from impingement sampling were collected in the fish and debris return sluice coming off of the traveling screens for each unit. Impingement sampling was conducted from August 31, 2006, through September 27, 2007. Impingement samples were collected over a continuous 24 hour period, once a week for 57 consecutive weeks. Each individual sample represented a six hour collection period. Impingement sampling was only conducted when the plant was operational. Operational is defined as having at least 1 circulating pump running at the time of sampling.

Schiller Station conducted an impingement collection efficiency study to determine what percentage of impinged fish on the screens they were able to collect within the fish return sluice as well as an impingement survival study.

Fish impingement losses peaked in April, with secondary peaks in the fall and early winter. White hake, Atlantic herring and cunner were fish exhibiting the highest impingement losses in April (Normandeau, 2008). In the fall, rainbow smelt, grubby and white hake were the species with the highest impingement losses (Normandeau, 2008).

The table below presents entrainment losses by species (adjusted raw numbers at design flow);

Estimated Annual Fish Impingement Losses from Schiller Station

Common Name	Fish Impinged
Alewife	25
American sand lance	9
Atlantic cod	38

Common Name	Fish Impinged
Atlantic herring	297
Atlantic menhaden	328
Atlantic silverside	122
Atlantic tomcod	50
Blueback herring	68
Bluegill	64
Cunner	668
Emerald shiner	33
Grubby	491
Herring family	9
Inland silverside	16
Lumpfish	357
Ninespine stickleback	149
Northern pipefish	621
Pollock	25
Pumpkinseed	9
Rainbow smelt	622
Red hake	9
Roch gunnel	26
Sea raven	16
Shorthorn sculpin	8
Silver hake	9
Skate family	17
Striped bass	25
Tautog	9
Threespine stickleback	53
Unidentifiable	0
White hake	736
White perch	198
Windowpane	75
Winter flounder	573
Total Impingement	**5,557**

No Atlantic sturgeon were collected as part of the impingement study at Schiller Station. Section 8.2.3 of the Fact Sheet contains a complete discussion of impingement mortality impacts from Schiller Station operation.

Finfish Impingement Mitigation

As part of the proposed permit Best Technology Available (BTA) requirements, EPA has identified the following technology to further mitigate adult and juvenile finfish losses, including the potential for Atlantic sturgeon impacts, from current expected impingement mortality levels at the cooling water intake structure (CWIS).

EPA proposes the installation of wedgewire screen intake structures with a mesh or slot size of

0.80 mm, 0.69 mm, or 0.60 mm to maintain an intake through-screen velocity of 0.5 feet per second (fps) or less. These slot sizes are estimated to reduce adult and juvenile finfish impingement by approximately 87% from current levels. The torpedo shaped intake structures will be installed parallel with the tidal currents of the river, approximately three feet off the bottom. EPA assumes that the expected swim speed of adult and juvenile Atlantic sturgeon can overcome a through-screen velocity of 0.5 fps (the average critical swim speed velocity of white sturgeon is estimated to be approximately 1.9 fps; see EPRI, 2000, Table A). Based on this information, EPA has made the preliminary determination that impingement of Atlantic sturgeon by the wedgewire screen CWIS will be unlikely.

Entrainment

The potential to impact aquatic organisms by entrainment largely depends on the presence and abundance of organisms that are vulnerable to entrainment, and the flow required for cooling. Organisms (including forage species) most vulnerable to entrainment in the vicinity of this proposed facility are species that have positively buoyant eggs, and/or pelagic larvae. Other important considerations include the location and design of the intake structure. According to section 316(b) of the Clean Water Act, any point source that uses a cooling water intake structure (CWIS) must ensure that its location, design, construction, and capacity reflects the best technology available (BTA) for minimizing adverse environmental impact.

Entrainment monitoring was conducted at Schiller Station for 41 weeks over a 13-month period with the following frequency. Samples were collected 1 day a week from January 2007 to March 2007 and June 2007 to September 2007. From September 2006 to December 2006 and from April to May 2007, samples were collected every other week.

Sorting, species and life stage identification and enumeration were all completed to generate entrainment rates (# of eggs or larvae per volume of water). Entrainment losses were calculated by multiplying the entrainment rate by the weekly plant cooling water flow.

