Harris Advanced Reactor (HAR)
Section 404(b)(1) Alternatives Analysis
Revision 2
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Executive Summary

Progress Energy Carolinas, Inc., (PEC) is proposing to add two Westinghouse AP1000 advanced nuclear reactors to the Shearon Harris Nuclear Power Plant site (Harris site) to meet growing demand for electrical power in its primary customer region. As part of the approval process with the Nuclear Regulatory Commission (NRC), PEC has also completed an Environmental Report (ER) for the Shearon Harris Nuclear Plant Units 2 and 3 Combined Operating License (COL) application.

PEC has evaluated a number of alternatives for achieving new baseload generation that is reliable and proximate to PEC's major customer base. The no-action alternative would not meet the stated purpose and need and was eliminated from consideration. Non-nuclear alternative energy sources were evaluated and found to not meet the stated purpose and need and were eliminated from further consideration. PEC evaluated 11 sites for potential use for adding the nuclear baseload required to meet purpose and need; 7 of these sites were eliminated through exclusionary criteria during the siting study. Of the four carried forward for further consideration (Marion site, Robinson site, Brunswick site, and Harris site), the Harris site was selected as the applicant's preferred alternative based on results of PEC's technical evaluation, strategic considerations, and preliminary transmission study.

Review of potentially adverse impact on the aquatic ecosystem indicated that the Marion site and Robinson site both would result in substantially greater impacts to wetlands and streams compared to the preferred alternative, the Harris site, both for construction of drought mitigation reservoirs and for transmission line upgrades. Neither the Marion nor the Robinson site constitutes an environmentally preferred alternative to the Harris site based on the greater environmental impacts to the aquatic ecosystem. The Marion and Robinson sites were dropped from further evaluation.

The Brunswick alternative would result in greater impact to wetlands through filling activities for the power block and support facilities, and through conversion of forested wetlands to herbaceous wetlands along the new transmission line upgrades than the Harris alternative would for either of these activities. The Harris alternative would result in inundation and conversion of wetland and stream habitats to reservoir habitats through reservoir expansion and conversion of forested wetlands along the new transmission line upgrades. Because neither alternative provided a clearly preferable environmental alternative based on potential impacts to the aquatic ecosystem, the Brunswick site was carried forward for more detailed evaluation against the Harris site.

Dredge and fill activities are considered to be loss of Waters of the United States. The U.S. Army Corps of Engineers and U.S. Environmental Protection Agency also consider inundation of wetlands and streams to be losses for permitting and mitigation consideration; however, aquatic functions are not permanently lost as they are through filling activities, but may be altered by conversion of existing wetlands and streams to non-linear surface waters. Although clearing for additional rights-of-way for required transmission line upgrades is not a dredge and fill activity or inundation impact, the

clearing of wetland community types, particularly forested habitats, will result in some aquatic resource functional diminishment. The following is a summary of potential losses based on magnitude and function for the Brunswick and Harris alternatives:

- The Brunswick alternative will result in more fill than the Harris alternative in special aquatic sites, including approximately 16 acres of estuarine tidal wetlands and 2.5 acres of associated estuarine tidal streams (1.2 miles total length), as well as 19 acres of forested riverine wetlands and a total of 1.8 miles of stream. The tidal stream and wetlands are part of Nancy's Creek, which is designated as a High Quality Water and Primary Nursery Area, and contains Essential Fish Habitat and comprises several Areas of Environmental Concern under the Coastal Area Management Act. The Harris alternative may result in fill to approximately 5 acres of forested riverine wetlands and 0.8 to 1.4 miles of stream.

- The Harris alternative may result in inundation of approximately 598 acres of riverine wetlands and 26.8 miles of stream, as well as 3,331 acres of non-linear surface waters (existing Harris Reservoir and 10 acres of ponds). The expansion of the reservoir by approximately 3,570 acres will result in a gain of approximately 61.9 miles of riparian perimeter with forested buffer compared to the existing reservoir. The gain of 61.9 miles of reservoir riparian zone is expected to offset functional losses from clearing and inundation of the existing forested riparian zone (53.6 miles based on 26.8 miles of stream with buffer on both streambanks). Reservoir habitats contained within the shallow littoral zone (less than 6.6 feet in depth) will experience a net gain of approximately 430 acres (increasing from 959 acres to 1,389 acres).

- The Brunswick alternative will result in clearing of approximately 1,450 acres of wetland habitats for transmission line upgrades, of which 580 acres are within areas identified as Significant Natural Heritage Areas. The Harris alternative will result in clearing of approximately 95 acres of wetland habitats for the Harris alternative, of which 6 acres are within areas identified as Significant Natural Heritage Areas.

- No other significant adverse environmental consequences were identified among the other public interest factors for either the Harris or Brunswick sites, other than for potential for impacting endangered and threatened species. The Brunswick alternative has greater potential adverse impacts to habitat for the federally endangered red-cockaded woodpecker along the new transmission line upgrades, and potential adverse impacts through increased incidental take of federally threatened and endangered sea turtles within the intake canal as flows are increased to provide water for the new units.

Although the Harris alternative has more impacts through filling and flooding combined in comparison to the Brunswick alternative, the Brunswick alternative will result in more adverse impacts to aquatic resources and aquatic resource functions through filling, forested wetland clearing, and degradation of wetlands identified as Significant Natural

Heritage Areas. Brunswick also has the potential for more adverse impacts to federally Endangered and Threatened species. Based on the difference in types of aquatic ecosystem impacts and the difference in functions lost or gained, the Brunswick alternative does not constitute an alternative demonstrating less adverse impact on the aquatic ecosystem in comparison to the preferred alternative, the Harris site. Because the Harris site has the least overall impact on the aquatic environment and no other significant adverse environmental consequences, the Harris site has been identified as the applicant's preferred alternative, and it is believed that the Harris site is also the least environmentally damaging practicable alternative (LEDPA).

I. Proposed Action

A. Project Background Information

Progress Energy Carolinas, Inc., (PEC) is proposing to add two Westinghouse AP1000 advanced nuclear reactors to the Shearon Harris Nuclear Power Plant site (Harris site) to meet growing demand for electrical power in its primary customer region. As part of the approval process with the Nuclear Regulatory Commission (NRC), PEC has also completed an Environmental Report (ER) for the Harris Advanced Reactor (HAR) Units 2 and 3 Combined Operating License (COL) application. The two units will be referred to as HAR-2 and HAR-3, respectively, in this document. The existing Shearon Harris Nuclear Power Plant Unit 1 will be referred to as HNP is this document. The ER provides detailed information on the proposed plan to add two advanced nuclear reactors to the existing Harris site. Also provided in the ER is information resulting from a proprietary siting study conducted in 2006 that identified potential sites and assessed each against numerous parameters to identify the four alternative sites described herein.

PEC is committed to a long-term, balanced solution to meeting growing energy needs – a solution that includes three main components: (1) increased energy efficiency; (2) investments in renewable energy sources and other emerging energy technologies; and (3) upgrading of existing power plants and investments in new plants when needed.

B. Proposed Action

PEC proposes to install two advanced nuclear reactors at the Harris site. The Harris Advanced Reactor project includes the construction of the facility itself, the construction of an intake structure and pipeline to supply make-up water from the Cape Fear River, placement of a second make-up discharge structure within Harris Lake, upgrades to transmission lines and roadways, and increasing the normal pool elevation of Harris Lake from 220 feet NGVD29 to 240 feet NGVD29 to mitigate potential impacts to downstream users of the Cape Fear River from drought conditions.

