R. R. Sgarro
Manager-Nuclear Regulatory Affairs

PPL Bell Bend, LLC
38 Bomboy Lane, Suite 2
Berwick, PA 18603
Tel. 570.802.8102 FAX 570.802.8119
rrsgarro@pplweb.com

ppl™

December 13, 2010

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

BELL BEND NUCLEAR POWER PLANT
BBNPP PLOT PLAN CHANGE COLA
SUPPLEMENT, PART 3 (ER); SECTION 5.3 AND
RESPONSE TO ER RAI's MET 5.3-3 & 5.3-4
BNP-2010-321 Docket No. 52-039

References: 1) BNP-2010-175, T. L. Harpster (PPL Bell Bend, LLC) to U.S. NRC, "July 2010 BBNPP Schedule Update," dated July 16, 2010

2) BNP-2010-246, R. R. Sgarro (PPL Bell Bend, LLC) to U.S. NRC, "BBNPP Plot Plan Change Supplement Schedule Update," dated September 28, 2010

3) BNP-2009-217, R. R. Sgarro (PPL Bell Bend LLC) to U.S. NRC, "Response to Requests for Additional Information, Second Submittal," dated August 10, 2009

4) BNP-2009-256, R.R. Sgarro (PPL Bell Bend LLC) TO U.S.NRC, "Response to Environmental Requests for Additional Information, Third Submittal," dated September 11, 2009.

In References 1 and 2, PPL Bell Bend, LLC (PPL) provided the NRC with schedule information related to the intended revision of the Bell Bend Nuclear Power Plant (BBNPP) footprint within the existing project boundary which has been characterized as the Plot Plan Change (PPC). As the NRC staff is aware, the plant footprint relocation will result in changes to the Combined License Application (COLA) and potentially to new and previously responded to Requests for Additional Information (RAIs). PPL declassified this docketed schedule information from regulatory commitment status in Reference 2, with an agreement to update the staff via weekly teleconferences as the project moves forward.

PPL has committed to provide the NRC with COLA supplements, consisting of revised COLA Sections and associated RAI responses/revisions, as they are developed. These COLA supplements will only include the changes related to that particular section of the COLA and will not include all conforming COLA changes. Conforming changes for each supplement necessary for other COLA sections will be integrated into the respective COLA supplements and provided in accordance with the schedule, unless the supplement has already been submitted. In the latter case, the COLA will be updated through the normal internal change process. The revised COLA supplements will also include all other approved changes since the submittal of COLA Revision 2. All COLA supplements and other approved changes will ultimately be incorporated into the next full COLA revision.

D102
NRO

Enclosure 1 provides the revised BBNPP COLA Supplement, Part 3 (Environmental Report), Section 5.3, Revision 2b. The revised BBNPP COLA section supersedes previously submitted information in its entirety.

No open RAIs are associated with the enclosed COLA section.

Previously submitted NRC RAI responses which refer directly to the enclosed COLA section were reviewed for impact from the PPC. The following previously submitted RAI responses were reviewed for impacts:

RAI No.	Response Impacted? (Yes/No)
AE 3.4-2	No
H 5.3-1	No
MET 5.3-1	No
MET 5.3-2	No
MET 5.3-3	Yes
MET 5.3-4	Yes
MET 5.3-5	No
NRHH 10.5-1	No

Enclosure 2 provides the revised responses to NRC RAI MET 5.3-3 and MET 5.3-4 identified above as impacted by PPC. These responses supersede the previous responses (References 3 and 4) in their entirety. The following revised RAI responses are included with this submittal:

RAI No.
MET 5.3-3
MET 5.3-4

Enclosure 3 provides data files for RAI MET 5.3-3.

The only regulatory commitment contained in this submittal is to include the revised COLA section (Enclosure 1) in the next COLA revision.

If you have any questions, please contact the undersigned at 570.802.8102.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on December 13, 2010

Respectfully,

Rocco R. Sgarro

RRS/kw

Enclosure 1) Revised BBNPP COLA Part 3 (ER); Section 5.3, Revision 2b

2) Response to RAI MET 5.3-3 for COLA Part 3 (ER); Section 5.3
Response to RAI MET 5.3-4 for COLA Part 3 (ER); Section 5.3

3) RAI MET 5.3-3 Data Files, Bell Bend Nuclear Power Plant, Luzerne County, Pennsylvania (Compact Disc)

cc: (w/o Enclosures)

Mr. Michael Canova
Project Manager
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

Mr. William Dean
Regional Administrator
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406-1415

Ms. Stacey Imboden
Senior Project Manager
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

Dr. Donald Palmrose
Senior Project Manager
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

Enclosure 1

Revised BBNPP COLA Part 3 (ER); Section 5.3, Revision 2b

5.3 COOLING SYSTEM IMPACTS

This section describes potential impacts from operation of the cooling systems at BBNPP. The BBNPP Circulating Water System (CWS) and Essential Service Water System (ESWS) (Ultimate Heat Sink (UHS)) will be closed-cycle systems. Water is recirculated through cooling towers to remove waste heat, primarily through evaporation. The amount of water required to be withdrawn for these systems is small compared to that of once-through cooling systems. To replace evaporative losses, blowdown, and drift losses from the cooling towers, makeup water from the Susquehanna River is supplied to the CWS and to the ESWS. The CWS will be supplied directly from the CWS Makeup Water Intake Structure. The Raw Water Supply System (RWSS) will supply makeup water from the CWS Makeup Water Intake Structure to the cooling towers associated with the ESWS during normal and shutdown/cooldown conditions. Under post-accident conditions lasting longer than 72 hours, the ESWS is supplied from an onsite ESWEMS Retention Pond.

Potential physical and aquatic impacts are associated with water withdrawal from the Susquehanna River at the CWS Makeup Water Intake Structure, heat dissipation to the atmosphere from the cooling towers, and elevated temperature of the blowdown as it is returned to the Susquehanna River.

5.3.1 Intake System

The CWS Makeup Water Intake Structure is located on the west bank of the Susquehanna River. The forebay of the intake structure is on the bank of the Susquehanna River, perpendicular to the river's flow. The CWS Makeup Water Intake Structure will be an approximately 124 ft (37.8 m) long, 90 ft (27.4 m) wide structure with three individual pump bays. In the intake structure, one CWS pump and one RWSS pump are located in each pump bay, along with one traveling screen. Section 3.4 provides the details regarding the design of these structures and systems.

Section 3.4.1.1 identifies that the maximum makeup flow from the Susquehanna River to the CWS is 23,808 gpm (90,113 lpm) during normal shutdown/cooldown. This accommodates the maximum evaporation rate, maximum blowdown rate, and drift loss for the CWS cooling towers.

Section 3.4.1.2 identifies that the maximum makeup flow from the Susquehanna River to the ESWS cooling towers will be 3,426 gpm (12,967 lpm) to accommodate the maximum evaporation rate and drift loss for the ESWS cooling towers during normal shutdown/ cooldown.

The CWS Makeup Water Intake Structure is located approximately 300 ft (91.4 m) downstream of the existing SSES Units 1 and 2 River Intake Structure. The SSES River Intake Structure houses four pumps, each with a pumping capacity of 13,500 gpm (51,103 lpm).

5.3.1.1 Hydrodynamic Descriptions and Physical Impacts

Physical impacts of cooling water intake operation could include alteration of site hydrology and modifications to sediment deposition. BBNPP will employ closed-cycle, cooling tower-based heat dissipation systems to remove heat from the main steam condenser, and safety-related and auxiliary cooling systems. The relative volume of water withdrawn through the intake will be small compared to both a once-through cooling system and the average annual flow of the Susquehanna River at the site. At a maximum withdrawal rate of 28,179 gpm (106,656 lpm), which includes maximum flow for both the CWS and RWSS, BBNPP should remove less than 1% of the average annual flow of the Susquehanna River, 10,700 cfs (303.0

m^3/sec), and 7% of the 7Q10 flow calculated at 890 cfs (25.2 m^3/sec), as measured at the Wilkes-Barre USGS gage located about 20 mi (32 km) upstream from the BBNPP site, as discussed in Section 2.3.2.1.2. Water withdrawal is not expected to significantly alter the flow pattern of the Susquehanna River as it travels past the intake.

Periodic sediment removal via dredging may be required to maintain the depth of the area immediately in front of the entrance to the intake structure. Dredging activities will be performed in accordance with U.S. Army Corps of Engineers and Commonwealth of Pennsylvania requirements. Dredging impacts are expected to be SMALL due to the limited size of the intake structure.

Based on the facts that: 1) the amount of cooling water makeup withdrawn from the Susquehanna River will be small compared to a once-through cooling system; 2) the BBNPP water withdrawal from the Susquehanna River as a percentage of the rivers' average annual flow is low; and 3) the water intake velocities will be less than 0.5 ft/sec (0.15 m/sec), it is concluded that the physical impacts of the BBNPP intake will be SMALL.

5.3.1.2 Aquatic Ecosystems

Aquatic impacts attributable to the operation of the CWS Makeup Water Intake Structure are impingement and entrainment. Impingement occurs when larger organisms become trapped on the intake screens, and entrainment occurs when small organisms, suspended in the water column, pass through the traveling screens and subsequently through the cooling water system. Factors that influence impingement and entrainment include cooling system and intake structure location, design, construction, and capacity. Clean Water Act Section 316(b) requires that cooling water intakes be designed to represent the Best Technology Available (BTA) for minimizing adverse environmental impact for these factors. The U.S. Environmental Protection Agency (EPA) promulgated regulations implementing Section 316(b) in 2001 for new facilities (Phase I) (USEPA, 2001). The BBNPP intake and cooling water systems conform to these regulations.

The U.S. EPA design criteria for Phase I new facilities are as follows:

- Reduce intake flow, at a minimum, to a level commensurate with that which can be attained by a closed-cycle, recirculating cooling water system,
- Achieve a maximum through-screen intake velocity of 0.5 ft/sec (0.15 m/sec),
- For a facility on a fresh water river, intake flow must be less than or equal to 5% of the mean annual flow,
- Select and implement design and construction technologies or operational measures for minimizing impingement mortality of fish and shellfish, if:
    - There are threatened, endangered or otherwise protected species potentially impacted
    - Migratory, sport or commercial species pass through the hydraulic zone of influence
- Select and implement design and construction technologies or operational measures for minimizing entrainment of entrainable life stages of fish and shellfish, if:

- There are threatened, endangered or otherwise protected species potentially impacted
- There would be undesirable cumulative stressors affecting entrainable life stages of species of concern.

The CWS Makeup Water Intake Structure will meet the U.S. EPA Phase 1 criteria as discussed above: BBNPP will employ closed-cycle, recirculating water cooling systems as discussed in Section 3.3 and Section 3.4. The percentage of Susquehanna River mean annual flow pumped through the CWS Makeup Water Intake Structure should be less than 1% at the maximum water demand of 28,179 gpm (106,636 lpm); and intake design through-screen velocities will be less than 0.5 ft/sec (0.15 m/sec). The water intake will feature bar grating to prevent large objects from entering the intake structure and a trash rake to clean the bar grating. A curtain wall will protrude down into the pumphouse bays to prevent any floating debris that passes the bar grating from approaching the pumps. The curtain wall will extend below the minimum water level in the forebay. The inlet area limited by the curtain wall will be sized large enough to maintain a flow velocity of less than 0.5 ft/sec (0.15 m/sec) during maximum flow through the inlet. Dual-flow traveling screens will screen the incoming water ahead of the pumps. Debris and aquatic organisms washed off of the traveling screens will be deposited into trash receptacles. As discussed below, based on current sampling data available at the SSES River Intake Structure and other locations on the Susquehanna River, additional design and construction technologies or operational measures to minimize impingement and entrainment are not required.

The CWS Makeup Water Intake Structure will be located approximately 300 ft (91 m) downriver of the existing SSES River Intake Structure. As such, information related to impingement and entrainment at the SSES River Intake Structure will be useful in predicting potential impingement and entrainment at the CWS Makeup Water Intake Structure. An entrainment study was completed in 1981 at the SSES River Intake Structure. Limited historic impingement sampling occurred at SSES in years when larval American shad were stocked upriver from SSES Units 1 and 2. This sampling was performed in the early fall and focused on impingement of outmigrating American shad young-of-year. No young-of-year American shad were collected during these investigations. In addition, two recent impingement studies have been completed at generating stations upstream and downstream of the BBNPP site which are used to evaluate potential impacts of the CWS Makeup Water Intake Structure on aquatic species present within the Susquehanna River. Impingement monitoring was performed during a year-long study in 2006 at Hunlock Power Station, which is approximately 10 mi (16 km) upstream from BBNPP. Impingement monitoring was also completed approximately 100 mi (161 km) downstream from BBNPP at Brunner Island Steam Electric Station (BISES) for a full year from 2005 to 2006. The study at BISES has very limited applicability to evaluation of potential impingement at BBNPP, but it is the most current impingement data known from a riverine section of the Susquehanna River.

The 1981 entrainment study at SSES Units 1 and 2 was completed during four sampling events, two in May, and once each in June and July (PPL, 1982). During each sampling event, samples were collected eight times. Each sample consisted of three replicate 5-minute samples, at both the surface and bottom of the water column, at the entrance to the SSES River Intake Structure. This sampling format yielded a total of seventy-two 5-minute samples during each sampling event. During the entrainment study, a total of 18 species and 3,374 larval fish was collected. Six species accounted for 82% of the total entrainment. Quillback was the most numerous (37%) followed by common carp (22%), tessellated darter (11%), spottail shiner (8%), and spotfin shiner (4%). Recreationally important species accounted for only a small percentage of the entrained organisms. No endangered, threatened, or rare species were collected.

Hunlock Power Station (HPS) consists of a 50 MWe coal-fired unit and a 44 MWe combustion turbine. The station withdraws water from the Susquehanna River through two conventional traveling screens. It is an open, once-through cooling system. However, the cooling water volumes are small and similar to those of SSES and the proposed BBNPP. The maximum plant intake flow rate during the study sampling events was 58.2 million gpd (220 million lpd) which is roughly comparable to the estimated maximum volume for BBNPP of 40.6 million gpd (154 million lpd). The impingement study performed in 2006 consisted of thirty-seven, 24-hour sampling events distributed throughout the year. A total of 282 fish representing 16 species was collected. This equates to 7.6 fish per day or approximately 228 fish per month. Gizzard shad was the numerically dominant species, accounting for 39% of the total impingement catch. Other abundant species included bluegill (23%), channel catfish (20%), and white crappie (5%). Note that most of the impingement (53%) occurred during two sampling events in the early fall and was associated with high river flows. No endangered, threatened, or rare species were collected.