At Schiller Station, entrainment losses of ichthyoplankton peaked in July, with a much smaller peak in the winter (January-March). Cunner eggs accounted for a large percentage of the losses in the July period (Normandeau, 2008). The peak in entrainment losses in the winter was comprised of winter spawners, such as American sand lance and rock gunnel (Normandeau, 2008). Macrocrustacean entrainment losses also peaked in July and were essentially almost non-existent during spring, fall and winter.

The table below presents entrainment losses by species (adjusted raw numbers at design flow);

Estimated Annual Entrainment Losses for Fish from Schiller Station

Common Name	Eggs & Larvae
Alligator fish	134,305
American eel	8,420
American plaice	1,061,867
American sand lance	13,677,174

Common Name	Eggs & Larvae
Atlantic cod	329,888
Atlantic cod/haddock	161,177
Atlantic cod/haddock/witch flounder	344,498
Atlantic herring	1,921,628
Atlantic mackerel	5,846,389
Atlantic menhaden	633,228
Atlantic seasnail	389,677
Atlantic tomcod	53,043
Cunner	32,539,552
Cunner/yellowtail flounder	72,955,812
Fourbeard rockling	1,723,189
Fourbeard rockling/hake	6,394,256
Goosefish	135,665
Grubby	3,393,233
Gulf snailfish	21,770
Haddock	7,072
Hake family	1,397,166
Longhorn sculpin	424,745
Northern pipefish	716,836
Pollock	661,273
Radiated shanny	201,269
Rainbow smelt	1,752,755
Rock gunnel	7,634,337
Sculpin family	59,139
Sea raven	13,329
Sea robin family	71,494
Shorthorn sculpin	93,113
Silver hake	275,997
Striped killifish	8,420
Summer flounder	11,904
Tautog	56,294
Unidentified	246,244
Windowpane	547,224
Winter flounder	372,846
Witch flounder	17,617
Wrymouth	5,790
Total Entrainment	**156,179,633**

According to entrainment monitoring at Schiller Station, no early life stages (ELS) of Atlantic sturgeon were identified in entrainment samples at the facility.

Section 8.2.3 of the Fact Sheet contains a complete discussion of entrainment mortality impacts from Schiller Station operation.

The area of the Piscataqua River influenced by Schiller Station is not considered to be a likely spawning area for Atlantic sturgeon due to its salinity range of up to 30 parts per thousand at high tide. If any limited spawning does occur in the vicinity, sturgeon egg and larval stages are not considered vulnerable to entrainment. That is because sturgeon eggs are highly adhesive and are deposited on the bottom, usually on hard surfaces (i.e. cobble) (Smith and Clugston 1997). The yolksac larval stage and older life stages of young also assume a demersal existence. The habitat utilized by these early life stages keeps them away from the influence of the facility's current intake, which is closer to the surface.

Finfish Entrainment Mitigation

As part of the proposed permit Best Technology Available (BTA) requirements, EPA has identified the following technology to further mitigate ELS finfish losses, including EFH species, from current expected entrainment mortality levels at the cooling water intake structure (CWIS).

EPA proposes the installation of wedgewire screen intake structures with a mesh or slot size of 0.80 mm, 0.69 mm, or 0.60 mm to maintain an intake through-screen velocity of 0.5 fps or less. These slot sizes are estimated to reduce finfish ELS entrainment by approximately 37%, 44% and 49% from current levels, respectively. The actual screen slot size selected will be subject to EPA approval and based upon the results of the Facility's pilot testing and demonstration report submitted to the agencies.

In addition, EPA proposes that the annual maintenance outage at Unit 5, when no water is withdrawn, take place in June. This is estimated to reduce finfish ELS entrainment mortality by another 4% from current levels.

The proposed BTA will also reduce the entrainment levels of macrocrustacean ELS, which are a food source for Atlantic sturgeon. Section 10 of the fact sheet includes a full discussion of a number of potential mitigation measures and their expected reduction of finfish as well as macrocrustacean ELS entrainment mortality.

In summary, EPA proposes permit requirements that are estimated to reduce finfish ELS entrainment by approximately 41% to 53%, depending on the wedgewire slot size selected.

Based on the expected location in the Piscataqua River of Atlantic sturgeon early life stages vulnerable to entrainment, the habitat where they reside, and the expected performance of the proposed BTA for entrainment reduction, EPA has made the preliminary determination that there is minimal potential for Atlantic sturgeon ELS entrainment, if at all. The operation of the CWIS is expected to have an insignificant or discountable effect on Atlantic sturgeon.