C. Specific Activity Requiring Department of the Army Permit

The discharge and intake structures constitute activities that may be considered water dependent. The remaining activities involve unavoidable impacts to jurisdictional wetlands and streams that are subject to the rebuttable presumption concerning non-water dependent activities pursuant to Section 404 regulations under the Clean Water Act (CWA). The purpose of the 404(b)(1) Guidelines is to restore and maintain the chemical, physical, and biological integrity of waters of the United States through the control of discharges of dredge or fill material. Direct discharges of dredge or fill material will result only from the construction of the HAR-3 cooling tower, intake structures, and temporary discharges associated with the makeup water pipeline. The inundation of wetlands and streams around Harris Lake is not a direct discharge of dredge or fill material, but will result in a conversion of habitat type and specific function through flooding, including conversion of upland areas to waters of the United States.

D. Analysis Methodology

The primary sources of information summarized within this analysis are the COL Application Environmental Report (COLA ER) and a proprietary siting study (PEC 2006). Information from these sources as well as additional information obtained from other PEC documents and supplemented by other available information from various sources was used to summarize potential impacts (direct, secondary, and cumulative) to resources that may be reviewed by the U.S. Army Corps of Engineers (USACE) to determine the LEDPA.

The primary consideration of this analysis was to summarize potential impact on the aquatic ecosystem as well as other potential environmental consequences. Direct impacts considered included potential siting location of the new facility, new or expanded cooling water sources, intake pipes, and related infrastructure improvements including new or relocated roads and transmission lines. This analysis also includes potential impacts on the following parameters, consistent with the 404(b)(1) guidelines: conservation, economics, aesthetics, general environmental concerns, wetlands, historic properties, fish and wildlife values, flood hazards, flood plain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership, and in general, the needs and welfare of the people. Non-nuclear alternatives and alternative sites were reviewed for practicability for meeting purpose and need; alternatives not meeting purpose and need or determined to be impracticable, or determined to result in greater adverse impact on the aquatic ecosystem than the preferred alternative were eliminated from further consideration at appropriate stages in the evaluation, as described in the following sections.

Desktop evaluation techniques and limited field evaluations were employed to supplement information available in the COLA ER and siting study to assist with identifying potential impacts to aquatic resources and other public interest factors. GIS and Data Management Tasks were completed using MS Access GeoDatabases and ESRI ArcGIS software with Spatial Analyst and 3D Analyst Extensions. The goal of this evaluation was to derive comparisons of the environmental factors at each of the four alternative sites carried forward from the siting study and COLA ER. This study was undertaken at three different levels of resolution: 400-acre potential power block impact zones, localized watersheds, and transmission lines.

Additional data were collected for the purpose of determining potential impacts to wetlands and streams. Following compilation and preliminary review of available GIS data, limited field evaluations were undertaken to refine the GIS-based aquatic resource impact estimates. Based on training data collected in the field, the estimated location and extent of wetlands were refined for comparable areas exhibiting similar landform, soils, vegetation, and hydrologic influence. Wetland habitats were characterized by the North Carolina Wetlands Assessment Method (NCWAM) dichotomous key for determining wetland types to facilitate comparison. Although not yet fully implemented, the USACE,

EPA, N.C. Division of Water Quality (DWQ), and N.C. Division of Coastal Management (DCM) intend to use NCWAM to make wetland functional assessments in North Carolina (USACE 2009).

Following refinement of wetlands approximations, site visits were conducted to review general accuracy at sites that had not been visited previously, with collection of additional training data as needed for further refinement of approximations. A field visit was held in the Brunswick County area on August 18, 2009 with the USACE to review methodology and preliminary results of the wetland approximations for the transmission line evaluation. Additional refinement of the aquatic resource estimated extent and NCWAM characterization occurred following site reviews at additional sites undertaken for functional assessment data collection in June 2010.

A 400-acre project study area (power block) was initially evaluated as a surrogate for onsite impacts that may result from build-out of the nuclear facility as well as attendant onsite infrastructure needs. To initially estimate impacts for the 400-acre potential power block area, the latitude and longitude coordinates for the alternative sites were provided by PEC and 400-acre circles were created outward from each of the center points. Data were extracted and quantified in Geodatabases from National Hydrography Dataset (High Resolution), National Wetlands Index Wetlands and Watershed Polygons, USGS Land Use Land Cover Grids, and the Natural Resources Conservation Service SSURGO Soils. These data were overlaid onto USGS Topographic Digital Raster Graphics and 2008 National Aerial Imagery Program 1-meter Orthoquads, and supplemented by USGS National Map Seamless Server LiDAR derived elevation files to develop a general picture of site condition. FEMA Flood data were not used for comparisons due to unavailability for Marion County.

Subsequent to the initial evaluation, more detailed information for the potential Harris power block and support facilities was utilized, along with results of the jurisdictional delineation for this area. Based on review agency concerns for consideration of avoidance and minimization of impacts, as well as consideration for the effects of future potential sea level rise, PEC also re-evaluated the initial 400-acre power block area evaluated for the Brunswick alternative. Complete avoidance of impacts to wetlands and streams was identified as not practicable, and the present evaluation is based on minor adjustments resulting from preliminary identification of site constraints as well as avoidance and minimization efforts for sensitive aquatic resources.

Volume and flood data for cooling water supply expansion had previously been estimated for the Harris site but not for Robinson or Marion sites. PEC provided estimates of storage volumes for the Robinson and Marion sites that would provide comparable cooling water for reliable operation during drought conditions to that determined for the Harris site, based on available inflow to each site. Grids of the 10 meter National Elevation Dataset were obtained for the Robinson and Marion site watersheds. These grids were converted to Triangulated Irregular Networks (TINs). Volumetric calculations were completed to assess the depth and aerial extent of water storage that would result at

each site to provide the equivalent drought mitigation to Harris, and the impacts associated with the water storage footprints.

General routes for transmission line upgrades were digitized from aerial photography and topographic imagery as well as from data obtained from PEC transmission engineers and the siting study. Potential impacts to aquatic resources were determined for additional right-of-way (ROW) clearing limits extending 50 feet to either side of existing cleared ROWs for each new line co-located with an existing right-of-way. ROW clearing limits for new lines on new location were based on 100 foot widths. Impacts for transmission line upgrades are based on clearing for new ROW only, no changes were projected for existing cleared, maintained ROW.

North Carolina Natural Heritage Program Element Occurrence Representations were extracted within a 1-mile buffer from the 400-acre power block sites, new or expanded reservoir limits, and transmission line upgrade routes. Potential impacts to red-cockaded woodpeckers were estimated based on occurrences within 1.0 mile of the project component that would need additional evaluation if the alternative is selected. Potential impacts to other federal endangered or threatened species were estimated based on occurrences within 500 feet of the project component.

II. Purpose and Need for the Project

A. Basic Project Purpose and Water Dependency

The basic project purpose is to generate electrical power. Electric power generation itself is not a water dependent activity. As a result, the applicant must rebut the presumption that a project alternative is available that would not affect special aquatic sites.

The proposed project is the development of new nuclear baseload generating capacity to supply electricity to PEC's service area, using advanced technology to produce reliable generation that is located proximate to its major customer base and that minimizes overall impacts to the environment.

B. Overall Project Purpose for the 404(b)(1) Analysis

The overall project purpose is to develop new nuclear baseload generating capacity to reliably supply electricity to PEC's service area using advanced technology. In this instance, advanced technology indicates nuclear power generation using advanced reactor technology. The purpose of this 404(b)(1) analysis is to provide the applicant's demonstration that its preferred alternative is the least environmentally damaging practicable alternative that meets the project purpose.