Brunner Island Steam Electric Station (BISES) consists of three coal-fired generating units. The total generating capacity of the three units is 1,483 MWe. The station withdraws water from the Susquehanna River through three conventional traveling screens. BISES has a once-through, open-cycle cooling system. Thus, substantially greater volumes of water are withdrawn from the Susquehanna River as compared to the closed-cycle CWS at BBNPP. The total maximum volume of cooling water withdrawn from the Susquehanna River at BISES is 795 million gpd (3,009 million lpd)) compared to a maximum estimate of 40.6 million gpd (154 million lpd) at BBNPP. The impingement study conducted during 2005 to 2006 at BISES consisted of forty, 24-hour sampling events and yielded 399,490 individuals of 39 fish species (Klienschmidt, 2007). This equates to 9,987 fish per day or approximately 299,617 fish per month. Gizzard shad was the dominant species, comprising 93% of all fish impinged. Smallmouth bass, the second most abundant species, accounted for 4% of the total impingement catch. Other common species included channel catfish, bluegill, flathead catfish, and spotfin shiner. No endangered, threatened, or rare species were collected.

A year-long impingement and entrainment study was conducted at the SSES River Intake Structure during 2008 and 2009. The program included weekly entrainment sampling during the fish spawning period, April to August 2008 and March to April 2009, and weekly impingement sampling from April 2008 to April 2009. Two entrainment samples were collected during the night on the same day each week. Each sample consisted of approximately 28,000 gal (105,992 l) of water that was pumped from the entrance of the intake structure. Weekly impingement samples were completed by collecting all materials washed from the SSES River Intake Structure traveling screens over a 24-hr period. Both the impingement and entrainment sampling programs were initiated on April 22, 2008.

The impingement study collected a total of 45, 24-hr samples. Over the entire sampling period, a total of 398 fish and crayfish was collected (Table 5.3-10). Crayfish (Orconected sp.) was the dominant organism, with 220 individuals collected representing 55.3% of the total impingement. The remainder of the impingement catch was composed of 178 fish representing 18 species. the most abundant fish was bluegill, representing 11.1% of the total. Other abundant fish as a percentage of the total impingement were rock bass (8.5%), channel catfish (7.8%), tessellated darter (4.5%), and spotfin shiner (4.0%). Other species that represented at least 1% of the total impingement catch included spottail shiner, margined madtom, smallmouth bass, white crappie, and white sucker.

The impingement catch was low throughout the study period with little week-to-week variation (FIgure 5.3-5). Impingement catch was the highest during a period from mid-February through April. A maximum of 42 fish and crayfish was collected during a single 24-hr sampling period on March 31. Fish or crayfish were collected on each collection date except for December 30.

Impingement was estimated for the entire year from April 2008 to April 2009. The total annual estimated impingement at SSES was 3,228 fish and crayfish. This equates to an average of 8.8 fish and crayfish per day and approximately 264 fish and crayfish per month. Estimates for fish alone were 3.95 per day, 120 per month and 1.442 per year.

Thrity-four entrainment samples were collected during 2008 over the 17 week sampling period. A total of 17 species and 3,039 fish were collected in the 34 samples (Table 5.3-11). Quillback (27.2%), Cyprinidae (17.6%), unidentified darter (12.6%), channel catfish (12.1%), common carp (11.4%), and white sucker (9.4%) were the numerically most abundant taxa. Other species that were colleted include the brown bullhead, chain pickerel, margined madtom, shield darter, rock bass, smallmouth bass, walleye, tessellated darter, banded darter, yellow perch, and spottail shiner.

A majority (55.9%) of the entrainment fish were larvae in the post yolk-sac life stage. Yolk-sac larvae was the second most abundant life stage comprising 17.0% of all individuals with the numbers of young-of-the-year (YOY) and the unknown life stage also being substantial, 14.1% and 12.9%, respectively. Only four yearling-plus individuals were collected and no fish eggs were collected in the entrainment samples during 2008.

Temporal variation in fish entrainment was evident with a majority of the fish being collected from the first week in May to mid-June (Figure 5.3-6). Few fish were collected in entrainment samples during April. The number of entrained fish was variable during July and August with two larger collections ocurring during the first week in July and the first week of August. The single largest entrainment sample collection ocurred on May 6 when 250 individuals were collected.

The overall estimated number fo fish entrained during the 2008 sampling period was 13,324,384 individuals. Cyprinidae was estimated to be the most abundant taxon entrained, comprising 21.5% of the total entrainment estimate. Other abundant taxa included channel catfish (19.3%), quillback (16.2 %), unidentified darter (12.3%), white sucker (9.8%), and common carp (6.7%).

Ten entrainment samples were collected during 2009 over the five week sampling period. A single Catostomidae egg was collected. The egg was collected on April 17, the last sampling event during 2009. No fish larvae or yearlings were collected. Estimated entrainment during the 2009 sampling period was 7,022 catostomid eggs.

No endangered, threatened, or species of special concern were collected in the impingement or entrainment samples. In addition, no migratory species (American Shad or American eel) were collected in the impingement or entrainment samples.

The report of the completed Impingement and Entrainment study is provided in COLA Part 11K.

Based on compliance with the 316(b) Phase I design criteria as well as the aforementioned impingement and entrainment data at SSES, HPS, and BISES, the CWS Makeup Water Intake Structure is not expected to have a substantial adverse effect on the Susquehanna River fish assemblage. The probability of entrainment and impingement will be low compared to other generating stations located on freshwater rivers. Importantly, no endangered, rare, or threatened fish species have been collected from the Susquehanna River in the vicinity of the BBNPP site. Numbers of recreationally important species that may be impinged at BBNPP will be low based on both the SSES and HPS data. Similarly, recreational species were entrained in low numbers at SSES during the 1981 and current entrainment study. Furthermore, low numbers of recreationally important fish species are likely to be entrained at BBNPP due to the reproductive strategy employed by these fishes (i.e., most are nest builders) and the location of spawning in relation to the CWS Makeup Water Intake.

The only species of special concern identified in the Susquehanna River in the vicinity of the proposed CWS Makeup Water Intake Structure are the mussels, green floater (subviridis) and yellow lampmussel (Lampsilis cariosa) as discussed in Section 2.4.2. It is highly unlikely that juveniles or adults of these species will be susceptible to impingement or entrainment. Mussels are burrowing, bottom oriented species and it is unlikely that these organisms would become entrained in the water column and enter the CWS Makeup Water Intake Structure. Neither of these species has been collected in impingement studies at SSES, BISES, or HPS. However, the small possibility does exist that fish that have been infected with glochidia (mussel larvae) could become entrained or impinged. This occurrence could make the glochidia susceptible to both entrainment and impingement. The host fish species for larvae of green floater are unknown. Yellow lampmussel glochidial hosts include white perch and yellow perch. No white perch were collected during impingement and entrainment sampling at SSES during 2008. Yellow perch was collected in low numbers in both entrainment (n=52) and impingement samples (n=3) at SSES during 2008.

Finally, because the proposed cooling tower-based heat dissipation system will withdraw small amounts of Susquehanna River water, the design of the CWS Makeup Water Intake Structure incorporates a number of features that will reduce impingement, and the results of fisheries studies performed in the vicinity of the SSES River intake suggest that the Susquehanna River fish populations have not been adversely affected by operation of SSES Units 1 and 2. It is concluded that the CWS Makeup Water Intake Structure impacts will be SMALL and will not warrant mitigation measures.

5.3.1.3 References

Ecology III, 1995. Environmental Studies in the vicinity of the Susquehanna Steam Electric Station, 1994 Annual Report, June 1995.

Ecology III, 2007. Environmental Studies in the vicinity of Susquehanna Steam Electric Station, 2006 Water Quality and Fishes, July 2007

Kleinschmidt, 2007. Brunner Island Steam Electric Station Impingement Study, December 2007.

PPL, 1982. Susquehanna Steam Electric Station 316(b) Entrainment Demonstration Program, July 1982.

UGI, 2007. UGI Hunlock Power Station Impingement Sampling Summary Report for Sampling Period 01/4/06 to 12/28/06.

USEPA, 2001. NPDES Regulations Addressing Cooling Water Intake Structures for New Facilities, Final Rule, Federal Register 66:243, U.S. Environmental Protection Agency, December 2001.

5.3.2 Discharge System

5.3.2.1 Thermal Description and Physical Impacts

A description of the cooling water system in general, and the blowdown return in particular, to the Susquehanna River is found in Section 3.4. Parameters important to estimating the thermal impacts of the blowdown discharge are summarized in this section.

In assessing the impact of the thermal discharge from the BBNPP, the average total effluent discharge flow was conservatively estimated to be 11,172 gpm (42,290 lpm). The BBNPP discharge structure will consist of a subsurface multi-port diffuser located approximately 720 ft (220 m) south of the CWS Makeup Water Intake Structure, extending about 310 ft (95 m) into the river at a low river flow depth of 10 ft (3.05 m). The diffuser will be similar to the existing SSES diffuser and will consist of seventy-two, 4 in (10 cm) nozzles located close to the bottom. The subsurface diffuser will rapidly mix blowdown discharge with the Susquehanna River.

The temperature rise from intake to the blowdown discharge will vary with electrical generation and seasonally with performance of the cooling tower. For the purposes of thermal plume modeling, a maximum summertime delta-T of 3.5°F (1.9°C) and a maximum winter time delta-T of 33.8°F (18.8°C) were assumed.

5.3.2.1.1 Susquehanna River Datasets

To capture the seasonal behavior of the thermal plume, a summer and a winter period were chosen for simulation. An examination of daily observations of Susquehanna River temperature at SSES from 1974 to the present showed a maximum temperature of 86.5°F (30.3°C) recorded on August 15, 1988 and on August 4, 2007. A minimum water temperature of 32.0°F (0.0°C) was recorded numerous times in January. August and January were therefore selected as representative months for simulation.

Susquehanna River flows, upstream of the BBNPP at the Wilkes-Barre gauge, shows a value of 890 cfs for the annual 7-day, 10-year low flow (7Q10). This annual 7Q10 value was multiplied by Pennsylvania Department of Environmental Protection default multiplier to convert the annual 7Q10 to a monthly 7Q10 rate. The multiplier for January is 3.2, and the multiplier for August is 1.4 (PADEP, 2003), yielding a January 7Q10 of 2,848 cfs (80.6 m^3/sec) and an August 7Q10 of 1,246 cfs (35.3 m^3/sec). For comparison, the monthly mean flows are 12,482 cfs (353.5 m^3/sec) and 4,473 cfs (126.7 m^3/sec) for January and August, respectively (USGS, 2008a) (USGS, 2008b).

Bathymetric data in the vicinity of BBNPP were developed from two sources: US Army Corps of Engineers, Philadelphia District (USACE) provided digital terrain maps (TIN's), shoreline data in ARC/INFO interchange file format (e00), and cross-section data from their FEMA HEC-RAS model (Arabatzis, 2008). More spatially-detailed bathymetric contours in the immediate vicinity of the SSES intake and discharge (1978) are provided in Figure 2.3-11. The ~~elevation~~centerline of the ~~bottom of the Susquehanna River~~ discharge diffuser is at the ~~BBNPP discharge is~~ 476 ft (145 ~~m).~~m) elevation, a minimum of 2 ft (0.6 m) above the river bottom.

To compute surface heat exchange, the coefficient of surface heat exchange (K) and equilibrium temperature (E) method was used. Monthly average and extreme values of K and E for National Weather Service sites in the U.S. are cataloged by the Environmental Protection Agency (EPA, 1971). The nearest cataloged site to BBNPP is Avoca, Pennsylvania (WBAN 14777), 27 mi (43 km) to the northeast of the site. Values for K and E, as well as for all other Susquehanna River datasets are shown in Table 5.3-1.

5.3.2.1.2 Discharge Thermal Plume Regulations

The Commonwealth of Pennsylvania provides the following criteria for temperature (PA, 2007):

> "Maximum temperatures in the receiving water body resulting from heated waste sources are regulated under Chapters 92, 96 and other sources where temperature limits are necessary to protect designated and existing uses. Additionally, these wastes may not result in a change by more than 2°F during a 1-hour period."

The protected water use for the Susquehanna River adjacent to BBNPP is Warm Water Fishes (WWF), as shown in Pennsylvania Code, Chapter 93. Water Quality Standards, Section 93.9(k) for the reach from the Lackawanna River to the West Branch Susquehanna River. The WWF temperatures are shown in Table 5.3-2. These values represent the maximum allowable water temperatures at an unspecified distance downstream of the discharge where fully-mixed conditions occur.

The Pennsylvania Department of Environmental Protection guidance document (PADEP, 2003) indicates that Pennsylvania Department of Environmental Protection may include in a NPDES permit issued to a permittee with a cooling water discharge an end-of-pipe limit of 110°F and a heat load limit based on the difference between ambient temperature and the critical use temperatures shown in Table 5.3-2. Because actual limits are set when the NPDES permit is issued, the thermal discharge limits that will be established for the BBNPP cannot be estimated at this time. In developing the NPDES permit conditions for BBNPP, Pennsylvania Department of Environmental Protection may choose to consider the cumulative effects of the combined SSES and BBNPP thermal discharge.

5.3.2.1.3 Discharge Plume Model

To compute the size and configuration of the thermal plume and provide the dilution rates, two types of models were used. These models are CORMIX for the near-field and GEMSS® for the far-field. The Cornell Mixing Zone Expert System (CORMIX) is primarily a design tool that has also been used by regulatory agencies to estimate the size and configuration of proposed and existing mixing zones resulting from wastewater discharges. CORMIX is a near-field model, i.e., it applies to the region adjacent to the discharge structure in which the wastewater plume is recognizable as separate from the ambient water and its trajectory is dominated by the discharge rate, effluent density, and geometry of the discharge structure.

The hydrodynamic model chosen to assess the far-field characteristics of the thermal plume and dilution is the Generalized Environmental Modeling System for Surface Waters (GEMSS®). GEMSS is an integrated system of 3-D hydrodynamic and transport modules embedded in a geographic information and environmental data system. GEMSS is in the public domain and has been used for similar studies throughout the U.S. and worldwide.