Discharge of Heated Effluent

The discharge of heated effluent may kill or impair organisms outright, or create intolerable conditions in otherwise high value habitats, and interfere with spawning. Thermal impacts associated with the discharge are related primarily to the dilution capacity of the receiving water, the rate of discharge, and the change in temperature (detla-T or ΔT) of the effluent compared to ambient water temperatures. Another important consideration is the presence of temperature-sensitive organisms and vegetated habitats.

As discussed in detail in Section 6.4 of the Fact Sheet, Schiller Station's existing permit's thermal discharge requirements are based on a CWA § 316(a) variance. The Facility initially requested that its new permit retain the same thermal discharge limits based on a renewal of its CWA § 316(a) variance. Schiller's request maintains, in essence, that the Facility's existing thermal discharge has not caused appreciable harm to the BIP and, indeed, could not have caused such harm given how small it is relative to the large volume and cold temperatures of the waters of the Piscataqua River estuary.

Based on the analysis of thermal plume monitoring and mapping data collected in the summer and fall of 2010, along with other supporting information (see Section 6.4.4. of the Fact Sheet), EPA concludes that Schiller Station's existing thermal discharge has not caused appreciable harm to the BIP. Moreover, EPA concludes that the record provides reasonable assurance that with the same thermal discharge limits in place, the Facility's thermal discharge will not cause such harm to the BIP in the future – in other words, will allow for the protection and propagation of the BIP. Indeed, the Facility's declining capacity factors indicate that, if anything, Schiller Station's thermal discharges will decrease overall in the future, though EPA cannot be sure of whether or when such reductions may occur.

Thus, EPA's new draft permit for Schiller Station proposes to retain the thermal discharge limits from the existing permit.

- A daily maximum discharge temperature limit (Max-T) of 95ºF;

- A daily maximum temperature differential between the intake and discharge temperatures (Delta-T) of 25ºF (this limit is increased to 30ºF for a two-hour period during condenser maintenance); and

- A prohibition of discharges that cause the receiving water to exceed a maximum temperature of 84°F at any point beyond a distance of 200 feet in any direction from the point of discharge.

Consistent with the Facility's request, EPA is proposing to issue these permit limits pursuant to a variance under CWA § 316(a).

Since the thermal plume has been documented as a near-surface feature which is relatively small in surface area (approximately 200 feet in any direction from the thermal outfalls; see Action Area of Schiller Station Effluent, above) and the maximum temperatures observed have not exceeded 82.4°F, the potential for acute or chronic impacts to finfish in the vicinity of the facility is discountable. In addition, since adult and juvenile Atlantic sturgeon are expected to be more closely associated with the benthic habitat, their encounter with the Schiller Station thermal plume is not likely.

It is unlikely that early lifestages of Atlantic sturgeon are present in that reach of the river. However, any larvae that are adrift in the water column and cannot avoid the discharge may become entrained in the plume. Lethal thermal conditions are not expected within the defined mixing zone. Non-lethal effects may render some organisms less fit for survival, but since organisms will be exposed for such a brief period of time (in most cases, a matter of seconds) adverse effects will likely be limited to a temporary increase in vulnerability to predation.

Based on relatively small size and intensity of the temperature plume and the brief exposure time of any lifestage of Atlantic sturgeon that may encounter the plume, this discharge is likely to have an insignificant or discountable effect on Atlantic sturgeon. Section 6.4 of the Fact Sheet discusses the thermal discharge from Schiller Station in detail.

Discharge of Pollutants

The Draft Permit also proposes limits on the following pollutants:

Effluent Characteristic	**Average Monthly**	**Maximum Daily**
Total Residual Chlorine	---	0.2 mg/L
Oil and Grease	15 mg/L	20 mg/L
Total Suspended Solids (TSS)	30 mg/L	100 mg/L
Total Copper	1.0 mg/L	1.0 mg/L
Total Iron	1.0 mg/L	1.0 mg/L
pH	6.5 – 8.0 S.U. (range)	

These limits are calculated to meet water quality standards and protect all aquatic organisms in the receiving water, including EFH species.

Chlorine

The Draft Permit limit for total residual chlorine is based on the existing permit in accordance with the antibacksliding requirements found in 40 CFR §122.44. This limit was originally established based on New Source Performance Standards (NSPS) established in the Federal Guidelines for the Steam Electric Power Generating Point Source Category (40 CFR Part 423.15(j)(1)).