C. Project Need

The new nuclear baseload generation needs to be reliable and proximate to PEC's major customer base. The project also needs to minimize overall environmental impacts as much as practicable. An increased volume of cooling water is needed to safely and reliably produce this baseload amount during drought conditions. As a result, the normal pool elevation of Harris Lake is proposed to be raised from 220 feet NGVD29 to 240 feet NGVD29 to provide this additional capacity.

III. Alternatives

A. Development of Alternatives

Headquarters of the U.S. Army Corps of Engineers (HQUSACE) guidance from 22 April 1986 and November 1992 requires that alternatives be practicable to the applicant and that the purpose and need for the project must be the applicant's purpose and need. This guidance also states that project purpose is to be viewed from the applicant's perspective rather than only from the broad, public perspective. The essential point of the HQUSACE policy guidance is that under the Section 404(b)(1) Guidelines, an alternative must be available to the applicant to be a practicable alternative. Section 40 CFR 230.10 (a) of the Guidelines state that "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant environmental consequences". Pursuant to 40 CFR 230.10(a)(2) practicable alternatives are those alternatives that are "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purpose". The 404(b)(1) Guidelines Preamble, "Economic Factors", 45 Federal Register 85343 (December 24, 1980) states, "if an alleged alternative is unreasonably expensive to the applicant, the alternative is not practicable".

Although sufficient information must be developed to determine whether the proposed activity is in fact the least environmentally damaging practicable alternative (LEDPA), the Guidelines do not require an elaborate search for practicable alternatives where, as here, it can be reasonably anticipated that there are only minor differences between the environmental impacts of the proposed activity and potentially practicable alternatives. Those alternatives that do not result in discernibly less impact to the aquatic ecosystem may be eliminated from the analysis since section 230.10(a) of the Guidelines only prohibits discharges when a practicable alternative exists which would have less adverse impact on the aquatic ecosystem. Since evaluating practicability is generally the more difficult aspect of the alternatives analysis, this approach should save time and effort for both the applicant and the regulatory agency. By initially focusing the alternatives analysis on the question of impacts to the aquatic ecosystem, it may be possible to limit, or eliminate altogether, the number of alternatives which have to be evaluated for practicability.

Section 404 authorization cannot be granted for jurisdictional impacts resulting from the discharge of dredge or fill material if there is a practicable alternative to the proposed action which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have any other significant adverse environmental consequences. The alternatives analysis must rigorously explore and objectively evaluate reasonable and practicable alternatives capable of achieving the overall project purpose.

B. Sequenced Search for Less Environmentally Damaging Alternatives

1. No-Action Alternative

The no-action alternative is a scenario under which the applicant does not undertake the proposed federal action and HAR 2 and HAR 3 (HAR), as described in COLA ER Chapter 2, is not constructed and no other generating station, either nuclear or non-nuclear, is constructed and operated. As stated in NUREG-1555, *Standard Review Plans for Environmental Reviews of Nuclear Power Plants*:

> The no-action alternative would result in the facility not being built, and no other facility would be built or other strategy implemented to take its place. This would mean that the electrical capacity to be provided by the project would not become available.

The most significant effect of the no-action alternative would be the loss of the potential 2000 megawatts electric (MWe) of energy, which could lead to a reduced ability of existing power suppliers to maintain reserve margins and supply lower-cost power to customers. COLA ER Chapter 8 describes the evaluation of the need for power and discusses a 2-percent annual increase in electricity demand in North Carolina over the next 10 years. The no-action alternative would restrict the ability of PEC to provide safe, reliable baseload power within North Carolina and South Carolina to meet the projected demand obligations of approximately 900 megawatts (MW) additional baseload every 4 years as discussed in COLA ER Section 8.4. Under the no-action alternative, PEC would not be able to satisfy the concerns about climate change and greenhouse gas reductions in North Carolina and the southeastern United States. As discussed in COLA ER Chapter 8 and COLA ER Subsection 9.2.1, because this area of the country already imports a portion of its electricity, the ability to import additional resources in a cost-effective manner is limited.

The options outlined above are not optimal from the standpoint of the cost of operation or the cost of supplied power. PEC's fuel supply within the Region of Interest (ROI) could become increasingly dependent on fossil-fuel generation and other alternatives. Without additional capacity, the region would not only remain heavily dependent on fossil fuel generation, it would not recognize the role of fuel diversity in the overall reliability of the State's power system, as discussed in COLA ER Section 8.4. If PEC took no action at all to meet growth demands, the ability to supply low-cost, reliable power to its customers would be impaired. PEC would not be able to support national goals, as established by the Energy Policy Act (EPACT) of 2005, to advance the use of nuclear energy.

In addition to the benefits in COLA ER Section 10.4, additional benefits of the construction and operation of the HAR include economic and tax impacts to the surrounding region that are described in COLA ER Subsections 4.4.2, 4.4.3, 5.8.2.1, and 5.8.2.2. Under the no-action alternative, none of the benefits of the proposed project as described in the COLA ER would be realized.

Under the no-action alternative, the predicted impacts from the project would not occur at the site. Impacts would result primarily from the construction of the facilities, increasing the operating level of Harris Reservoir and the withdrawal of water from the Cape Fear River. The impacts from construction of the HAR include impacts to land use, water-related impacts, ecological impacts, and socioeconomic impacts as summarized in Table 4.6-1 of the COLA ER. Impacts resulting from operation are summarized in Table 5.10-1 of the COLA ER. The benefits of implementing the no-action alternative would include avoiding the impacts resulting from the project as described in the COLA ER sections referenced above; however, none of the project objectives would be realized.

The no-action alternative does not meet the applicant's stated purpose and need and is not a viable alternative. As such, the no-action alternative was dropped from further consideration.

A second no-action alternative for evaluation was identified by the USACE as an alternative for the NRC's preferred alternative, the Harris alternative (see Section III.B.3.d), that would not require a 404 permit (no impacts to Waters of the U.S.). This alternative was evaluated to determine the reliability of the cooling water supply if the existing Harris Reservoir level was maintained at its current 220-foot NGVD29 operating level, supplemented by withdrawals from the Cape Fear River, and used to supply cooling water to all three nuclear reactor units. Hydrologic modeling, as described in a technical memorandum, Determination of Future Harris Reservoir Storage Requirements, demonstrated that the reservoir provided an insufficient water supply for the facility for more than 40 percent of the 80-year simulation period (CH2M HILL 2010). This no-action alternative does not meet the applicant's stated purpose and need and is not a viable alternative. As such, this no-action alternative was also dropped from further consideration.

2. Other Project Designs

The Environmental Report (COLA ER) identified alternatives that would require the construction of new generating capacity, such as wind, geothermal, oil, natural gas, hydropower, municipal solid wastes, coal, photovoltaic cells, solar power, wood waste/biomass, and energy crops, as well as any reasonable combination of these alternatives. In addition, alternatives that would not require new generating capacity were evaluated, including initiating energy conservation measures and Demand-Side Management (DSM), reactivating or extending the service life of existing plants within the power system, and purchasing electric power from other sources. Section 9.2 of the COLA ER discusses these alternatives. All but coal and natural gas were eliminated from further consideration based on availability in the region, overall feasibility, and environmental consequences.