Thermal plume configuration and size for the BBNPP thermal discharge for two extreme scenarios are reported herein: August and January low Susquehanna River flows combined with extreme Susquehanna River temperatures. To show the combined thermal effects of the BBNPP and SSES discharges, the size and configuration of the thermal plume from the existing cooling tower blowdown discharge from the SSES was also simulated using the far-field model. For the near-field, only the BBNPP was modeled because CORMIX is incapable of modeling two plumes simultaneously. This approach is satisfactory because in the near-field, the plumes do not overlap due to the 380 ft (116 m) separation of the SSES and BBNPP discharges. For each extreme scenario, design values of the SSES and BBNPP intake and discharge rates, temperatures, and total dissolved minerals were used as shown in Table 5.3-3. Winter temperature rises for the blowdown discharge are significantly higher than the summer temperature rises due to differences in cooling tower performance from winter to summer.

5.3.2.1.4 Thermal Plume Configuration and Size

The near-field thermal plume size from the BBNPP thermal discharge computed with CORMIX is shown in Table 5.3-4 and Table 5.3-5.

CORMIX simulations for thermal plume also provided near-field dilution values. At 50 ft (15 m) from the discharge, the dilution is 11.8 for the August scenario and 19.2 for the January scenario.

The impact of the combined BBNPP and the SSES discharges are shown in Figure 5.3-1 and Figure 5.3-3 for the August and January scenarios. These figures show the surface thermal plume. The extent of this combined plume is very small. The surface excess temperatures are less than 0.8°F (0.4°C) for August and less than 0.6°F (0.3°C) for January.

The corresponding figures for the thermal plume attributable only to the BBNPP discharge are Figure 5.3-2 and Figure 5.3-4 for the August and January scenarios, respectively. The maximum excess temperatures at the surface are less than 0.3°F (0.2°C) for August and less than 0.3°F (0.2°C) for January.

To assess compliance with WWF temperature limits at seasonal extremes, additional near-field simulations were made to determine the size of the thermal plume under conditions when blowdown temperatures are at a maximum and Susquehanna River temperatures are at a minimum, yielding the maximum temperature rise in the River. These simulations utilized average Susquehanna River flows to represent a severe, but not extreme, case. The comparison metric is the distance along the centerline downstream of the BBNPP discharge where WWF temperatures are attained. These distances are shown in Table 5.3-6. In this table, the blowdown temperature rise is the difference between the blowdown temperature and the WWF ambient stream temperature (PPL, 2006). The WWF ambient stream temperature is an assumed natural temperature typically used by the Pennsylvania Department of Environmental Protection in computing waste heat load allocations. The target excess temperature in Table 5.3-6 is the difference between the WWF ambient temperature and the WWF temperature limit; this difference represents the excess temperature isotherm at which the WWF temperature limit is attained.

Centerline distances are very small and none of the target excess temperature contours reach the water surface. The results of this calculation indicate that the BBNPP blowdown plume will be in compliance with WWF temperatures during other WWF periods.

5.3.2.2 Aquatic Ecosystems

The potential effects of power plant discharges on aquatic ecosystems have been vigorously studied and documented (Majumdar, 1987). They include attraction of fish to the thermal plume, cold shock, blockage of movement and migration, changes in benthic species composition, growth of nuisance species, habitat modification, alteration of reproductive patterns, and chemical effects of biocides. These effects are typically lessened by installation of a closed-cycle, wet cooling system, which is the type of cooling system proposed for BBNPP (Section 3.4). Discharge effects have been studied at SSES and provide a basis for assessing the potential ecological impacts of the BBNPP discharge (Ecology III, 1995) (Ecology III, 2004) (Ecology III, 2007a) (Ecology III, 2007b) (Ecology III, 2008). The effects of the BBNPP discharge are anticipated to be similar to the SSES discharge. The existing SSES discharge will be used to gauge and evaluate the potential for impacts to result from the BBNPP discharge.

No substantial detrimental ecological impacts resulting from operation of the SSES discharge have been documented in 24 years of monitoring (Ecology III, 1995) (Ecology III, 2004) (Ecology III, 2007a) (Ecology III, 2007b) (Ecology III, 2008). The studies have shown that populations of many of the key recreational fish species have increased in abundance. In fact, improvements in overall water quality and increases in abundance of sensitive benthic macroinvertebrates have occurred (Ecology III, 1995). This long-term monitoring suggests that the discharge of cooling tower blowdown and wastewaters from BBNPP will have a SMALL impact on the Susquehanna River in the vicinity of BBNPP.

5.3.2.2.1 Thermal Effects

Pennsylvania provides water quality standards that include temperature criteria to protect designate water use and temperature limits for water bodies within the Commonwealth (PA, 2007). The guidelines provide maximum allowable temperatures for critical periods during the year and state that a discharge may not change the temperature of the receiving water body by more than 2°F (1.1°C) during any one hour period. The designated water use of the Susquehanna River in the vicinity of the BBNPP site is warm water fishery (WWF). This WWF designation requires the maintenance and propagation of fish species and additional flora and fauna which are indigenous to warm water habitats.

The BBNPP thermal plume is predicted to be similar to the existing SSES thermal plume. Based on its location, the BBNPP plume will likely have minimal interaction with the SSES plume. Its small cross-sectional area is unlikely to create a barrier to fish migration and the small area of thermal enhancement should limit attraction of fish such that they will not become acclimated and entrapped there, particularly during winter when fish are susceptible to cold shock from plant shutdown. Since fish are unlikely to become acclimated to the small plume, gas bubble disease should not occur.

The existing SSES plume was determined to have limited downstream temperature impact (Ecology III, 1987 and Ecology III, 2009). Both sets of studies yielded vertical temperature profiles consisting of temperature measurements made at 1-ft (0.3-m) intervals at 20 to 27 locations immediately downstream of the SSES diffuser structure.. Spring, fall, and winter studies were completed in 1986 and 1987 that measured the temperature and downstream extent of the thermal increase. During these studies the maximum increase above ambient temperatures within the plume ranged from 0.5 to 1.0°F (0.3 to 0.6°C) and the plume extent varied from 25 to 130 ft (7.6 to 40 m) downstream from the diffuser pipe. The study indicated that Susquehanna River flow, not discharge temperature increase above ambient, was the most important determinant of the temperature and areal extent of the plume.

In 2008, summer season plume studies were performed at about mid-day on August 21 and September 3 at river flows of 3,230 cfs (91.5 m^3/s) and 2,140 cfs (60.6 m^3/s), respectively. During each survey, both boiling water reactors were at full power. The river water withdrawal at the intake on both days was approximately 39,000 gpm (147,631 lpm) with a mean temperature of 74.4 °F (23.6°C), and the blowdown, as it exited the cooling tower basins on site, was 12,000 gpm (45,425 lpm) at an average of 82.7 °F, (28.2 °C). The August study found that the 0.5 °F (0.3 °C) isotherm thermal plume was less than 40 ft (12.2 m) wide at the diffuser and narrowed as it extended 120 ft (36.6m) downriver. The thermal plume did not reach the river surface. In September, the 0.5 °F (0.3 °C) isotherm thermal plume was 100 ft (30.5m) wide and extended 300 ft (91.4m) downriver from the diffuser. A much smaller subsurface plume within the 1.0 °F (0.6 °C) isotherm was observed immediately downriver of the diffuser. The summer season surveys confirmed that the thermal plume from the SSES diffuser is very limited, even during low flow conditions, and does not pose a hazard to aquatic life.

Modeling of the BBNPP discharge was performed to predict the temperature gradient and downstream extent of the plume. The modeling effort evaluated the maximum possible size of the plume during winter and summer. To accomplish this, summer and winter low flow conditions and extreme water temperatures were inputs to the model. The model indicated that within the near-field plume, the discharge temperature decreased quickly to very small values above ambient river temperature due to rapid mixing. During the summer period, the discharge has an excess temperature of 3.46°F (2.0°C) which decreases to 0.13 to 0.29°F (0.07 to 0.16°C), depending on river flow, within 50 ft (15 m) of the discharge. During the winter period, the discharge has an excess temperature of 33.81°F (19.0°C) that decreases to 0.5 to 1.75°F (0.3 to 1.0°C), depending on river flow, within 50 ft (15 m) of the discharge.

Modeling was also performed to evaluate the combined impact of the SSES and BBNPP thermal plumes. The model indicated that the combined thermal plume at the bottom of the Susquehanna River was slightly warmer than for BBNPP alone, but the extent of the plume was very small under the summer and winter conditions evaluated. Effects for the surface were even smaller.

The potential for fish kills resulting from attraction of fish to the BBNPP plume are unlikely given that the existing SSES plume temperatures are typically less than 1°F (0.6°C) above ambient temperature and no fish kills are known to have occurred as a result of the plume (Ecology III, 1987).

Both the minimal temperature increase and the small areal extent of the plume are predicted to have no significant impact on the benthic macroinvertebrate, mussel, or fish community. The increase in Susquehanna River temperature from the plume is within the range of natural temperature variability in lotic systems. Assuming that the characteristics of the BBNPP discharge will be similar to that of SSES's discharge and the predictive model, impacts to the aquatic community are expected to be SMALL.

5.3.2.2.2 Chemical Effects

Chemical effects of the discharge include the addition of biocides to limit fouling within the cooling water systems and other chemical agents to limit scaling. Discharge concentrations of these constituents will be limited by the National Pollutant Discharge Elimination System (NPDES) permit issued by the Pennsylvania Department of Environmental Protection. These concentration limits are set to protect the designated water use within the receiving water body and the concentrations in the BBNPP discharge will be lower than concentrations that could harm aquatic organisms present in the Susquehanna River. In addition, the NPDES permit will account for the combined impacts of both the BBNPP and SSES discharges.

Based on this, the chemical effects of the BBNPP discharge to the aquatic biota will be SMALL. Similar conclusions were drawn regarding the existing SSES discharge which is similar in volume to the proposed BBNPP discharge (NRC, 1981).

5.3.2.2.3 Physical Effects

Physical effects from the discharge will be limited to the turbulence created by the diffuser jets. These jets will direct the water downstream at a 45-degree angle toward the surface of the river. This turbulence will not harm aquatic organisms (PPL, 1978). The velocities created by the jets are sufficient to discourage fish from swimming in the mixing area near the diffuser for extended periods, thus eliminating the potential for gas-bubble disease. The action of the jets quickly mixes the heated water and limits the potential for fish to be attracted to the area. The spatial extent of the heated discharge and length of the diffuser pipe will be too small to create a thermal block across the river. A similar design at the existing SSES thermal discharge has limited physical impacts. It is expected that the physical impacts associated with BBNPP will also be SMALL due to similar design and operation of the diffuser bar.

No loss or alteration of unique habitat is expected or reduction in density, species composition or community structure of the aquatic community.

5.3.2.3 References

Arabatzis, 2008. Letter (with accompanying DVD) to Edward M. Buchak, Planning Division, Philadelphia District U.S. Army Corps of Engineers, April 1, 2008.

Ecology III, 1987. Thermal plume studies in the Susquehanna River at the discharge diffuser of the Susquehanna Steam Electric Station, 1986-1987, November 1987.

Ecology III, 1995. Environmental Studies in the vicinity of the Susquehanna Steam Electric Station, 1994 Annual Report, June 1995.

Ecology III, 2005. Environmental Studies in the vicinity of the Susquehanna Steam Electric Station, 2004 water quality and fishes, June 2005.

Ecology III, 2007a. Environmental Studies in the vicinity of the Susquehanna Steam Electric Station, 2005 water quality and fishes, February 2007.

Ecology III, 2007b. Environmental Studies in the vicinity of the Susquehanna Steam Electric Station, 2006 water quality and fishes, July 2007.

Ecology III, 2008. Environmental Studies in the vicinity of the Susquehanna Steam Electric Station, 2007 water quality, benthic macroinvertebrates, and fishes, July 2008.

Ecology III, 2009. Thermal Plume Surveys in the Susquehanna River at the Susquehanna Steam Electric Station Discharge Diffuser, Summer 2008, Revision 2. Prepared for PPL Bell Bend, LLC, February 2009.

Majumdar, 1987. Environmental Consequences of Energy Production: Problems and Prospects, The Pennsylvania Academy of Science, 531 pp, S.K. Majumdar, F.J. Brenner, and E. Willard Miller, 1987.

NRC, 1981. Final Environmental Statement related to the Operation of Susquehanna Steam Electric Station, Units 1 and 2, U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, 1981.

PA, 2007. Pennsylvania Code Section 93.7, Specific Water Quality Criteria, Amended January 5, 2007, Website: http://www.pacode.com/secure/data/025/chapter93/s93.7.html, Date accessed: May 15, 2008.

PADEP, 2003. Implementation Guidance for Temperature Criteria, PA DEP ID# 391-2000-017. October 3, 1997 with minor changes made through December 18, 2003.

PPL, 1978. Pennsylvania Power and Light Company, Susquehanna Steam Electric Station, Units 1 and 2, Environmental Report Operating License Stage (Volumes 1, 2, and 3), May 1978.

PPL, 2006. PPL Susquehanna, LLC, Supplemental Environmental Report, Extended Power Uprate, Susquehanna Steam Electric Station, PPL Susquehanna, LLC, Unit 1, Docket No. 50-387, License No. NPF-014; Unit 2, Docket No. 50-388, License No. NPF-022, March 2006.

USEPA, 1971. United States Environmental Protection Agency, Effect of Geographical Location on Cooling Pond Requirements and Performance, in Water Pollution Control Research Series. Report No. 16130 FDQ, March.1971

USGS 2008a, Summary of All Available Data, USGS 01536500 Susquehanna River at Wilkes-Barre, PA, Website: http://waterdata.usgs.gov/pa/nwis/inventory/?site_no=01536500&amp Date accessed: 4/21/2008.

USGS, 2008b. Summary of All Available Data, USGS 01540500 Susquehanna River at Danville, PA, Website: http://waterdata.usgs.gov/pa/nwis/inventory/?site_no=01540500&amp Date accessed: 4/21/2008.

5.3.3 Heat Discharge System

5.3.3.1 Heat Dissipation to the Atmosphere

BBNPP requires water for cooling and operational uses. Primary water consumption is for turbine condenser cooling. Cooling water for the turbine condenser and closed-cooling heat exchanger for normal plant operating conditions is provided by the Circulating Water System (CWS). The excess heat from the CWS is dissipated to the environment with a closed-loop cooling system. A closed-loop cooling system recirculates water through the plant components and cools this water for reuse by transferring excess heat to air, or the atmosphere, with a cooling tower.

The cooling system for BBNPP will be a closed-cycle, wet cooling system, consisting of two natural draft cooling towers for heat dissipation. The existing SSES Units 1 and 2 also use a closed-loop cooling system each with a natural draft cooling tower.