Section 423.15(j)(1) limits the maximum and average concentration of free available chlorine discharged in cooling tower blowdown as shown below. The quantity of pollutant (mass limit) is determined by multiplying the flow of cooling tower blowdown by the concentration listed in the table. However, the existing and Draft Permit limits' are expressed as concentration limits pursuant to Section 423.15(m).

40 C.F.R. Part 423.15(j)(2) prohibits the discharge of free available chlorine or total residual chlorine (TRC) from any unit for more than two hours in any one day, and; not more than one unit in any plant may discharge free available or total residual chlorine at any one time unless the utility can demonstrate that the units in a particular location cannot operate at or below this level of chlorination.

At these extremely low chlorine concentrations, coupled with the limited duration of such an event, the discharge of this pollutant is likely to have an insignificant or discountable effect on Atlantic sturgeon.

Total Suspended Solids

The Draft Permit limits for Total Suspended Solids (TSS) and Oil and Grease (O&G) are based on the existing permit in accordance with the antibacksliding requirements found in 40 CFR §122.44. These limits were originally established based on NSPS established in the Federal Guidelines for the Steam Electric Power Generating Point Source Category (40 CFR Part 423.15(c) for low volume waste source(s)).

Section 423.15(c) limits the maximum and average concentration of TSS and O&G discharged in low volume waste source(s) as shown below. The quantity of pollutant (mass limit) is determined by multiplying the flow of low volume waste source by the concentration listed in the table. However, the existing permit, as well as the Draft Permit limits, are expressed as concentration limits pursuant to Section 423.15(m). The permit reflects these limits prior to mixing with cooling water in the tower.

Studies of the effects of turbid waters on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). The studies reviewed by Burton demonstrated lethal effects to fish at concentrations of 580mg/L to 700,000mg/L depending on species. Sublethal effects have been observed at substantially lower turbidity levels. For example, prey consumption was significantly lower for striped bass larvae tested at concentrations of 200 and 500 mg/L compared to larvae exposed to 0 and 75 mg/L (Breitburg 1988 in Burton 1993). Studies with striped bass adults showed that pre-spawners did not avoid concentrations of 954 to 1,920 mg/L to reach spawning sites (Summerfelt and Moiser 1976 and Combs 1979 in Burton 14 F993). While there have been no directed studies on the effects of TSS on Atlantic sturgeon, shortnose sturgeon juveniles and adults are often documented in turbid water. Dadswell (1984) reports that shortnose sturgeon are more active under lowered light conditions, such as those in turbid waters. Based on the general similarity of the two sturgeon species, Atlantic sturgeon are assumed to be as least as tolerant to suspended sediment as other estuarine fish such as striped bass. Based on this information, it is likely that the discharge of total suspended solids in the low concentrations allowed by the Draft Permit will have an insignificant effect on Atlantic sturgeon.

Oil and Grease

This extremely low concentration of oil and grease will be localized within a small mixing zone area. Levels of O&G will quickly drop below the detection limit in the high energy tidal currents of the Piscataqua River. Based on this information, it is likely that the discharge of O&G in the low concentrations allowed by the Draft Permit will have an insignificant effect on Atlantic sturgeon.

pH

EPA, in consultation with NHDES has determined that the current permit as well as this Draft Permit retains the pH limited range of 6.5 - 8.0 S.U. Since this pH range is generally considered harmless to marine life in Great Bay, no adverse effects to Atlantic sturgeon are likely to occur as a result of a discharge meeting the permitted pH range.

Heavy Metals

EPA's draft permit proposes to require (a) that the non-chemical metal cleaning waste be discharged from Outfall 016A subject to the 1.0 mg/L limits for total copper and total iron, and (b) that compliance monitoring for this type of metal cleaning waste occur after treatment but before discharge being comingled with any other waste streams. Furthermore, the draft permit allows low volume, runoff and drainage waste streams to be combined and discharged through Outfall 016 subject to the relevant effluent limits other than the technology-based copper and iron limits. Copper and iron limits will no longer be in Outfall 016 but will instead be in Outfall 016A.

These limits are calculated to meet water quality standards and protect all aquatic organisms in the receiving water, including protected species.