For coal, impacts to the aquatic environment would not be less than the preferred alternative, and coal would also have additional significant adverse environmental consequences (COLA ER 9.2.3.1). The nuclear plant would require a dry land footprint

of 400 acres compared to 1,700 acres required for a coal–fired plant. Both types of facilities would require a similar amount of inundated footprint for cooling water. Transmission line upgrades would be similar for both types of facilities. Conventional coal systems produce emissions resulting in carbon footprint approximately 200 times higher than a nuclear power generation facility. Human health effects from coal combustion are also greater, and acid rain is a potential impact. Coal was dropped from further consideration.

For natural gas, impacts to the aquatic environment would not be less than the preferred alternative, and gas would also have additional significant adverse environmental consequences (COLA ER 9.2.3.2). The gas-fired alternative would require a footprint of 110 acres, plus at least an additional 3,600 acres of land required for wells, collection stations, and pipelines to bring the natural gas to the generating facility. The natural gas facility would also require significant cooling water (COLA ER 9.2.3.2.3). Transmission line upgrades would be similar for both types of facilities. Current gas-powered electricity generation has a carbon footprint that is about half that of coal, but still approximately 100 times higher than the carbon footprint of a nuclear power generation facility. Natural gas was dropped from further consideration.

Based on environmental impacts and economics, PEC has concluded that nuclear power is a suitable electric generating power source (COLA ER 10.4.1.2). For the remaining analysis, nuclear will be considered the technology of choice.

3. Alternative Sites

PEC has identified the need for new base load generation through advanced reactor technology to begin commercial operation in 2018 or later for HAR-2 and 2019 or later for HAR-3 (COLA ER 1.1.7). During the evaluation process certain key assumptions and/or criteria were used to aid in locating and optimal site for building and operating an advanced reactor for new nuclear base load generation. They are as follows:

- The new nuclear plant siting location must be suitable to envelope the range of specific design parameters contemplated for deployment of a standard plant design as certified by the NRC.
- The location must be compatible with PEC's System Operation and Transmission Delivery capabilities.
- The recommended site's expected licensing path and regulatory outlook must reduce PEC's schedule and financial risk for establishing new nuclear base load generation.
- The cost of the new nuclear generation as impacted by the location must be reasonable and fair, and methods to ensure greater certainty of the cost/schedule during the licensing, design engineering, and construction phases of the project must be included.
- Evaluation criteria and methodology established as part of the EPRI Early Site Permit Demonstration Program will be employed in the nuclear plant site selection process. Specifically, the EPRI Siting Guide: Site Selection and

Evaluation Criteria for an Early Site Permit Application dated March 2002 will be utilized.

- The evaluation and selection process will include "greenfield" (e.g., locations with no current generation facilities), existing nuclear generation plant locations, and other potentially suitable sites.
- Compliance with current NRC regulations and NRC guidance (as of November 2005), including 10 CFR Part 50 – "Domestic Licensing of Production and Utilization Facilities", 10 CFR Part 52- "Early Site Permits, Standard Design Certifications, and Combined Licenses for Nuclear Power Plants", SECY-05-0139, "Semi-annual Update of the Status of New Reactors Licensing Activities and Future Planning for New Reactors", dated August 4, 2005.
- Compliance with NEPA – National Environmental Policy Act requirements.

In accordance with the EPRI Siting Guide, the site selection process typically involves sequential application of exclusionary, avoidance, and suitability criteria evaluation (includes site reconnaissance, topographic data collection), and technical screening by application of scoring and associated weighting factors applied to the suitability criteria. The exclusionary, avoidance, and suitability criteria address a full range of considerations important in nuclear power facility siting, including health and safety, environmental, socioeconomic and land use, and engineering and cost aspects. The region of interest is screened using exclusionary criteria to identify the potential sites by eliminating areas in which it is not feasible to site a nuclear facility due to regulatory, institutional, facility design impediments, or environmental constraints (PEC 2006).

Eleven potential sites in North and South Carolina were evaluated by PEC using exclusionary and avoidance criteria (see COLA ER 9.3.1.1 for further details). Seven sites evaluated by PEC were eliminated from further consideration due to seismic criteria not able to be met (one site), tract of land not of suitable size (one site), soil liquefaction issues (one site), insufficient water supply (one site), location outside PEC's Service Territory and the ROI (one site), and being actively considered for new fossil plants and lacking sufficient off-site voltage to support a nuclear plant (two sites). Four alternative sites considered further included one greenfield (undeveloped) site (Marion site), and three locations with existing nuclear generating capabilities, Shearon Harris Nuclear Plant site (Harris site), H.B. Robinson Nuclear Plant site (Robinson site), and the Brunswick Steam Electric Plant site (Brunswick site).

The process then becomes one of comparing the alternative sites, and identifying a site that possesses the most favorable set of conditions for siting a nuclear power facility. The evaluation technique to this point ensures the remaining alternative sites have no fatal flaws that could result in extended licensing delays and increased costs. Thus, the remaining alternative sites are evaluated against suitability criteria, resulting in a transition from the elimination approach to an evaluation approach for the suitable sites. The objective of evaluation against suitability criteria is to rank the alternative sites for determination of the preferred site(s). The suitability criteria are grouped into four categories with features in each category relevant to the specific aspects of facility development that are weighted and scored to provide a relative comparison of the

candidate sites. These categories are as follows: (1) health and safety; (2) environmental; (3) land use and socioeconomic; and (4) engineering and cost-related. The multiple features of the suitability criteria are combined into one composite value for each of the alternative sites (PEC 2006).

For each of the four alternative sites, PEC determined a 400-acre project study area (power block) would be used to identify the location where the facility footprint would be located. Each 400-acre power block for each alternative site was assessed against the suitability criteria identified earlier as well as other criteria consistent with 404(b)(1) guidelines as described in Section I.D, Analysis Methodology. Infrastructure required for the construction/operation of a nuclear site was also assessed during this phase of the evaluation, including drought mitigation water supply, and necessary transmission line upgrades. Potential impacts from transmission line upgrades likely will consist primarily of conversion of forested wetlands to cleared ROW. During transmission line design, PEC will employ measures to minimize impacts by avoiding siting of structures within wetlands, surface waters, and floodplains to the greatest degree practicable.

a. Marion Site

Site Description

The Marion site is currently undeveloped land (greenfield site) that lies adjacent to the Pee Dee River in Marion County, South Carolina. Approximately 94 percent of the 400-acre power block identified by PEC is forested. The remaining 6 percent consists of pasture, crops, and developed lands.

Approximately 40 percent (160 acres) of the forested land within the 400-acre power block may be wetlands. The forested wetlands are characterized as NCWAM types riverine swamp forest and bottomland hardwood forest. Approximately 1 acre of non-tidal freshwater marsh is also present in the 400-acre site, within the transmission ROW along the northern edge of the site. A previous study by PEC characterized the wetland types as comprising bottomland hardwoods, mixed-hardwood wetlands, depression wetlands, jurisdictional ditches, and an excavated pond (S&ME 2001). The Marion site has the greatest amount of wetlands occurring within the potential 400-acre power block of any of the four alternative sites. Approximately 0.6 mile of stream channel was identified within the northeastern portion of the site. Even with avoidance and minimization efforts within the site, the potential for direct impacts to wetlands as a result of site development is high and will likely result in the loss of wetland habitat. Marion site elevations appear to be at or slightly below the 100-year floodplain. As a result, construction on this site may also impact federally designated floodways. Additional wetland impacts and land disturbance would result from the construction of the necessary infrastructure to support the new facility at this location. This may include, but is not limited to, roadways, railroad spurs, transmission lines, etc. Large expanses of existing forested wetlands would have to be crossed to reach the site. Wetland areas would have to be crossed to connect a railroad with a spur line servicing any future facility.