There will also be four smaller Essential Service Water System (ESWS) cooling towers to dissipate heat from system. The ESWS provides cooling water to the Component Cooling Water System heat exchangers and the heat exchangers of the Emergency Diesel Generators. Each of these four safety-related trains uses a safety-related two-cell mechanical draft cooling tower to dissipate heat. Heated ESWS water returns through piping to the spray distribution header of the ESWS cooling tower. Water exits the spray distribution piping through spray nozzles and falls through the tower fill. Two fans provide upward air flow to remove latent heat and sensible heat from the water droplets. The heated air exits the tower and mixes with ambient air, completing the heat rejection process. The cooled water is collected in the tower basin for return to the pump suction for recirculation through the system. Table 3.4-1 provides nominal heat loads and flow rates in different operating modes for the ESWS. Makeup water is normally provided from the RWSS but can also be supplied from the safety-related ESWEMS pumps housed in the ESWEMS Pumphouse. Table 3.4-3 provides ESWS Cooling Tower design specifications.

5.3.3.1.1 Circulating Water System Cooling Tower Plume

A visible mist or plume is created when the evaporated water from the cooling tower undergoes partial recondensation. The plume creates the potential for shadowing, fogging, icing, localized increases in humidity, and possibly water deposition. In addition to evaporation, small water droplets drift out of the tops of the wet cooling tower. The drift of water droplets can deposit dissolved solids on vegetation or equipment.

For BBNPP, the impacts from fogging, icing, shadowing, and drift deposition were modeled using the Electric Power Research Institute's Seasonal/Annual Cooling Tower Impact (SACTI) prediction code. This code incorporates the modeling concepts (Policastro, 1993) which were endorsed by the NRC in NUREG-1555 (NRC, 1999). The model provides predictions of seasonal, monthly, and annual cooling tower impacts from mechanical or natural draft cooling towers. It predicts average plume length, rise, drift deposition, fogging, icing, and shadowing, providing results that have been validated with experimental data (Policastro, 1993).

Detailed cooling tower design information is provided in Section 3.4. This information was used to develop input to the SACTI model. A summary of the design parameters are provided in Table 5.3-7.

SACTI requires the following inputs on an hourly basis: wind speed, wind direction, dry bulb temperature, dew point temperature, relative humidity, cloud cover, and wet bulb temperature if dry bulb and dew point temperatures are missing. All of these parameters were available from the onsite meteorological data set for calendar years 2001 through 2007 from the SSES Units 1 and 2 site meteorological tower except for cloud cover. Hourly meteorological parameters, including wind speed, wind direction, cloud cover, dry bulb temperature, and dew point temperature for the period 2001-2007 were obtained for the Wilkes-Barre International Airport (WBAN 14777; call sign AVP) through the National Climatic Data Center (NCDC) Climate Data Online (CDO) web site.

A composite data set was created from onsite and the Wilkes-Barre International Airport sources. Dry bulb and dew point temperatures from the the Wilkes-Barre data were included in this composite data set. Relative humidity was calculated from dew point and dry bulb temperatures utilizing algorithms adapted from U.S. EPA's AERMET processor. The composite data set was created in the format (CD-144) required as input to SACTI. Additionally, twice-daily mixing heights for 2001-2007 were calculated based on upper air soundings obtained from the Albany, New York National Weather Service (NWS) station (the closest sounding station to Bell Bend). Sounding data were obtained from NOAA, and processed with USEPA's MIXHT program. The composite data set therefore contained temperature and cloud cover data from Wilkes-Barre and winds (speed and direction) from the onsite tower 60 meter level.

The normal heat loads from the ESWS cooling towers are approximately 3% of the heat load to the CWS cooling towers. The maximum heat load is less than 7% of the CWS cooling towers heat load. Any impacts from the heat dissipation to the atmosphere by the ESWS cooling towers would be much less than the CWS cooling tower. In addition, a cumulative effect would be negligible. Therefore, the ESWS cooling towers are not considered further in the analysis.

5.3.3.1.2 Length and Frequency of Elevated Plumes

The SACTI code calculated the expected plume lengths annually and for each season by direction for the CWS cooling towers. The plumes would occur in all compass directions. The average plume length and height was calculated from the frequency of occurrence for each plume by distance from the tower. Modeled plume parameters for the cooling tower are provided in Table 5.3-8.

The average plume ~~length~~lengths would range from ~~0.274~~0.294 mi ~~(0.440~~(0.473 km) in the summer season to ~~0.615~~0.635 mi ~~(0.990~~(1.023 km) for the ~~spring~~winter season. The annual prediction for average plume length would be ~~0.372~~0.405 mi ~~(0.549~~ (0.652 km). The median plume lengths would range from ~~0.231~~0.235 mi ~~(0.371~~(0.378 km) in the summer season to ~~0.578~~0.640 mi ~~(0.931~~(1.031 km) in the winter season. The annual median plume length is ~~0.263~~0.292 mi ~~(0.423~~(0.470 km). The median plume length would not reach the site boundary in the predominant direction of the plume except in the winter season.

The average plume height would range from ~~776~~810 ft ~~(236~~(247 m) in the summer season to ~~961~~ 997 ft ~~(294 m)~~ (304 m) for the winter season. The annual prediction for average plume height would be ~~818~~853 ft ~~(249~~(260 m). The median plume height would range from ~~808~~ 856 ft ~~(247~~(261 m) in the summer season to ~~greater than 982~~ 1007 ft ~~(299~~(307 m) in the winter season. Due to the varying directions that the plume travels and short average and median plume height and length, impacts from elevated plumes would be SMALL and not warrant mitigation.

5.3.3.1.3 Ground-Level Fogging and Icing

The SACTI output indicated that no fogging and icing would occur for the Bell Bend natural draft cooling towers. The SACTI model suspends this calculation, since ground-level impacts are not possible for plumes from tall natural draft cooling towers.

Salt Deposition

Cooling tower drift is water droplets in the cooling tower that get entrained in the buoyant air of the cooling tower exhaust and leave the tower. These droplets eventually evaporate or settle out of the plume onto the ground, vegetation or equipment nearby.

The drift rate was based on 0.001% of the Circulating Water System flow. The makeup water for the CWS has a maximum chloride concentration of 39.6 milligrams per liter of water. The equivalent concentration of sodium chloride of 326.3 milligrams per liter was conservatively used for the salt concentration of the makeup water. The Circulating Water System was assumed to have five cycles of concentration. Water droplets drifting from the cooling tower would have the same concentration of salt as the water in the Circulating Water System. Therefore, as these droplets evaporate, either in the air or on vegetation or equipment, they deposit these salts.

The maximum salt deposition rate from the cooling tower is provided in Table 5.3-9. The maximum predicted salt deposition is well below the NUREG-1555, Section 5.3.3.2 (NRC, 1999) significance level for possible vegetation damage of 8.9 lb/ac per month (10 kg/ha per month) in all directions from the cooling tower during each season and annually. The maximum predicted salt deposition is less than 0.1 kg/ha per month. Therefore, no impacts to vegetation from the salt deposition would be expected for both on site and off site locations.

The ~~electrical switchyard~~ BBNPP Switchyard will be located approximately 650 ft (200 m) to the southeast of the proposed location for the circulating water supply system (CWS) cooling towers. A maximum predicted solids deposition rate of 0.0008 pounds per acre per month (0.0009 kg per hectare per month) is expected at the BBNPP Switchyard during the spring season. The Susquehanna 500 kV Switchyard #2 will be located approximately ~~1,300~~ 2,600 ft ~~(400~~(800 m) to the ~~south~~northeast of the proposed location for the ~~CWS~~ circulating water supply system (CWS) cooling towers. A maximum predicted solids deposition rate of ~~0.0023 lb/ac~~ 0.0074 pounds per acre per month ~~(0.0026 kg/ha~~(0.0083 kg per hectare per month) is expected at the ~~BBNPP switchyard~~ Susquehanna 500 kV Switchyard #2 during the ~~spring~~winter season. Additionally, the ~~electrical switchyard for SSES Units 1 and 2~~ Susquehanna 500 kV Switchyard #1 is located approximately ~~3,300~~ 3,900 ft ~~(1,000~~(1200 m) to the ~~east southeast~~ east-southeast from the proposed location of the BBNPP CWS cooling towers. The maximum predicted solids deposition expected at the ~~SSES Units 1 and 2 electrical switchyard~~ Susquehanna 500 kV Switchyard #1 due to operation of the BBNPP CWS cooling towers will be 0.0008 ~~lb/ac~~ pounds per acre per month (0.0009 ~~kg/ha~~kg per hectare per month), during the spring season.

Based on industry experience, adjustments to maintenance frequencies (e.g., insulator washing) may be necessary due to salt deposition; however, the expected deposition rates will not affect switchyard component reliability or increase the probability of a transmission line outage at SSES Units 1 and 2, or BBNPP.

The ESWS cooling towers will be operated using fresh water from the Susquehanna River. Salt deposition at the ~~SSES Units 1~~ Susquehanna 500 kV Switchyards #1 and ~~2,~~#2, and the BBNPP ~~electrical switchyards~~ Switchyard resulting from operation of the BBNPP ESWS cooling towers will be small, and is bounded by the salt deposition estimates for the BBNPP CWS cooling towers.

In summary, impacts from salt deposition from the BBNPP cooling towers would be SMALL. The modeling predicts salt deposition at rates below the NUREG-1555 significance level where visible vegetation damage may occur for both onsite and offsite locations.

5.3.3.1.4 Cloud Shadowing and Additional Precipitation

Vapor from a cooling tower can create clouds or contribute to existing clouds. The clouds would prevent or reduce the amount of sunlight reaching the ground. This shadowing is of particular importance in agricultural areas. There are several agricultural areas in the BBNPP site vicinity as described in Section 2.2. Cloud shadowing at the nearest agricultural area would occur a maximum of ~~56~~92 hours during the spring season. Cloud shadowing at nearest roadway would occur for a maximum of approximately ~~157~~161 hours in the ~~summer~~winter season. Annually, cloud shadowing is predicted to occur for ~~202~~266 hours at nearest roadway.

Rain and snow from vapor plumes are known to have occurred at some locations. SACTI predicts the amount of water deposited in the vicinity of a natural draft cooling tower, i.e. the additional precipitation due to the tower discharge. The additional precipitation amounts would range from 0.0001 in (0.00254 mm) in the spring season to ~~0.00014 in (0.00356~~0.00011 inches (0.00279 mm) in the winter and fall ~~season.~~seasons. This value is small when compared to the annual rainfall amount at the Wilkes-Barre International Airport of 37.56 in (954.02 mm).

Impacts from cloud shadowing and additional precipitation would be SMALL and would not require mitigation.

5.3.3.1.5 Ground-Level Humidity Increase

For the same reasons that ground level fogging and icing do not occur with natural draft cooling towers, ground level humidity increases also do not occur and are not evaluated by SACTI.

5.3.3.1.6 Noise

The principal noise sources associated with normal operation of the BBNPP cooling water system are the CWS and ESWS cooling towers. Noise generated from cooling towers is more specific to mechanical draft cooling towers, which use numerous fans to aid in heat dissipation. Noise levels from natural draft cooling towers (i.e., no use of fans) are expected to be insignificant. ~~A noise survey was~~ Noise surveys were conducted in the vicinity of SSES in February and March ~~2008,~~ 2008 and June, 2010, to measure ambient environmental community noise levels to establish a baseline noise level in the presence of the existing two-unit SSES. Environmental sound levels were measured continuously at five area-wide locations in 2008 over a 312-hour period during leaf-off and leaf-on seasonal conditions. ~~As a result, any noise emissions from~~ Environmental sound levels were measured continuously at two additional and one of the ~~existing two-unit SSES would be highest due to the lack of tree leaf noise reduction.~~ five original area-wide locations over a 336-hour period during leaf-on seasonal conditions. The instantaneous sound ~~level was~~ levels were measured at ~~five~~seven locations on a continuous and simultaneous basis over the ~~312-hour period~~ 13 to 14 day periods using precision data loggers. In addition, attended 10-minute sampling measurements were carried out at each location during day and night periods using hand-held precision data loggers. The attended measurements were carried out to observe sources of environmental sounds and to record the frequency spectrum of the sound level. The residual ambient noise was found to be essentially constant for all practical purposes at any of the monitoring locations near the SSES cooling towers. This occurs in areas where the environmental sound sources are far off in distance relative to the distance between monitoring points and where the natural sources are similar at all locations. The sound of rain and high wind were indicated on the plot of sound levels. The major source of environmental noise in the project area is from far-off unidentifiable traffic. Absolutely no sounds were detectable during attended measurement for normal operation on February 28, 2008, when the plant was operating. Measured ambient sound levels during plant operation could be attributed to normal, current environmental sources, such as traffic noise, high wind and rain and are not related to the existing SSES plant.

As such, impact would be SMALL and would not require mitigation.

5.3.3.1.7 Similar Operating Heat Dissipation Systems

Data and information on similar heat dissipation systems within a 31 mi (50 km) radius or similar climate are available for the SSES Units 1 and 2. Both units use natural draft cooling towers with the Susquehanna River as the makeup water. At these units, impacts from salt drift were not observed. Based on the cooling tower plume modeling that was conducted for the SSES Environmental Report - Operating License, it was concluded that "frequent long visible plumes are the primary projected meteorological effect of the operation of the cooling towers. No occurrence of fogging or icing are expected. Other weather modification effects, such as rainfall augmentation, are unlikely due to the small increase in atmospheric moisture introduced by cooling tower operation into the already moisture-laden environment."

The NRC described impacts from mechanical and natural draft cooling towers in the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NRC, 1996). As stated in Draft NUREG-1437, Supplement 35: "Based on information in the GEIS, the Commission found that impacts from salt drift, icing, fogging, or increased humidity have not been a problem at operating nuclear power plants and are not expected to be a problem during the renewal term. The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC, 2007a). Documents reviewed included Effects of Simulated Salt Drift from the Susquehanna Steam Electric Station Cooling Towers on Field Crops Summary Report (Ecology III, 1987c). Therefore the NRC staff concludes that there would be no cooling tower impacts on crops and ornamental vegetation during the renewal term beyond those discussed in the GEIS." The NRC came to a similar conclusion for the potential cooling tower impacts on native plants.