Polynuclear Aromatic Hydrocarbons (PAHs)

PAHs are a group of organic compounds that form through the incomplete combustion of hydrocarbons. PAHs are also present in crude oil and some heavier petroleum derivatives and residuals such as No. 6 fuel oil. Discharge of these products can introduce PAHs into the environment where they strongly adsorb to suspended particulates and biota. PAHs can also bio-accumulate in fish and shellfish. The ultimate fate of those PAHs which accumulate in the environment is believed to be biodegradation and biotransformation by benthic organisms. Several PAHs are well known animal carcinogens, while others are not carcinogenic alone but can enhance the response of the carcinogenic PAHs.

There are 16 PAH compounds identified as priority pollutants under the CWA (*see* Appendix A to 40 C.F.R. Part 423). In view of evidence of PAH-induced animal carcinogenicity and the type of petroleum products stored at the facility, the draft permit establishes monitoring requirements, without limits, for these Group I and II PAHs, as listed below.

Group 1 PAHs comprise seven known animal carcinogens:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Chrysene
- Dibenzo(a,h)anthracene
- Indeno(1,2,3-cd)pyrene

Quarterly monitoring of the above Group I PAHs, without limits, is required.

Group II PAHs comprise nine priority pollutants which are not considered carcinogenic alone, but which can enhance or inhibit the response of the carcinogenic PAHs:

- Acenaphthene
- Acenaphthylene
- Anthracene
- Benzo(g,h,i)perylene
- Fluoranthene
- Fluorene
- Napthalene
- Phenanthrene
- Pyrene

Quarterly monitoring of the above Group II PAHs, without limits, is required. Of these, naphthalene is considered an important limiting pollutant parameter based upon its prevalence in petroleum products and its toxicity (i.e., naphthalene has been identified as a possible human carcinogen).

For the maximum protection of human health from the potential carcinogenic effects of exposure to PAHs through ingestion of contaminated water and contaminated aquatic organisms, EPA established human health "organism only" *National Recommended Water Quality Criteria* for individual PAH compounds based on the increase of cancer risk over the lifetime and consumption of contaminated fish. The human health criteria for Group I PAHs were established in ng/L, which is many orders of magnitude below the current Practical Quantitation Limits (PQLs) for determining PAH concentrations in aqueous solutions.

The draft permit also requires that the quantitative methodology used for PAH analysis must achieve a minimum level for analysis ("ML") using approved analytical methods in 40 C.F.R. Part 136. The ML is not the minimum level of detection, but rather the lowest level at which the test equipment produces a recognizable signal and acceptable calibration point for an analyte, representative of the lowest concentration at which an analyte can be measured with a known level of confidence. The ML for each Group I PAH compound must be <0.1 µg/L. The ML for each Group II PAH compound must be <1 µg/L. These MLs are based on those listed in Appendix VI of EPA's Remediation General Permit. Sample results for an individual compound that is at or below the ML should be reported according to the latest EPA Region 1 *NPDES Permit Program Instructions for the Discharge Monitoring Report Forms (DMRs)*. These values may be reduced by modification pursuant to 40 CFR §122.62 as more sensitive tests become available or are approved by EPA and the State.

EPA believes these requirements are necessary for the protection of human health, to maintain the water quality standards established under Section 303 of the CWA, and to meet New Hampshire's water quality criteria. Should monitoring data indicate the presence of PAHs in concentrations that may cause or contribute to an excursion above water quality criteria, the permit may be modified, reissued or revoked pursuant to 40 CFR §122.62.

Finding

As detailed in this attachment and the Draft Permit's Fact Sheet, the proposed CWIS BTA is designed to reduce current levels of impingement by 87% and entrainment by from 41% to 53%. The thermal discharge has been granted a CWA §316(a) variance. During discharge, any regulated pollutants rapidly mix in all tidal occurrences, with the exception of the brief slack tide period. Based on these factors and the analysis of potential impacts to Atlantic sturgeon presented in this attachment, EPA has determined that impacts to Atlantic sturgeon from Schiller Station's CWIS and regulated effluent, if any, will be insignificant or discountable.

Therefore, EPA has judged that a formal consultation pursuant to Section 7 of the ESA is not required. EPA is seeking concurrence from NMFS regarding this determination through the information in this attachment, as well as supporting information contained in the Fact Sheet and the Draft Permit. In addition, a letter under separate cover will be sent to NMFS from EPA to request concurrence.

Reinitiation of consultation will take place: (a) if new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in the consultation; (b) if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the consultation; or (c) if a new species is listed or critical habitat is designated that may be affected by the identified action.