Drought Mitigation Reservoir

Based on water storage projections that would provide adequate cooling water for reliable operation during drought conditions as determined for the Harris site, the calculated storage needed for the Marion site would be approximately 58,000 acre-feet; this is based on inflow available (7Q10) of 688 cfs for the Pee Dee River (PEC 2009c). Engineering studies have not been conducted for siting the potential dam, but a preliminary evaluation using Spatial Analyst and 3D Analyst indicates that a dam placed on the Pee Dee River just upstream from the proposed Marion site would require inundating more than 12 river miles of the Pee Dee River to achieve the necessary storage area. The generally flat topography associated with river and stream valleys in this area could result in the reservoir having depths of three feet or less in most areas. The shallow nature of the proposed reservoir could also lead ultimately to potential issues with water quality resulting from lack of thermal stratification, as found in deeper lakes, as well as potential oxygen depletion resulting from this lack of stratification and eutrophication. Eutrophication results from the decay of organic material and an increase in nutrient supply, often from runoff occurring upstream (Brewer 1994). The extensive wetland areas that would be inundated by the proposed reservoir would tend to provide a large amount of organic matter that would support the eutrophication process. The Pee Dee

River itself would likely provide increased nutrient inputs from upstream runoff that would, at least temporarily, be held within the reservoir further contributing to the eutrophication process. Additionally, although the reservoir would be located upstream from the facility, the facility would be at an elevation lower than the normal pool of the reservoir, which would present a hazard during flood events without extensive dike construction or raising the power block. The process of creating a reservoir on the Pee Dee River, which is classified as a Navigable Water through the area to be inundated, would also require extensive permitting with state and federal agencies and would likely be a multi-year process involving extensive analysis as part of the Section 10 permitting process for the dam. In addition to impeding navigation, the dam on the Pee Dee River would also impede natural movement of resident and anadromous fish species up and down the river.

The approximately 28,000-acre reservoir could impact approximately 20,714 acres of wetlands and 33.4 miles of stream channel. Dominant wetland types potentially impacted by inundation include bottomland hardwood forest and riverine swamp forest wetlands along the Pee Dee River and its tributaries. The western side of the Pee Dee River is slightly lower in elevation than the east side and as a result, the wetland areas are more extensive with some areas of potential wetland extending up to three miles across the landscape on the west side of the river. The loss of riparian habitat, including riverine wetlands, along the Pee Dee River would be detrimental to the aquatic and wetland dependant species occupying that habitat. Riparian areas provide food resources for animals throughout the food web. Riparian vegetation along streams is critical as a primary food source to invertebrates that form the base of the food web (National Research Council 2002). Although the creation of this reservoir on the Pee Dee River has the potential to negatively affect special aquatic sites, it is reasonable to assume that the creation of new special aquatic sites (primarily non-tidal freshwater marsh and aquatic beds) would likely result from the inundation in those areas where conditions are suitable. Factors such as topography and soil type would dictate where wetlands would reform around the new reservoir.

Transmission Line Upgrades

Necessary transmission upgrades would include the following new transmission lines: Marion to Whiteville 230-kV line; Marion to Cumberland 230-kV line; Whiteville to Wallace 230-kV line; Fort Bragg Woodruff Street to Raeford 230-kV line; and several transformer replacements (PEC 2006). The new transmission lines total approximately 221.6 miles in length. New transmission lines are anticipated to be co-located along existing ROWs where practicable, but are anticipated to require clearing of an additional 100 feet of new ROW width. Approximately 639 acres of wetlands may be present within the new ROW clearing limits. The new ROW clearing could result in conversion of approximately 397 acres of riverine forested wetlands (headwater forest, bottomland hardwood forest, riverine swamp forest, and floodplain pool wetlands) and approximately 241 acres of non-riverine forested wetlands (hardwood flat, pine flat, pocosin, seep, and small basin wetland) to wetlands maintained at the herbaceous level. No changes would be expected for the approximately 1 acre of non-tidal freshwater marsh or 10 acres of surface waters identified in the new clearing limits. The new clearing limits would

encompass approximately 20.7 miles of stream channel, but the transmission lines are expected to span streams and no direct impacts to stream channels are expected.

Marion Summary

Table 1. Estimated Wetlands and Streams within each Marion Project Component.

Aquatic Resource	400-acre Site	Drought Mitigation Reservoir	Transmission Upgrades
Wetlands (ac)			
Headwater Forest	0	0	96
Bottomland Hardwood Forest	37	12,157	85
Riverine Swamp Forest	123	8,467	216
Floodplain Pool	0	0	<1
Non-tidal Freshwater Marsh	1	90	1
Subtotal Riverine Wetlands	161	20,714	398
Hardwood Flat	0	0	1
Pine Flat	0	0	141
Pocosin	0	0	98
Seep	0	0	<1
Small-basin Wetland	0	0	1
Subtotal Non-riverine Wetlands	0	0	241
Total Wetlands	161	20,714	639
Non-linear Surface Waters	0	816	10
Streams (mi)			
Perennial Channel	0.5	18.4	9.8
Intermittent Channel	<0.1	15.0	5.5
Naturalized Ditch/Canal	0	0	5.4
Total Streams	0.6	33.4	20.7

b. Robinson Site

Site Description

The H.B. Robinson Steam Electric Plant (Robinson site) is located on Lake Robinson, which was formed by impounding Black Creek in the late 1950s. Lake Robinson is approximately 7 miles long, 0.25 to 0.75 mile wide, and has approximately 20 miles of shoreline. It has a mean depth of 14.4 feet and a maximum depth of 44 feet at the dam (Robinson ER 2.2). The Robinson site is an existing PEC facility located on approximately 6,020 acres of property in northwestern Darlington and southwestern Chesterfield counties in South Carolina, including the 2,250-acre Lake Robinson. The site has an existing 710 MW nuclear reactor as well as fossil and combustion turbine generating capabilities. The 400-acre power block on the Robinson site, as identified by PEC, contains both terrestrial and open water areas. Land use impacts associated with the addition of two additional units to the Robinson site are expected to be minor due to the disturbed nature of approximately 50 percent of the 400-acre power block site evaluated.

Jurisdictional wetlands may account for approximately 18 acres and waters of the U.S. may account for approximately 93 acres of the 400-acre power block area, with Lake Robinson accounting for approximately 86 acres and other excavated ponds accounting for approximately 7 acres. Bottomland hardwood forest wetlands comprise approximately 18 acres and non-tidal freshwater marsh wetlands comprise less than 1 acre. Approximately 0.7 mile of stream channel was identified within the 400-acre site. Direct impacts to special aquatic sites within the 400-acre power block resulting from the additional units would be relatively small.

Drought Mitigation Reservoir

Based on water storage projections that would provide adequate cooling water for reliable operation during drought conditions as determined for the Harris site, the estimated storage needed for the Robinson site would be over 2,000,000 acre-feet; this is based on inflow available (7Q10) of 19 cfs for Black Creek (PEC 2009c). Engineering studies have not been conducted for siting the potential dam, but a preliminary evaluation using Spatial Analyst and 3D Analyst indicates that raising the existing dam would result in flooding the existing nuclear plant at the point in the landscape where only approximately 3% of the required additional storage is obtained. Increasing the reservoir to the full size needed to achieve the required additional storage capacity was determined to not be a viable option based on limited additional capacity that could be achieved without flooding out the existing facility. Additional constraints associated with Lake Robinson involve the lack of ownership of much of the land surrounding the lake. Lake expansion would require numerous land acquisitions and relocations. Raising the lake even to the point of achieving 3% of the additional storage capacity needed is likely to result in impacts to the residential homes encircling the lake edge. Large expanses of bottomland hardwood wetlands comprising hundreds of acres also occur in the headwater areas of Lake Robinson (ESI 2005).