Modeling of the SSES cooling tower plumes revealed that the plumes are at average heights of ~~640~~810 to ~~1,140 ft (195~~997 feet (247 to ~~347~~304 m). Modeling of the BBNPP cooling tower plumes revealed an annual average height of ~~818~~853 ft ~~(249~~(260 m). The proposed location of the BBNPP cooling towers is ~~west-west southwest~~ west of the existing SSES cooling towers at a distance of approximately ~~4,000~~2,600 ft ~~(1,200~~(800 m). The predominant directions that visible cooling tower plumes from SSES and BBNPP would travel are toward the west-southwest (SSES) and south-southwest (BBNPP). The cooling tower plumes from the two plants could only interact when the wind is from the ~~east-east~~east northeast or ~~west-west~~west southwest (based on the two plant locations). Modeling indicates that the BBNPP plumes will travel beyond the SSES cooling towers in the ~~east-east northeast~~ east direction at most approximately ~~3.2%~~7.2% of the time during the winter when the plume lengths are expected to be longest. Modeling indicated that the SSES plumes will travel beyond the BBNPP cooling towers approximately ~~12.5%~~2.9% of the time in the ~~west-west southwest~~ west direction. Visible cooling tower plumes for BBNPP and the two cooling towers of SSES would be expected to occur in the same general predominant direction and would be expected to fluctuate in a similar manner, so that no synergistic effects with the proposed CWS cooling towers with respect to mixing fog or drift would be expected to occur.

Interaction with Existing Pollution Sources

There are no major sources of air pollution in the vicinity of the BBNPP site. Existing diesel generators and boilers at SSES Units 1 and 2 operate for limited periods. Diesel generators that are associated with BBNPP will also operate for limited periods. Interactions between pollutants emitted from these sources and the plumes from the cooling towers for SSES Units 1 and 2 are of sufficient distance and would not have a significant impact on air quality. Impacts would be SMALL and would not require mitigation.

5.3.3.1.8 References

NRC, 1996. Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437, Nuclear Regulatory Commission, May 1996.

NRC, 1999. Standard Review Plans for Environmental Reviews of Nuclear Power Plants, NUREG-1555, Nuclear Regulatory Commission, October 1999.

Policastro, 1993. A Model for Seasonal and Annual Cooling Tower Impacts, Atmospheric Environment, Volume 28, No. 3, Pages 379-395, A. Policastro, W. Dunn, and R. Carhart, 1993.

5.3.3.2 Terrestrial Ecosystems

Heat dissipation systems associated with nuclear power plants have the potential to impact terrestrial ecosystems through salt drift, vapor plumes, icing, precipitation modifications, noise, and avian collisions with cooling towers.

5.3.3.2.1 Potential Impacts Due to Salt Drift

The cooling towers constructed to provide heat dissipation for BBNPP will release drift capable of depositing as much as ~~0.0045~~0.0177 lb/ac per month ~~(0.0050~~(0.0198 kg/ha per month) of dissolved solutes, primarily originating from the Susquehanna River makeup water, during the ~~fall~~winter season on terrestrial ecosystems located in the vicinity of the BBNPP site. This value represents the maximum overall deposition rate during the ~~fall.~~winter. Maximum overall deposition rates during the ~~winter, spring~~spring, summer, and ~~summer~~fall were similar and ranged from ~~0.0036~~0.0079 lb/ac per month ~~(0.0040~~(0.0088 kg/ha per month) to ~~0.0042~~0.0101 lb/ac per month ~~(0.0047~~(0.0113 kg/ha per month).

The component of terrestrial ecosystems most vulnerable to cooling tower drift is vegetation, especially the upper stratum of vegetation whose foliage lies directly under the released droplets of water forming the drift (NRC, 1996). Forest communities are the predominant vegetation cover in the BBNPP ~~Owner Controlled Area (OCA).~~ site. Hence, woody vegetation forming the tree canopy and woody understory is potentially subject to the greatest exposure. However, vegetation damage from drift-based salt deposition originating from natural draft cooling towers has been shown to be SMALL (NRC, 1996).

5.3.3.2.1.1 Plant Communities Potentially Affected by Salt Deposition Isopleths

The results of the vapor plume analysis for the BBNPP natural draft cooling towers indicated that salt deposition rates for the vicinity of the ~~OCA~~ BBNPP site were well below levels with documented impacts to vegetation as discussed below.

Plant Communities Exposed to Highest Salt Deposition Levels

The results of the vapor plume analysis for the BBNPP natural draft cooling towers indicated that salt deposition rates for the vicinity of the ~~OCA~~ BBNPP site were well below levels with documented impacts to vegetation as discussed in Section 5.3.3.2.1.2. Therefore, maps showing salt deposition rates across the ~~OCA~~ BBNPP site have not been provided.

Plant Communities Exposed to Lower Salt Deposition Rates

The results of the vapor plume analysis for the BBNPP natural draft cooling towers indicated that salt deposition rates for the vicinity of the ~~OCA~~ BBNPP site were well below the levels with documented impacts to vegetation in Section 5.3.3.2.1.2. Therefore, map showing salt depostion rates across the ~~OCA~~ BBNPP site have not been provided.

5.3.3.2.1.2 Potential Effects of Salt Deposition to Specific Plant Species

Salt drift deposited at rates approaching or exceeding 10 kg/ha per month in any month during the growing season may cause leaf damage in many species. However, deposition rates of 1 to 2 kg/ha per month are generally not damaging to plants (NRC, 1996). Since the highest salt deposition rate projected for the proposed BBNPP cooling towers is only ~~0.0045~~0.0177 lb/ac per month ~~(0.0050~~(0.0198 kg/ha per month), the risk of acute injury to vegetation is low. However, information in the published scientific literature regarding the sensitivity of individual plant species to salt deposition is limited. This is especially true with respect to low level chronic injury such as stunted growth that is not as visually apparent as acute injury such as browned leaves.

According to NUREG-1437, the most sensitive native plant species on the BBNPP site is flowering dogwood (Cornus florida), which experiences acute injury at salt deposition rates exceeding approximately 4.7 lb/ac per month (5.2 kg/ha per month). Flowering dogwood occurs occasionally in the understory of deciduous forest on the BBNPP site but is not dominant in any vegetative stratum.

Although acute injury is unlikely, given the low projected deposition rates, there is still risk of chronic injury to flowering dogwood such as reduced growth rate and reduced vigor. Chronic injury might not be visible, but could leave affected trees more susceptible to environmental stresses such as drought or biotic stresses such as dogwood anthracnose, a fungal disease that has killed many dogwoods in the northeast. Because flowering dogwood is not a dominant tree in either the canopy or understory of forests within the BBNPP site, the overall character of the affected forest vegetation would not be substantially changed even if the few flowering dogwoods in the affected areas were to eventually die. The ability of the affected forest vegetation to provide habitat for forest interior dwelling species and other wildlife favoring forest habitat would not be substantially diminished.

Of other tree species on the BBNPP ~~OCA,~~site, NUREG-1437 provides information only for white ash (Fraxinus americana), eastern hemlock (Tsuga canadensis), white pine (Pinus strobus), chestnut oak (Quercus prinus), black locust (Robinia pseudoacacia) and red maple (Acer rubrum). Red maple is the most abundant species in the ~~OCA~~ BBNPP site and is dominant in both upland and wetland vegetation communities. White ash and black locust are also common onsite. The minimum salt deposition rates reported to cause acute injury to these species range from approximately 36 lb/ac per month (41 kg/ha per month) for eastern hemlock to approximately1,833 lb/ac per month (2,054 kg/ha per month) for red maple. These values are more than several orders of magnitude higher than the maximum projected deposition rate ~~0.0045~~0.0177 lb/ac per month ~~(0.0050~~(0.0198 kg/ha per month) for the BBNPP cooling towers. Although the potential for chronic injury to these species can not be definitively ruled out, the risk appears to be substantially lower than for flowering dogwood.

Quantitative studies of vegetation and plant diseases were conducted for SSES from 1977 through 1994. Significant changes detected in plant community composition over this time were attributed to normal vegetation dynamics such as succession and animal interaction, and not to SSES Units 1 and 2 operation (Ecology III, 1995). In addition, findings for plant diseases were similar for preoperational (1977 to 1982) and post-operational (1983 to 1994) study periods. No effects of salt drift were detected.

5.3.3.2.1.3 Potential Overall Effects on Terrestrial Ecosystems

Since the highest projected salt deposition rate of ~~0.0045~~0.0177 lb/ac per month ~~(0.0050~~(0.0198 kg/ha per month) is well below the rates reported in the scientific literature to cause acute injury to woody vegetation, the likelihood of salt drift causing rapid or extensive changes to the general structure and composition of affected vegetation is low. The tree canopy in forested areas is unlikely to die rapidly or extensively. Hence, conversion of forest to scrub-shrub vegetation unsuited to wildlife favoring forested habitat, including forest interior dwelling species, is unlikely. The ability of affected forest vegetation to stabilize soil on steep slopes is unlikely to be impaired.

Occasional trees or shrubs, especially in the area of higher salt deposition, could experience chronic injury such as reduced vigor, reduced growth rate, or slow and gradual die off. The risk is greatest for individuals that are simultaneously of a salt-sensitive species (such as flowering dogwood), old, or subject to localized environmental stresses such as sandy soils, which are subject to greater drought stress that could act synergistically with the projected low salt deposition levels to injure trees.

Small gaps in the tree canopy resulting from the death of individual trees would mimic the natural die-off of individual trees in mature forests and not substantially alter the suitability of the forests for most wildlife species. Dead trees would be left in place to provide nesting cavities and snags for wildlife.

The potential for injury to terrestrial vegetation or to terrestrial wildlife inhabiting areas of terrestrial vegetation, as a result of salt drift, is low. Thus, the impacts of salt drift on terrestrial ecology would be SMALL, and would not warrant mitigation.

5.3.3.2.2 Potential Impacts of increased Fogging, Humidity, and Precipitation

The vapor plume analysis indicated that no icing or fogging events, or ground level humidity increases will result from the operation of the BBNPP natural draft cooling towers. Maximum rates of additional precipitation are predicted to range from ~~0.00010~~0.00009 in ~~(0.00254~~(0.0023 mm) per year during the spring to ~~0.00014~~0.00011 in ~~(0.00356~~(0.0028 mm) per year during the ~~fall.~~ fall and winter. Therefore, potential adverse impacts from these phenomena are expected to be SMALL and, therefore, not require mitigation.

5.3.3.2.3 Potential Impacts from Cooling Tower Noise

Noise caused by human and vehicular activity at the BBNPP could discourage use by terrestrial wildlife of adjoining natural habitats on the BBNPP site. However, noise generated by the CWS and ESWS cooling towers is expected to be below EPA and HUD requirements, and unlikely to have deleterious effects on wildlife. Wildlife is generally more sensitive to sudden and random noise events, which can induce a startle response similar to that induced by a predator, than to the steady continuous noise produced by operation of a cooling tower (Manci, 1988). Potential adverse impacts to terrestrial wildlife caused by cooling tower noise are therefore expected to be SMALL and not require mitigation.

5.3.3.2.4 Potential Impacts Due to Bird Collisions with Cooling Towers

As summarized in Section 4.3.1, the proposed natural draft cooling towers would not be expected to cause substantially elevated bird mortality due to collisions. Although infrequent bird collisions with the cooling towers are possible, the overall mortality potentially resulting from bird collisions with cooling towers are reported to have only SMALL impacts on bird species populations (NRC, 1996). The forest interior bird species would not find suitable habitat close to the cooling towers, which would be constructed on a cleared, treeless pad. Strobe lights installed on the cooling towers would be expected to reduce the probability of collision by eagles or raptors migrating along the Susquehanna River corridor and minimize attraction of nocturnal migrating birds. No other mitigation appears to be necessary to prevent substantial adverse impacts to bird species populations caused by collisions with the cooling towers.

5.3.3.2.5 References

Ecology III, 1995. Environmental Studies in the Vicinity of the Susquehanna Stream Electric Station, 1994 Annual Report, Ecology III Inc, May 1995.

Manci, 1988. Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife: A Literature Synthesis, U.S. Fish and Wildlife Service, National Ecology Research Center, NERC-88/29, p 88, K. Manci, D. Gladwin, R. Villella, and M. Cavendish, 1988.

NRC, 1996. Generic Environmental Impact Statement for License Renewal of Nuclear Plant, NUREG-1437, Nuclear Regulatory Commission, May 1996.

5.3.4 Impacts to Members of the Public

Operation of the BBNPP cooling water systems includes heat transfer to the atmosphere from the cooling towers and the discharge of blowdown to the Susquehanna River. Potential impacts to the public include the release of thermophilic bacteria from within the towers and noise from tower operation.

5.3.4.1 Thermophilic Microorganism Impacts

Thermophilic organisms are typically associated with fresh water. Health consequences of thermally enhanced microorganisms have been linked to plants that use cooling ponds, lakes, or canals that discharge to small rivers. Elevated temperatures within cooling tower systems are known to promote the growth of thermophilic bacteria including the enteric pathogens Salmonella sp. and Shigella sp, as well as Pseudomonas aeruginosa and fungi. The bacteria Legionella sp, and the amoeba Naegleria and Acanthamoeba have also been found in these systems. The presence of the amoeba N. fowleri in fresh water bodies adjacent to power plants has also been identified as a potential health issue linked to thermal discharges (CDC, 2007) (NRC, 1999).

The Center for Disease Control (CDC) maintains records of outbreaks of waterborne diseases and reported 16 cases of Legionella sp. infection in Pennsylvania between 2001 and 2004, all associated with drinking water (CDC, 2004) (CDC, 2006).

The CWS design cooling tower outlet temperature is approximately 90°F (32.2°C) and the maximum hot year CWS inlet temperature is 94.8°F (34.9°C). Biocide treatment of the inlet water should minimize the propagation of micro-organisms. As a result, pathogenic thermophilic organisms are not expected to propagate within the condenser cooling tower system and should not create a public health issue.

Makeup water for the natural draft towers will be supplied from the Susquehanna River. The CWS will require approximately 23,808 gpm ~~(30,010~~(90,123 lpm) of makeup water. Of this, approximately 7,928 gpm ~~(90,123~~(30,011 lpm) will be used in blowdown. Biocide treatment of the CWS will limit the propagation of thermophilic organisms. Blowdown will discharge to the Susquehanna River.

Potential health impacts to workers from routine maintenance activities associated with the towers will be controlled through the application of industrial hygiene practices including the use of appropriate personal protective equipment.

~~It is concluded that~~Based on the above, the risk to public health from thermophilic microorganisms will be SMALL and will not warrant mitigation, except for the noted biocide treatment of the condenser cooling and service water systems.

5.3.4.2 Noise Impacts

Operation of the two CWS cooling towers and four ESWS for BBNPP will generate additional noise.

There ~~were~~are no known State or County noise ordinances. Salem Township has a qualitative noise standard in Section 318 of the Zoning Ordinance. It states "Noise which is determined to be objectionable because of volume, frequency or beat shall be muffled or otherwise controlled."

EPA developed human health noise guidelines to protect against hearing loss and annoyance and established an outdoor activity guideline of 55 dBA (EPA 1974).

To determine ambient noise levels in the vicinity of the BBNPP site, a survey was conducted during the February and March 2008 leaf-off period at one location on the proposed BBNPP site, at the 3 closest residential land uses and on the power line rights-of-way approximately 200 ft (61 m) from Route 11. A leaf-on survey at the five locations described above was conducted in June 2008. In addition, a leaf-on survey that included the onsite location and two additional locations to the north of the proposed BBNPP was conducted in June 2010. There were no observed audible levels from the operations of SSES Units 1 and 2 at any of the sampling stations for continuous measurements. The major source of environmental noise in the project area is from far-off unidentifiable traffic. The Ldn 24-hour logarithmic average Day/Night sound levels ranged from 57 dBA to 65 dBA during the leaf-off survey and ranged from ~~53~~48 dBA to 58 dBA during the leaf-on ~~survey (AREVA 2008 b, c).~~surveys.

As indicated in Section 5.8.1.3, modeled noise contours show that the CWS cooling tower sound pressure levels are approximately equal to or less than the measured ambient at most sound survey locations and less than the EPA guideline value. Subjectively, cooling tower noise would be essentially imperceptible at the offsite receptors ~~except at location 4 (~~during most times of ~~Figure 5.8-1), which is~~ the ~~closest residence to the towers.~~ day and night. Cooling tower noise would be perceptible ~~at this location at an Leq of 40 dBA~~ during quiet periods of the day or night and imperceptible at other times. The typical noise level from the two cell ESWS mechnical draft cooling tower is approximately 54 dBA at 800 ft (244 m), which is below the EPA guideline. The nearest residences is approximately ~~900~~1200 ft ~~(274~~(366 m) from the ESWS cooling tower, and noise levels are expected to be less than the EPA and HUD criteria.

Power plants generally do not result in offsite noise levels greater than 10 dB(A) above background and noise at levels between 60 and 65 dB(A) were generally considered of small significance (NRC, 1999). As a result, the impact of noise generation associated with the operation of cooling towers at BBNPP on members of the public will be SMALL, and will not warrant any mitigation.

5.3.4.3 References

CDC, 2004. Surveillance for Waterborne-Disease Outbreaks Associated with Drinking Water - United States, 2001-2002, Centers for Disease Control, October 22, 2004 / 53(SS08), 23-45, Website:http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5308a4.htm.

CDC, 2006. Surveillance for Waterborne Disease and Outbreaks Associated with Drinking Water and Water not Intended for Drinking - United States, 2003-2004, Centers for Disease Control, December 22, 2006 / 55(SS12); 31-58, Website:http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5512a4.htm.

CDC, 2007. Centers for Disease Control Fact Sheet, Naegleria Infection, Website: http://www.cdc.gov/ncidod/dpd/parasites/naegleria/2007_Naegleria.pdf.

EPA, 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, Environmental Protection Agency, PB 550/9-74-004, Website:http://www.nonoise.org/library/levels74/levels74.htm#table%20of%20contents.

NRC, 1999. Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437, Nuclear Regulatory Commission, Website:http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1437/v1/index.html.

Table 5.3-1— Parameter Values for the Simulations

Parameter	Units	January	August
Extreme ambient temperature	°F (°C)	32.0 (0.0)	86.5 (30.3)
Discharge temperature	°F (°C)	65.8 (18.8)	90.0 (32.2)
Temperature rise	°F (°C)	33.8 (18.8)	3.5 (1.9)
Discharge TMS	mg/l	556	642
Average intake rate	gpm (lpm)	27,850 (105,273)	27,850 (105,273)
Maximum intake rate	gpm (lpm)	34,460 (130,259)	34,460 (130,259)
Average discharge rate	gpm (lpm)	9,290 (35,116)	9,290 (35,116)
Maximum discharge rate	lpm (lpm)	11,170 (42,223)	11,170 (42,223)
Low Susquehanna River flow	cfs (cms)	2,848 (80)	1,246 (35)
Low Susquehanna River elevation	ft (m)	486.8 (148.4)	486.0 (148.1)
Mean Susquehanna River flow	cfs (cms)	12,482 (349)	4,473 (125)
Mean Susquehanna River elevation	ft (m)	489.8 (149.3)	487.5 (148.6)
Susquehanna River TMS	mg/l	134	196
Heat exchange coefficient (K)	BTU ft^{-2} day^{-1} °F^{-1} (KW m^{-2} °C^{-1})	58 (13.7)	104 (24.6)
Equilibrium Temperature (E)	°F (°C)	34 (1.1)	85 (29.4)

Table 5.3-2— Protected Use Receiving Water Body Temperatures °F (°C)

Critical use period	Warm Water Fishes (WWF) temperature
January 1-31	40 (4.4)
February 1-29	40 (4.4)
March 1-31	46 (7.8)
April 1-15	52 (11.1)
April 16-30	58 (14.4)
May 1-15	64 (17.8)
May 16-31	72 (22.2)
June 1-15	80 (26.7)
June 16-30	84 (28.9)
July 1-31	87 (30.6)
August 1-15	87 (30.6)
August 16-30	87 (30.6)
September 1-15	84 (28.9)
September 16-30	78 (25.6)
October 1-15	72 (22.2)
October 16-31	66 (18.9)
November 1-15	58 (14.4)
November 16-30	50 (10.0)
December 1-31	42 (5.6)

Table 5.3-3— Simulation Summary with Scenario Descriptions

Parameter	August	January
Susquehanna River flow, cfs (cms)	1,246 (35)	2,848 (80)
Water surface elevation, ft (m)	486.0 (148.1)	486.8 (148.4)
Susquehanna River Temperature, °F (°C)	86.5 (30.3)	32.0 (0.0)
SSES		
Temperature rise, °F (°C)	12.5 (6.9)	31.0 (17.2)
Intake rate, gpm (lpm)	42,300 (160,123)	42,300 (160,123)
Discharge rate, gpm (lpm)	11,200 (42,397)	11,200 (42,397)
BBNPP		
Temperature rise, °F (°C)	3.5 (1.9)	33.8 (18.8)
Intake rate, gpm (lpm) (Note 1)	34,458 (130,251)	34,458 (130,251)
Discharge rate, gpm (lpm) (Note 1)	11,172 (42,290)	11,172 (42,290)
Note(s) 1. These values bound those presented in Table 3.3-1.		

Table 5.3-4— Near-Field Plume Area (ft^2) and Volume (ft^3)

Temperature rise isotherm, °F	August		January	
	Area	Volume	Area	Volume
10	-	-	118	15.4
5	-	-	569	305.7
3	26	3.4	1,739	2,851.5
2	83	10.9	4,034	15,759.5
1	296	89.8	Not achieved in near-field	Not achieved in near-field

Table 5.3-5— Near-Field Plume Area (m^2) and Volume (m^3)

Temperature rise isotherm, °C	August		January	
	Area	Volume	Area	Volume
5.6	-	-	11	0.4
2.8	-	-	53	8.7
1.7	2	0.1	162	80.8
1.1	8	0.3	375	446.3
0.6	28	2.5	Not achieved in near-field	Not achieved in near-field

Table 5.3-6— Extreme Period Analysis of Plume Size

Period	WWF, °F (°C)	WWF ambient, °F (°C)	Blowdown temperature, °F (°C)	Blowdown temperature rise, °F (°C)	Target excess temperature for compliance, °F (°C)	Centerline distance to WWF, ft (m)
January 1-31	40 (4.4)	35 (1.7)	65.8 (18.8)	30.8 (17.1)	5.0 (2.8)	1.0 (0.3)
July 1-31	87 (30.6)	75 (23.9)	90 (32.2)	15.0 (8.3)	12.0 (6.7)	0.3 (0.1)
August 1-15	87 (30.6)	74 (23.3)	90 (32.2)	16.0 (8.9)	13.0 (7.2)	0.3 (0.1)
August 16-30	87 (30.6)	74 (23.3)	90 (32.2)	16.0 (8.9)	13.0 (7.2)	0.3 (0.1)

Table 5.3-7— CWS Cooling Tower Design Parameters

Design Parameter	Value
Number of cooling towers	2
Diameter overall	350 ft (107 m)
Diameter outlet	222 ft (68 m)
Height total	475 ft (145 m)
Altitude (above mean sea level)	~~694~~700 ft ~~(212~~(213 m)
Design duty	11,081 MMBtu/hr (3,238 MW)
Typical drift rate (percentage of circulating water flow rate)	0.001%
Circulating water flow rate	720,000 gpm (2,725,496 lpm)
Cooling range	27.6°F (15.3°C)
Approach	17°F (9.4°C)
Air flow rate total	54,848,028 ft^3/min (25,885 m^3/s)
Air mass flow rate	56,692 lb/s (25,715 kg/s)
Cycles of concentration	3.0
Salt (NaCl) concentration (mg/l)[1]	326.3 max. 211.8 ave.
[1]The salt concentration is conservatively based on 5 cycles of concentration. The plant is expected to normally operate at 3 cycles of concentration.	

Table 5.3-8— Modeled Plume Parameters

	Winter	Spring	Summer	Fall	Annual
Predominant direction[a]	East Northeast	South Southwest	South Southwest	South Southwest	South Southwest
Average plume length	~~0.615~~0.635 mi ~~(0.990~~(1.023 km)	~~0.359~~0.388 mi ~~(0.578~~(0.625 km)	~~0.274~~0.294 mi ~~(0.440~~(0.473 km)	~~0.385~~0.422 mi ~~(0.620~~(0.680 km)	~~0.372~~0.405 mi ~~(0.599~~(0.652 km)
Median plume length	~~0.578~~0.640 mi ~~(0.931~~(1.031 km)	~~0.246~~0.260 mi ~~(0.396~~(0.419 km)	~~0.231~~0.235 mi ~~(0.371~~(0.378 km)	~~0.289~~0.366 mi ~~(0.465~~(0.541 km)	~~0.263~~0.292 mi ~~(0.423~~(0.470 km)
Predominant direction ~~Note a~~	East Northeast	South Southwest	South Southwest	South Southwest	South Southwest
Average plume height ~~Note b~~	~~961~~997 ft ~~(293~~(304 m)	~~809~~846 ft ~~(247~~(258 m)	~~776~~810 ft ~~(236~~(247 m)	~~830~~869 ft ~~(253~~(265 m)	~~818~~853 ft ~~(249~~(260 m)
Median plume height ~~Note b~~	~~982~~1007 ft ~~(299~~(307 m)	~~828~~879 ft ~~(252~~(268 m)	~~808~~856 ft ~~(247~~(261 m)	~~846~~896 ft ~~(258~~(273 m)	~~836~~889 ft ~~(255~~(271 m)

~~Note(s)~~
a. Direction toward which plume is traveling.
b. Plume height from top of cooling tower.

Table 5.3-9— Maximum Salt Deposition Rate

Maximum deposition rate	~~0.0045 lbs/ac~~0.0177 lbs/acre per month ~~(0.0050 kg/ha~~(0.0199 kg/hectare per month)
Distance to maximum deposition	~~328.1~~3,937 ft ~~(100~~ (1,200 m)
Direction to maximum deposition	~~South Southwest~~East Northeast
Maximum deposition at the BBNPP substation/switchyard	~~0.0023 lbs/ac~~0.0008 lbs/acre per month ~~(0.0026 kg/ha~~(0.0009 kg/hectare per month)
Maximum deposition at the Susquehanna 500 kV Switchyard #2	0.0074 lbs/acre per month (0.0083 kg/hectare per month)
Maximum deposition at the ~~SSES Units 1 and 2 substation/switchyard~~ Susquehanna 500 kV Switchyard #1	0.0008 ~~lbs/ac~~ lbs/acre per month (0.0009 ~~kg/ha~~ kg/hectare per month)

Table 5.3-10— Total number and percent composition of fish and crayfish collected in impingement samples at the SSES River Intake Structure from April 22 , 2008 to April 20, 2009.

Common Name	Scientific Name	Total Number	Percent Composition
crayfish	Orconectes sp.	220	55.3
bluegill	Lepomis macrochirus	44	11.1
rock bass sp.	Ambloplites rupestris	34	8.5
channel catfish	Ictalurus punctatus	31	7.8
tessellated darter	Etheostoma olmstedi	18	4.5
spotfin shiner	Cyprinella spiloptera	16	4.0
spottail shiner	Notropis hudsonius	5	1.3
margined madform	Noturus insignis	4	1.0
smallmouth bass	Micropterus dolomieu	4	11.0
white crappie	Poxomis annularis	4	1.0
white sucker	Catostomus commersoni	4	1.0
yellow perch	Perca flavescens	3	.8
banded darter	Etheostoma zonale	2	.5
pumpkinseed	Lepomis gibbosus	2	.5
walleye	Sander vitreus	2	.5
bluntnose minnow	Pimephales notatus	1	.3
brown trout	Salmo trutta	1	.3
northern hog sucker	Hypentelium nigricans	1	.3
unidentified fish	-	1	.3
yellow bullhead	Ameiurus natalis	1	.3
Total		398	

Table 5.3-11— Total number and percent composition of each life stage of fish collected in entrainment samples from SSES River Intake Structure from April 22 to August 13, 2008.

(Page 1 of 2)

Common Name	Scientific Name	Life Stage						
		Unknown	Yolk-sac larvae	Post yolk-sac larvae	YOY	Yearling plus	Total	Percent Composition
banded darter	*Etheostoma zonale*	0	0	0	0	2	2	0.1
brown bulhead	*Ameirus natalis*	0	0	0	2	0	2	0.1
common carp	*Cyprinus carpio*	161	5	179	0	0	345	11.4
chain pickerel	*Esox niger*	0	1	1	0	0	2	0.1
channel catfish	*Ictaluru punctatus*	0	0	0	367	0	367	12.1
Clupeidae	*Clupeidae*	0	0	1	0	0	1	<0.1
Cyprinidae	*Cyprinidae*	0	40	495	0	0	535	17.6
Lepomis sp.	*Lepomis sp.*	0	0	5	0	0	5	0.2
margined madtom	*Noturus Insignis*	0	0	0	10	0	10	0.3
Percidae	*Percidae*	3	3	40	0	0	46	1.5
quillback	*Carpiodes cyprinus*	190	202	433	3	0	828	27.2
rock bass	*Ambloplites ruestris*	0	0	40	1	0	41	1.3
shield darter	*Percina peltata*	0	0	0	0	1	1	<0.1
smallmuoth bass	*Mocriopterus dolomieu*	0	0	60	2	0	62	2.0
spottail shiner	*Notropis hudsonius*	0	0	4	23	0	27	0.9
tessellated darter	*Etheostoma olmstedi*	0	0	0	0	1	1	<0.1
unidentified fish	-	7	0	0	0	0	7	0.2
unidentified darter	-	31	246	105	0	0	382	12.6
walleye	*Sander vitreus*	0	6	31	0	0	37	1.2
white sucker	Catostomus commersoni	0	11	256	19	0	286	9.4
yellow perch	Perca flavescens	0	4	48	0	0	52	1.7

Table 5.3-11— Total number and percent composition of each life stage of fish collected in entrainment samples from SSES River Intake Structure from April 22 to August 13, 2008.