Expansion of Lake Robinson was determined to not be viable and an alternative option was evaluated for a new reservoir upstream from the existing reservoir. Engineering studies were not conducted for siting the alternative reservoir, but a preliminary evaluation using Spatial Analyst and 3D Analyst indicates that a dam placed on Black Creek just upstream from US 1 could inundate approximately 4,870 acres before additional consideration would be needed to avoid flooding the adjacent watershed. At this level the alternative reservoir would only provide approximately 98,000 acre feet, or less than 5% of the additional new storage needed. At this level the new reservoir could impact approximately 1,814 acres of wetlands and 34.5 miles of stream channel. Dominant wetland types potentially impacted by inundation include bottomland hardwood forest and riverine swamp forest. The new reservoir would impact approximately 3,365 acres of the Carolina Sandhills National Wildlife Refuge and 56 acres of the Sandhills State Forest WMA. Negotiations with the U.S. Fish and Wildlife Service and State of South Carolina, respectively, for impacts to federal and state lands are expected to be lengthy processes.

Additional measures that would be required to obtain needed storage have not been evaluated since impacts to aquatic resources from the drought mitigation reservoir achieving 5% of the needed storage, along with the other project components, are much greater for the Robinson site than for the Harris (preferred) site.

Transmission Line Upgrades

Necessary transmission line upgrades would include the following new lines: Robinson to Camden 230-kV line; Robinson to Sumter 230-kV line; Robinson to Florence 230-kV line; Robinson to Laurinburg 230-kV line; and replacement of numerous transformers along several existing routes (PEC 2006). The new transmission lines total approximately 166.2 miles in length. New transmission lines are anticipated to be co-located along existing ROWs where practicable, but are anticipated to require clearing of an additional 100 feet of new ROW width. Approximately 288 acres of wetlands may be present within the new ROW clearing limits. The new ROW clearing could result in conversion of approximately 187 acres of riverine forested wetlands (headwater forest, bottomland hardwood forest, and riverine swamp forest) and approximately 97 acres of non-riverine forested wetlands (hardwood flat, pine flat, and pocosin) to wetlands maintained at the herbaceous level. No changes would be expected for the approximately 4 acres of non-tidal freshwater marsh wetlands or 8 acres of surface waters identified in the new clearing limits. The new clearing limits would encompass approximately 12.2 miles of stream channel, but the transmission lines are expected to span streams and no direct impacts to stream channels are expected.

Robinson Summary

Table 2. Estimated Wetlands and Streams within each Robinson Project Component.

Aquatic Resource	400-acre Site	Drought Mitigation Reservoir [a]	Transmission Upgrades
Wetlands (ac)			
Headwater Forest	0	0	30
Bottomland Hardwood Forest	18	1,761	105
Riverine Swamp Forest	0	53	52
Non-tidal Freshwater Marsh	<1	0	4
Subtotal Riverine Wetlands	18	1,814 [a]	191
Hardwood Flat	0	0	7
Pine Flat	0	0	23
Pocosin	0	0	67
Subtotal Non-riverine Wetlands	0	0	97
Total Wetlands	**18**	**1,814 [a]**	**288**
Non-linear Surface Waters	93	86	8
Streams (mi)			
Perennial Channel	< 0.1	24.9	3.7
Intermittent Channel	0.7	9.6	7.5
Naturalized Ditch/Canal	0	0	1.0
Total Streams	**0.7**	**34.5 [a]**	**12.2**

[a] Estimates are for reservoir that achieves only 5% of needed capacity; additional measures to obtain remaining 95% of capacity would incur additional impacts.

c. Brunswick Site

Site Description

The Brunswick site is located on approximately 1,200 acres in Brunswick County, North Carolina. The site has two existing nuclear units (Units 1 & 2). The Brunswick site is on land already owned by PEC and is already zoned for uses compatible with the development of new units. The 400-acre power block identified by PEC contains both terrestrial and open water areas. Land use impacts associated with the addition of two additional units are expected to be minor.

Jurisdictional wetlands and waters of the U.S. may account for approximately 35 acres of the 400-acre power block area, which excludes the intake and outfall canals. Tidal wetlands comprise approximately 16 acres, including 11 acres of salt/brackish marsh and 5 acres of estuarine woody wetland. Forested riverine wetlands comprise approximately 19 acres, consisting 12 acres of riverine swamp forest and 7 acres of headwater forest. Approximately 1.8 miles of stream is present within the 400-acre area, including 1.2 miles (2.5 acres) of regularly flooded tidal stream (Nancy's Creek), 0.2 miles of perennial stream, and 0.4 mile of intermittent stream.

Drought Mitigation Reservoir

Due to the nature of the intake and proximity to the Atlantic Ocean, there are no practical flow constraints (PEC 2006). The flow at the mouth of the Cape Fear River draws upon a drainage area of 9,140 square miles. Of this, stream flow from about 6,000 square miles is gauged continuously by USGS. Average daily freshwater discharge rate of the river at the mouth is estimated to be between 8,100 and 10,000 cubic feet per second (cfs) (PEC 2006). As such, no drought mitigation reservoir would be required for the Brunswick site, and no wetland or stream impacts would be required for this component which would be required by the other three sites.

Cooling water for all existing and additional units will flow through a single common intake canal. The additional generating capacity resulting from the added reactors at the Brunswick site will require an increased volume of cooling water to be pumped through the existing canal. The Brunswick site currently operates two units with once through cooling. This cooling water is withdrawn from the Cape Fear River Estuary, provides cooling capacity to the existing units, and is then discharged to the Atlantic Ocean via a 6-mile long discharge canal. Current velocity in the intake canal, with the existing units, is approximately 0.6 feet per second (Brunswick ER Section 3.1.2.1). The two added units would use closed cycle cooling, which will require less water flow than once through cooling, but will result in an overall greater volume of water being necessary to cool the original reactors and provide water for the closed-cycle system that will cool the new reactors. The increased volume of cooling water will require an increase in the velocity of water being pumped through the intake canal to provide the additional cooling water required by the two AP1000 units. The increase in water flow required as a result of the addition of the closed cycle cooling system, though nominal in comparison to once through cooling systems, could cumulatively increase the entrainment and impingement of aquatic organisms.

The NPDES permit for the Brunswick site (NC0007064) limits cooling water flows to 922 cubic feet per second per unit (cfs/unit) over the December-March period and 1,105 cfs/unit over the April-November period, with the stipulation that one unit may increase its flow to 1,230 cfs during the months of July, August, and September (Brunswick ER Section 3.1.2.1). These reduced flows in the winter months are necessary for the additional reductions of the entrainment losses of finfish larvae, particularly winter-spawning fish such as menhaden, spot, croaker, and flounder. The flows are allowed to return to 1,105 cfs in the spring. The additional 134 cfs required for the two AP1000 units would be required year-round and would result in reliability issues if a higher flow limit is not granted through NPDES permitting.

Transmission Line Upgrades

The necessary transmission upgrades would include the following new transmission line routes: Brunswick to Cumberland 230-kV line; Brunswick to Clinton 230-kV line; Brunswick to Jacksonville 230-kV line; and Brunswick to Wommack 230-kV line. The new transmission lines total approximately 360 miles in length. New transmission lines are anticipated to be co-located along existing ROWs where practicable, but are anticipated to require clearing of an additional 100 feet of new ROW width. Approximately 1,450 acres of wetlands may be present within the new ROW clearing limits. The new ROW clearing could result in conversion of approximately 663 acres of riverine forested wetlands (headwater forest, bottomland hardwood forest, and riverine swamp forest) and approximately 758 acres of non-riverine forested wetlands (hardwood flat, pine flat, pocosin, pine savannah, seep, and small-basin wetland) to wetlands maintained at the herbaceous level. No changes would be expected for the approximately 29 acres of tidal freshwater marsh, non-tidal freshwater marsh, and non-tidal freshwater marsh wetlands or 27 acres of surface waters identified in the new clearing limits. The new clearing limits would encompass approximately 12.7 miles of stream channel; however, the transmission lines are expected to span streams and no direct impacts to stream channels are expected to result from the discharge of dredge or fill material.

Brunswick Summary

Table 3. Estimated Wetlands and Streams within each Brunswick Project Component.

Aquatic Resource	400-acre Site	Drought Mitigation Reservoir [a]	Transmission Upgrades[b]
Wetlands (ac)			
Salt/Brackish Marsh	11	NA	3
Estuarine Woody Wetland	5	NA	0
Tidal Freshwater Marsh	0	NA	24
Subtotal Tidal Wetlands	16	NA	27
Non-Tidal Freshwater Marsh	0	NA	2
Riverine Swamp Forest	12	NA	443
Headwater Forest	7	NA	127
Bottomland Hardwood Forest	0	NA	93
Subtotal Riverine Wetlands	19	NA	665
Pocosin	0	NA	421
Pine Flat	0	NA	291
Pine Savanna	0	NA	37
Hardwood Flat	0	NA	6
Small-basin Wetland	0	NA	2
Seep	0	NA	<1
Subtotal Non-Riverine Wetlands	0	NA	758
Total Wetlands	**35**	**NA**	**1,450**
Non-linear Surface Waters	20	NA	27
Streams (mi)			
Tidal Channel	1.2	NA	0.2
Perennial Channel	0.2	NA	4.6
Intermittent Channel	0.4	NA	7.1
Naturalized Ditch/Canal	0	NA	0.8
Total Streams	**1.8**	**NA**	**12.7**

[a] No drought mitigation reservoir required.
[b] Streams occurring in expanded ROW area only.

d. Harris Site (Preferred Action)

Site Description

The Harris site is an existing PEC facility that currently generates electrical power with one nuclear reactor (Unit 1). The actual plant site currently covers approximately 440 acres and the proposed addition of the HAR-2 and HAR-3 will affect up to approximately 400 additional acres. PEC owns 10,744 acres at the site which was originally planned to support four operating units with a larger reservoir. The construction of HAR-2 and HAR-3 will also require appurtenant facilities including electric transmission lines, an electric switchyard, and modifications to the Harris Reservoir dam, intake structures and pumphouse, the Harris Reservoir makeup water system pipeline, a discharge structure on Harris Lake, and blowdown pipelines from HAR-2 and HAR-3 into Harris Reservoir. The existing infrastructure at the Harris site, including Harris Lake, combines to make this the Preferred Action for PEC. Although PEC proposes to raise the level of Harris Reservoir to provide a reliable cooling water source during drought conditions for HAR-2 and HAR-3, PEC believes that this site can be defined as the LEDPA pursuant to Section 404(b)(1) when compared to the overall impacts to aquatic resources, including functional changes or losses, that would result from any of the other three alternative sites.

Jurisdictional wetlands and waters of the U.S. account for approximately 5 acres of the 400-acre power block area originally identified for site evaluation. Based on the jurisdictional delineation of the 400-acre power block area, riverine forested wetlands comprise approximately 5 acres. Approximately 0.8 mile of stream is present within the 400-acre area, including 0.3 mile of perennial channel and 0.5 mile of intermittent channel. Direct impacts to wetlands and streams within the 400-acre power block resulting from the additional units are relatively small compared to the other alternatives.

Drought Mitigation Reservoir

To provide a reliable water source for HAR-2 and HAR-3 during drought conditions, the normal pool elevation of Harris Reservoir is proposed to be increased from 220 feet NGVD29 to 240 feet NGVD29. The original discharge that served to create Harris Reservoir occurred during construction of the Harris Lake Dam pursuant to the USACE permit (SAWCO77-N-019-0441) issued in 1977. Harris Reservoir was originally formed between the period 1980-1983 when approximately 3,610 acres were flooded as a result of dam construction across Buckhorn Creek. A second, smaller impoundment, the 360-acre Auxiliary Reservoir, occurs on the Tom Jack Creek arm above Harris Reservoir and serves as a source of water for the emergency service water system for the HNP (COLA ER 1.1.2). The Harris Reservoir dam was designed for a maximum water level elevation of 250 feet NGVD29, but the initial permitting for HNP Unit 1 reflected a maximum water elevation of 239.1 feet NGVD29. Harris Reservoir's additional water capacity will come from a combination of natural fill due to rain and from water withdrawal from the Cape Fear River. The proposed rise in normal pool elevation of Harris Lake will inundate special aquatic sites including intermittent and perennial streams along with wetlands that occur between the 220 feet NGVD29 and 240 feet NGVD29 contours.

Additionally, non-tidal freshwater marsh wetlands that occur below the 220 feet NGVD29 contour will also be inundated but are expected to reestablish at new elevations over time once the new lake elevation stabilizes.

The approximately 7,633-acre reservoir could impact approximately 598 acres of wetlands and 26.8 miles of stream channel. The majority of the wetlands that will affected by reservoir expansion (70%) are non-tidal freshwater marsh wetlands located along the existing shoreline of Harris Lake, beginning at the 220-foot contour and extending out to a maximum depth of 6.6 feet. The non-tidal freshwater marsh and associated fringe wetlands, which are currently part of the lake's riparian zone, were formed as a result of the original Harris Reservoir construction and are man-induced (artificial) wetlands. Because reservoirs are entirely artificial environments, "natural reference condition" has no meaning (EPA 1998). Most of these non-tidal freshwater marsh wetlands also have an abutting lacustrine fringe wetland, which according to North Carolina Wetland Assessment Method (NCWAM) should be included in the assessment of the non-tidal freshwater marsh as long as herbaceous vegetation is dominant in the overall assessment area. This guidance was applied to the lacustrine fringe identified in the delineation effort and resulting jurisdictional determination. Approximately 422 acres of non-forested wetlands will be affected by reservoir expansion.

Approximately 177 acres of riverine forested wetlands, and the functions currently being provided by them, may be impacted by the reservoir expansion. Wetlands to be inundated from reservoir expansion include riverine swamp forest located within the influence of the normal pool of the existing reservoir, and bottomland hardwood forest and headwater forest located along tributaries feeding the reservoir. The loss of riparian habitat, including riverine wetlands, associated with raising the lake elevation will temporarily impact the aquatic and wetland-dependent species occupying that habitat.

Although the expansion of Harris Reservoir has the potential to impact special aquatic sites, it is reasonable to assume that the creation of new special aquatic sites (primarily non-tidal freshwater marsh and aquatic beds) will result from the inundation in those areas where conditions are suitable. PEC annual monitoring reports document the relatively rapid formation of these herbaceous wetlands within and surrounding the reservoir normal pool following completion (ESI 2010). Factors such as topography and soil type would dictate where wetlands would reform around the new reservoir normal pool.