(Page 2 of 2)

Common Name	Scientific Name	Life Stage						
		Unknown	Yolk-sac larvae	Post yolk-sac larvae	YOY	Yearling plus	Total	Percent Composition
Total		392	518	1,698	427	4	3,039	

Figure 5.3-1— Temperature Rise Above Ambient at the Surface for the Combined BBNPP and SSES Blowdown Discharges for August

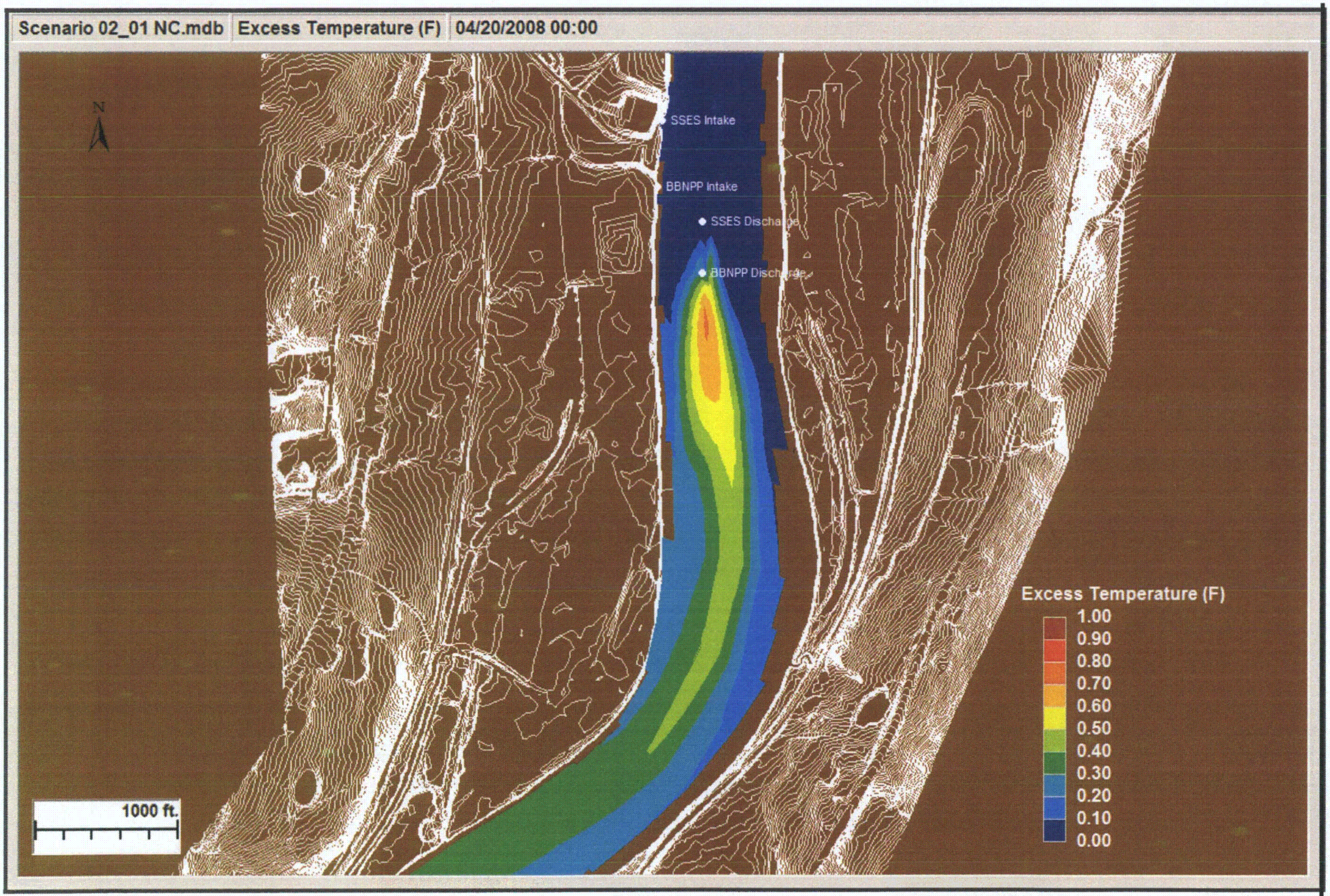


Figure 5.3-2— Temperature Rise Above Ambient at the Surface for the BBNPP Blowdown Discharge for August

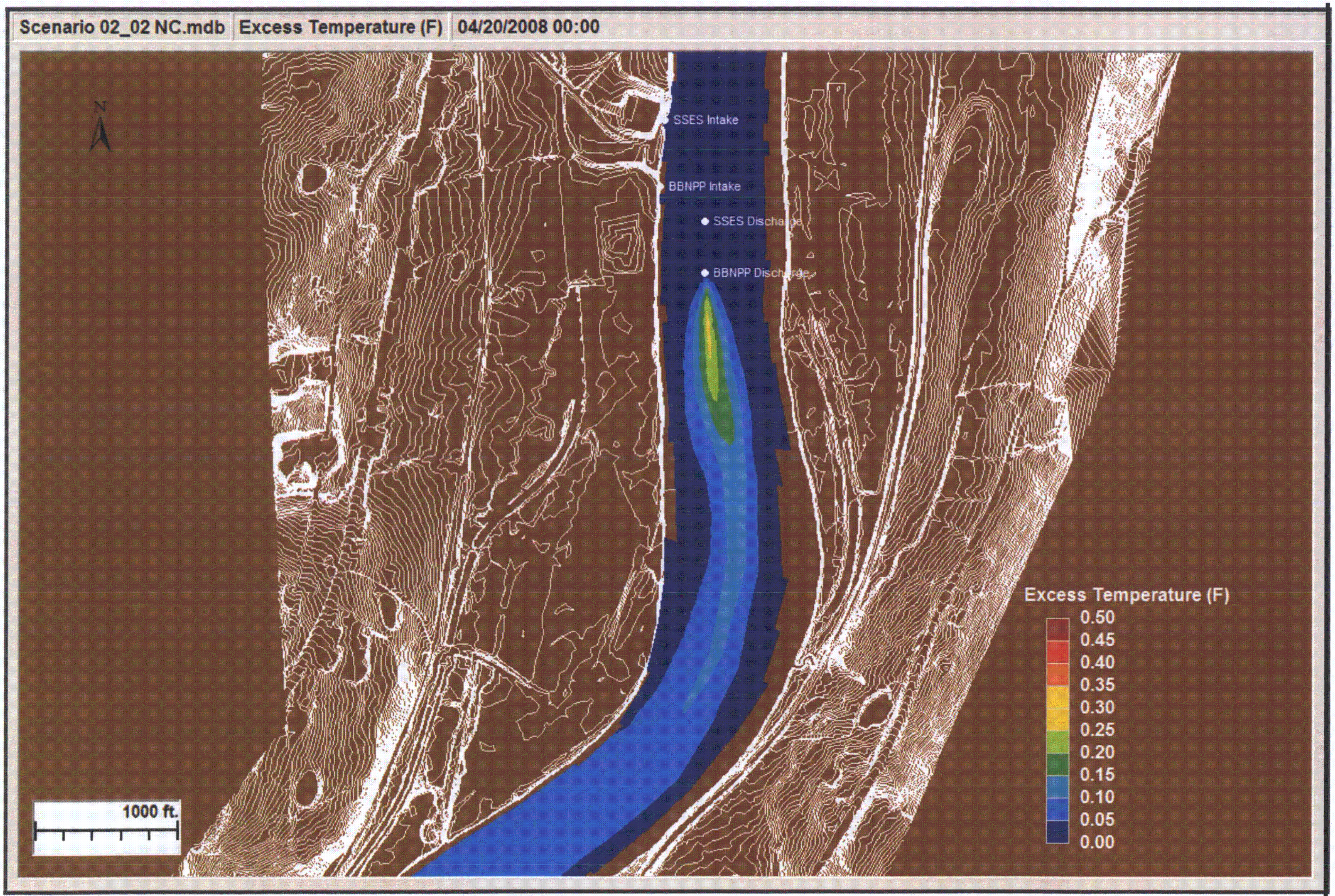


Figure 5.3-3— Temperature Rise Above Ambient at the Surface for the Combined BBNPP and SSES Blowdown Discharges for January

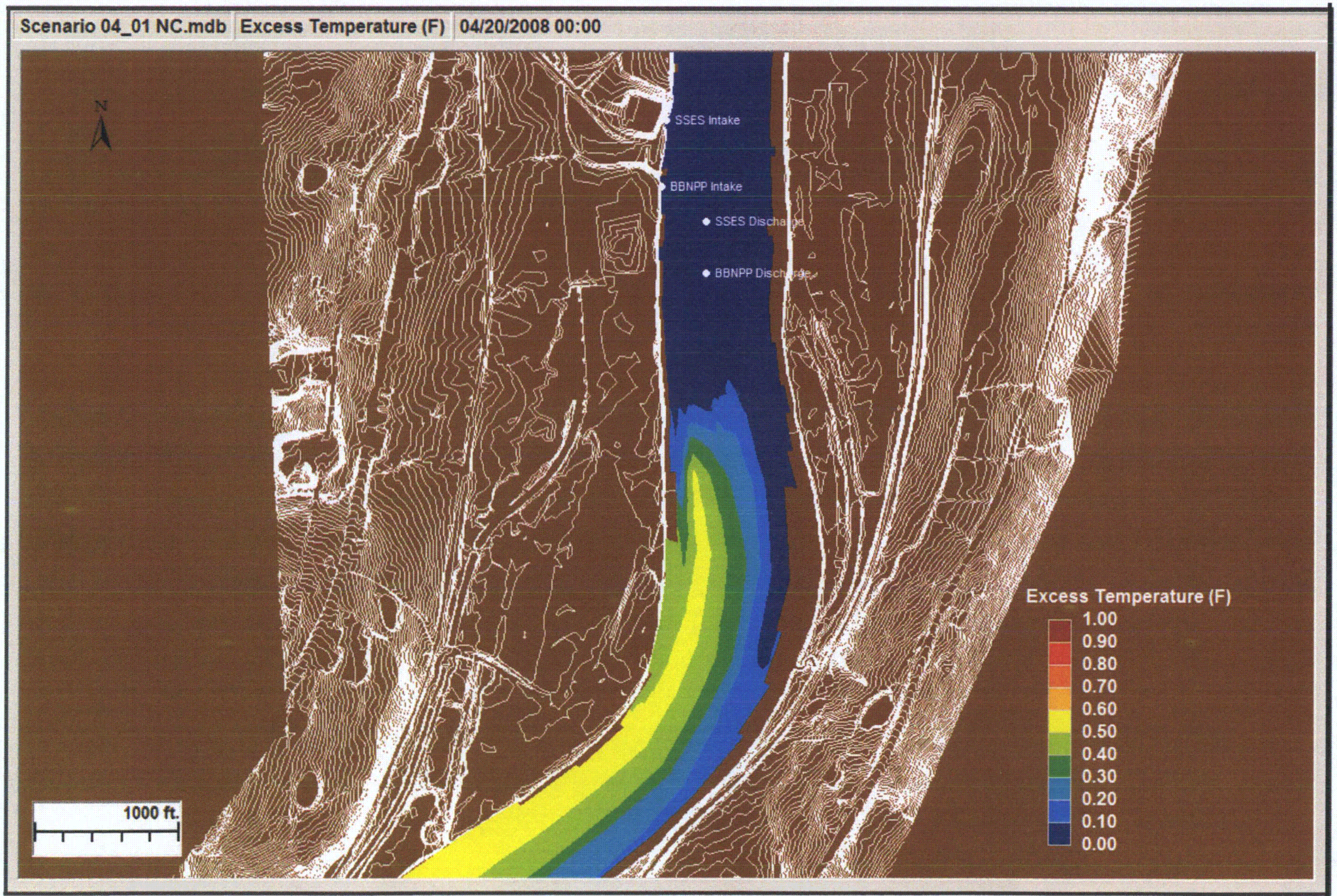


Figure 5.3-4— Temperature Rise Above Ambient at the Surface for the BBNPP Blowdown Discharge for January

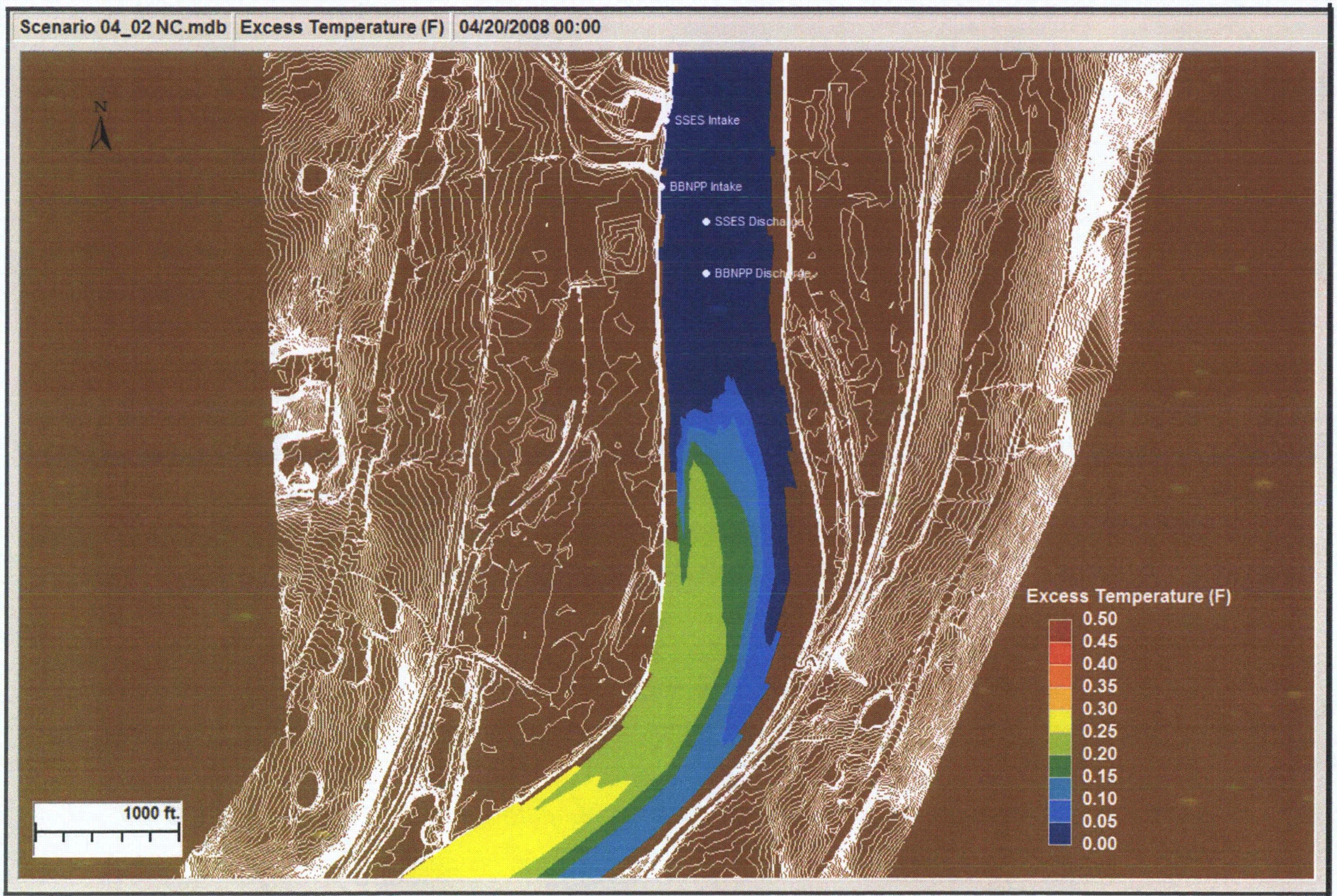


Figure 5.3-5— Total Number of Fish and Crayfish Collected in Impingement Samples at the SSES CWS, April 22, 2008 to August 12, 2008

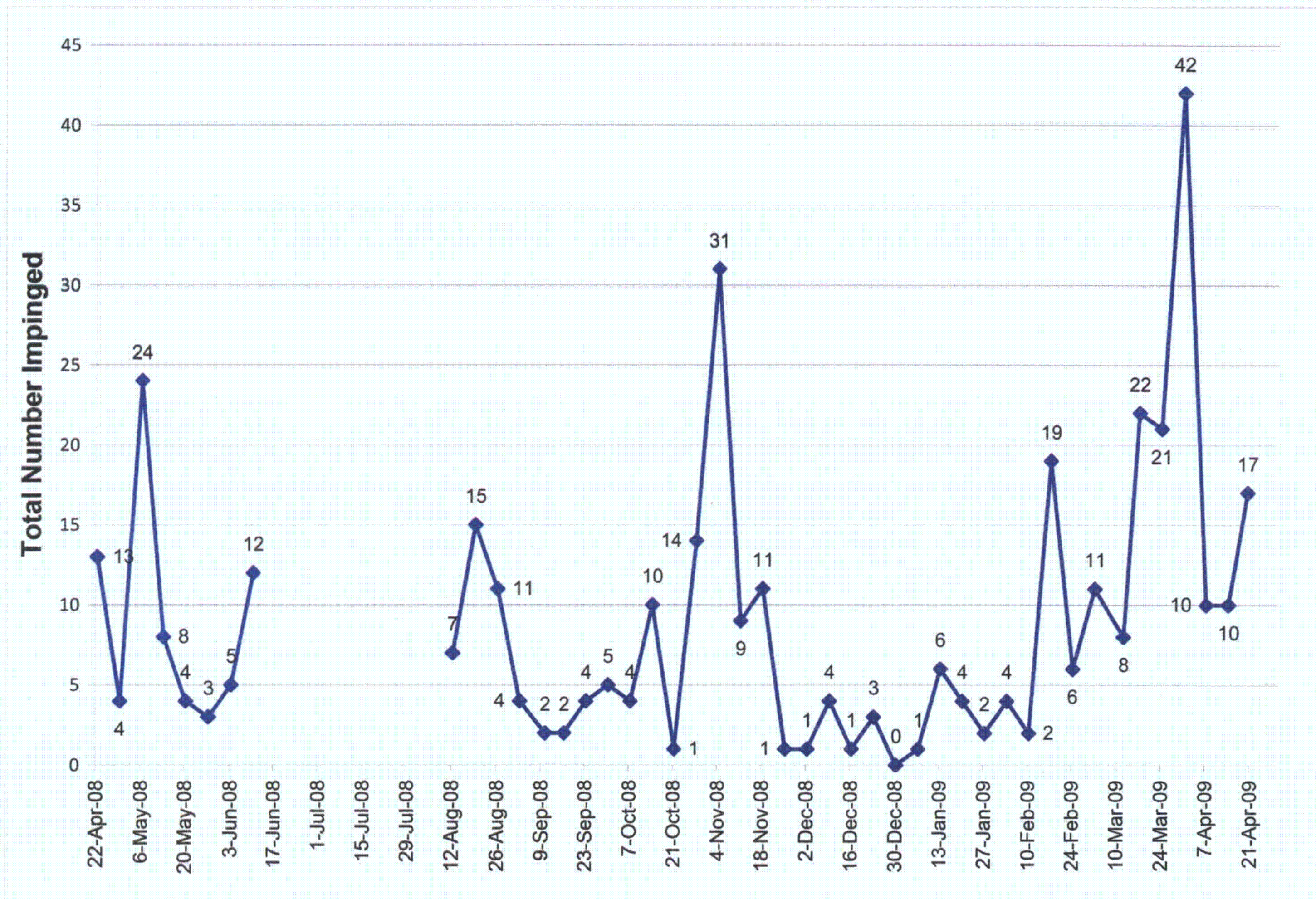
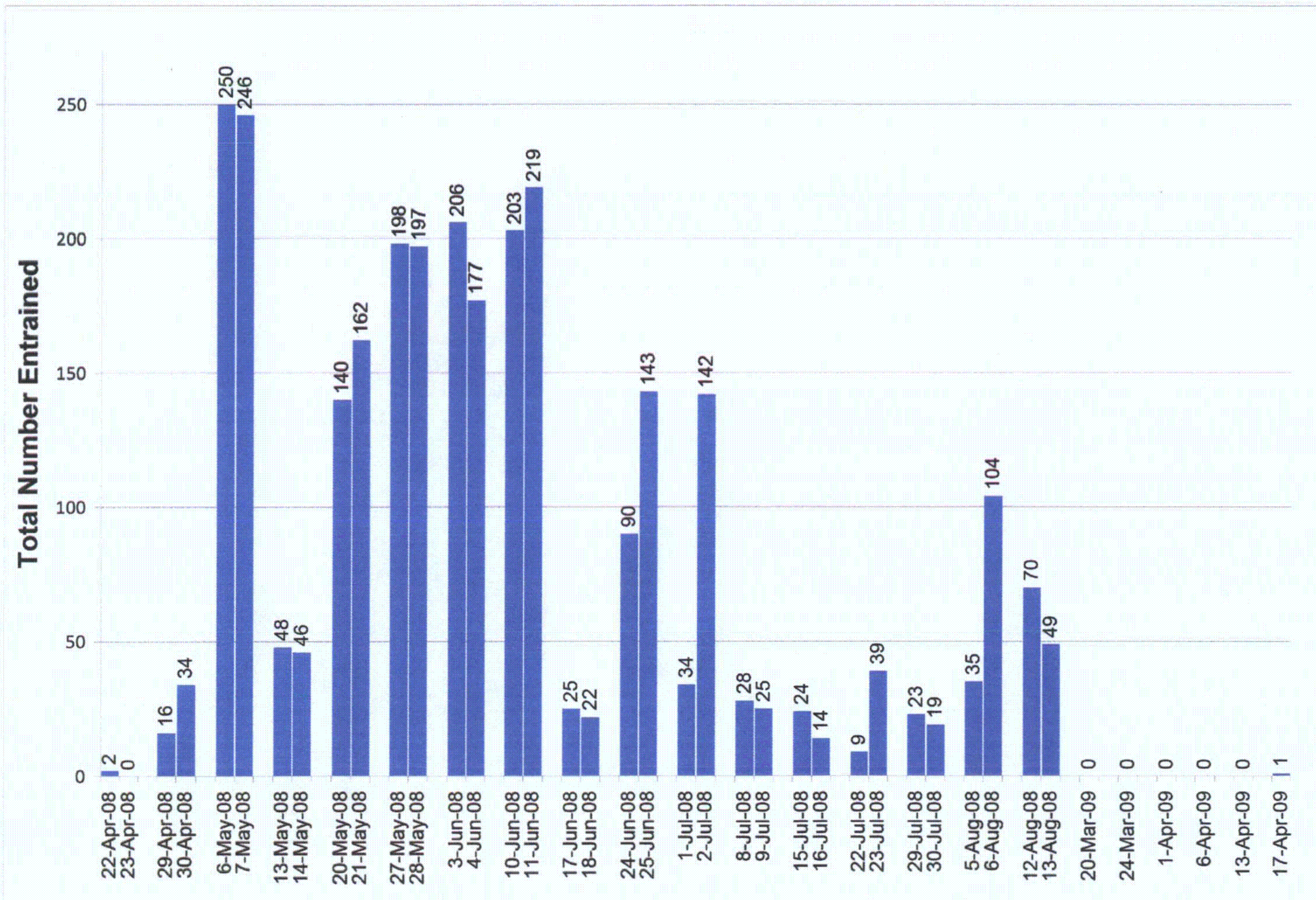


Figure 5.3-6— Total Number of Fish Collected in Entrainment Samples at the SSES River Intake Structure, April 22, 2008 to June 4, 2008



Enclosure 2

Response to RAI MET 5.3-3 for COLA Part 3 (ER); Section 5.3

Response to RAI MET 5.3-4 for COLA Part 3 (ER); Section 5.3

MET 5.3-3

ESRP 5.3.3.1

Summary: *Provide the SACTI input/output files for staff confirmatory analysis.*

Full Text: In accordance with ESRP 5.3.3.1, the NRC staff intends to perform a confirmatory analysis of impacts from cooling tower plumes. NRC staff will evaluate the applicant's SACTI model inputs, run the code, and compare the results with applicant's model output files. Therefore, provide in electronic format the input and output files for the SACTI code.

Response: Enclosure 3 contains the compact disc containing the SACTI code files.

Due to the Plot Plan Change, the location of the cooling towers was revised. The SACTI input/output files have subsequently changed since the original RAI response. The accompanying compact disc contains the SACTI code files requested in RAI MET 5.3-3 that incorporate the new location of the cooling towers due to the Plot Plan Change.

The files on the accompanying compact disc are as follows:

Date/Time	File Name	File Description
(SACTI Run #1)		
Sep 8 2010 7:55 pm	CD144_7Y.DAT	Met data file input to SACTI/surface data
Sep 8 2010 7:55 pm	MIX_7Y.TXT	Met data file input to SACTI/mixing heights
Sep 8 2010 7:55 pm	MULT.USR	Input /control stream for SACTI MULT processor
Sep 8 2010 7:55 pm	MULT.OUT	Text output listing for SACTI MULT processor
Sep 8 2010 7:55 pm	PREP.USR	Input /control stream for SACTI PREP processor
Sep 8 2010 7:55 pm	PREP.OUT	Text output listing for SACTI PREP processor
Sep 8 2010 7:44 pm	TABLES.USR	Input /control stream for SACTI TABLES processor
Sep 8 2010 7:55 pm	TABLES.OUT	Text output listing for SACTI TABLES processor

Date/Time	File Name	File Description
(SACTI Run #2-for Susquehanna 500 kV Switchyard #2)		
Sep 8 2010 8:09 pm	MULT.USR	Input /control stream for SACTI MULT processor
Sep 8 2010 8:09 pm	MULT.OUT	Text output listing for SACTI MULT processor
Sep 8 2010 8:09 pm	PREP.USR	Input /control stream for SACTI PREP processor
Sep 8 2010 8:09 pm	PREP.OUT	Text output listing for SACTI PREP processor
Sep 8 2010 8:09 pm	TABLES.USR	Input /control stream for SACTI TABLES processor
Sep 8 2010 8:09 pm	TABLES.OUT	Text output listing for SACTI TABLES processor

COLA Impact
The COLA will not be revised as a result of this response.

MET 5.3-4

ESRP 5.3.3.1

Summary: *Provide the location of the Essential Service Water Supply System (ESWS) and height of ESWS towers above ground level relative to nearby structures and roads. Provide an assessment of the potential for increases in ground-level fogging and icing due to the ESWS cooling towers being physically closer to the ground than SSES cooling towers.*

Full Text: ESRP 5.3.3.1 directs staff to evaluate impacts associated with cooling tower plumes. In the ER, the four smaller ESWS mechanical draft cooling towers are qualitatively dismissed as having little impact, especially when compared to the larger CWS cooling towers. Provide justification for this statement, considering the ESWS cooling towers are considerably shorter and therefore could contribute to ground-level fogging and icing in the immediate vicinity of the cooling towers.

Response: Due to the Plot Plan Change the location of the ESWS towers has changed with respect to nearby roads.

The ESWS towers have a height of 96 feet (29 m) above ground. Nearby offsite roads (Market St.) and structures are approximately 500 feet (152 m) away.

The SACTI model was applied to the ESWS towers for the Calvert Cliffs project to analyze simultaneous operation of two of the four ESWS units, i.e., the worst-case operation, to estimate these impacts. The SACTI results indicate a low probability of occurrence of visible plumes from the ESWS units, with the highest frequency of occurrence limited to a distance of 100 meters from the location of the ESWS units. Beyond a distance of 100 meters the SACTI results show the plume dissipating rapidly and the plume frequency dropping to a range of 0% to 2.1% depending on distance and direction.

Based on the SACTI modeling results for the ESWS towers for the Calvert Cliffs project (same heat dissipation rate and tower height as Bell Bend), the impacts from the Bell Bend ESWS towers would not be expected to contribute to ground-level fogging and icing in the immediate vicinity (at the nearest roads and structures) of the cooling towers.

COLA Impact

The COLA will not be revised as a result of this response.

Enclosure 3

RAI MET 5.3-3 Data Files, Bell Bend Nuclear Power Plant, Luzerne County, Pennsylvania
(Compact Disc)