Transmission Line Upgrades

The necessary transmission line upgrades would include the following new lines: Harris to Wake 230-kV line, Harris to Erwin 230-kV line and Harris to Fort Bragg Woodruff Street 230-kV line. The new transmission lines total approximately 103 miles in length. New transmission lines are anticipated to be co-located along existing ROWs where practicable, but are anticipated to require clearing of an additional 100 feet of new ROW width. Approximately 95 acres of wetlands may be present within the new ROW clearing limits. The new ROW clearing could result in conversion of approximately 91 acres of riverine forested wetlands (headwater forest, bottomland hardwood forest, and

riverine swamp forest) to a low-growing herbaceous or shrub-scrub type wetland. No changes would be expected for the approximately 4 acres of non-tidal freshwater marsh wetlands or 23 acres of surface waters identified in the new clearing limits. The new clearing limits would encompass approximately 5.3 miles of stream channel, but the transmission lines are expected to span streams and no direct impacts to stream channels are expected.

Harris Summary

Table 4. Estimated Wetlands and Streams within each Harris Project Component. [a]

Aquatic Resource	400-acre Site and Infrastructure	Drought Mitigation Reservoir	Transmission Upgrades
Wetlands (ac)			
Headwater Forest	5	177	19
Bottomland Hardwood Forest			68
Riverine Swamp Forest			4
Non-tidal Freshwater Marsh	0	422	4
Total Wetlands	**5**	**598**	**95**
Non-linear Surface Waters	5	3,331	23
Streams (mi)			
Perennial Channel	0.3	15.8	1.5
Intermittent Channel	0.5	10.9	3.6
Naturalized Ditch/Canal	0	0	0.2
Total Streams	**0.8**	**26.8**	**5.3**

[a] Numbers presented in Table 4 are based on the jurisdictional delineation for the 400-acre power block and support facilities area and reservoir expansion area, and GIS modeling with limited field verification for the transmission line upgrades. A GIS-based effort with limited field verification was conducted for the reservoir expansion area for comparison to actual delineation results. The GIS effort resulted in identification of approximately 136 acres of forested wetlands, 422 acres of herbaceous wetlands, 8.7 miles of perennial stream channel, and 15.7 miles of intermittent stream channel. The GIS effort was not as effective at identifying wetlands on non-hydric soils that have been influenced by increased hydroperiods induced by the normal pool of the reservoir. The GIS effort identified most of the stream channels, but identified most of the stream channels as intermittent rather than perennial as determined by the jurisdictional delineation.

4. Summary and Alternatives Carried Forward

Four alternative sites were evaluated for potential impacts to aquatic resources to determine which, if any, would clearly result in greater impacts to wetlands and streams than would result from the preferred alternative (Harris site). Table 5 provides a summary of the potential wetland and stream impacts for the 400-acre power block, drought mitigation reservoir, and transmission line upgrades identified for each of the four alternatives.

Table 5. Estimated Wetlands and Streams within each Alternative Project Component.

Project Component	Feature	Alternative Site			
		Marion	Robinson [a]	Brunswick	Harris [b]
400-acre Site	Wetlands (ac)	161	18	35	5
	Streams (mi)	0.6	0.7	1.8	0.8
Drought Mit. Reservoir	Wetlands (ac)	20,714	1,814 [a]	0	598
	Streams (mi)	33.4	34.5 [a]	0	26.8
Transmission Upgrades	Forested Wetlands (ac) [c]	638	284	1,421	91
	Non-forested Wetlands (ac) [d]	1	4	29	4
	Streams (mi) [e]	20.7	12.2	12.7	5.3
Total Wetlands (ac)		**21,514**	**2,120 [a]**	**1,485**	**698**
Total Streams (mi)		**54.7**	**47.4 [a]**	**14.5**	**32.9**

[a] Estimates provided for new Robinson reservoir are for reservoir that would only partially achieve necessary drought mitigation storage; site constraints for potential site located upstream from existing Lake Robinson would allow achieving only 5% of necessary storage without breaching interstream divide into adjacent watershed. Additional measures will be required to obtain needed storage but have not been evaluated since Robinson impacts would be higher than Harris even with partial drought mitigation efforts.

[b] Wetlands and streams for the Harris alternative are based on the jurisdictional delineation for the 400-acre power block and support facilities area and reservoir expansion area, and GIS modeling with limited field verification for the transmission line upgrades.

[c] Only includes forested wetlands (riverine and non-riverine) subject to conversion to non-forested wetlands for new ROW clearing.

[d] Non-forested wetlands present in new ROW clearing, no adverse impacts expected.

[e] Stream lengths include amount in new ROW areas; does not include amount in existing ROWs.

Conceptual siting of the 400-acre power block areas evaluated for the Harris, Brunswick, and Robinson sites has been considered for better avoidance and minimization of fill impacts to wetlands and streams. The Marion site is likely to incur wetland impacts for the site facility based on the prevalence of wetlands in and near the site.

Additional water storage capacity was identified as needed for the Marion, Robinson, and Harris sites to provide reliable cooling water during drought conditions. New or expanded reservoirs at these three sites would result in substantial wetland and stream impacts. The Brunswick site was identified as having sufficient water supply to meet the needs of the new units without additional water storage required.

Transmission line upgrades will be required for all four alternatives. PEC has demonstrated through numerous other transmission line construction projects that detrimental impacts to wetlands streams from ROW construction from fill or surface disturbance are minimal because most areas can be spanned completely. If discharges are necessary, they are typically limited to footings for support structures. Impacts from line expansions are expected to be primarily from clearing and converting forested wetland types to herbaceous wetlands within the new ROW limits. Conversion of mature forested wetland habitat to herbaceous wetland habitat results in reductions of many wetland functions.

Based on the evaluation of the potential impacts, in comparison to the preferred alternative (Harris site), the Marion and Robinson alternatives have substantially greater impacts to both wetlands and streams resulting primarily from the required drought mitigation reservoir and substantially greater impacts through conversion of forested wetlands for the transmission line upgrades. The Marion and Robinson alternatives are eliminated as viable alternatives since neither will result in less impact to wetland or streams than the preferred alternative and neither is environmentally preferable to the Harris site.

Based on preliminary siting considerations for the Brunswick site, complete avoidance of wetland and stream impacts is not possible based on site constraints. Fill activities associated with the Brunswick 400-acre power block and support facilities will result in substantially greater impact to wetlands and streams than for the Harris alternative, with approximately 16 acres of the fill occurring in tidal wetlands and fill occurring in 1.2 miles of tidal streams. The Brunswick alternative will impact substantially greater acreage of forested wetlands as a result of conversion to a maintained ROW for the transmission line upgrades than the Harris alternative, but will not require construction of a drought mitigation reservoir. Based on the impacts to wetlands and streams from the increased lake elevation at Harris, the Brunswick site was not eliminated from further consideration. Therefore, the Brunswick site is being carried forward for further evaluation and comparison to the preferred alternative (Harris site) pursuant to Section 404(b)(1).

IV. Evaluation

This section of the document will evaluate in greater detail the anticipated changes to the physical, chemical and biological characteristics of the aquatic environment as well as human use characteristics and impacts that may result from the construction of new reactors at either the Brunswick site or the Harris site. Information provided from Section IV.A.1 through Section IV.C.5 is included to provide supporting documentation for compliance with 40 CFR 230: Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material. Sections IV.A.5 through IV.A.9 may be considered a component of Section IV.A.2, but are documented in more detail herein.

A. Anticipated Changes to the Physical/Chemical Characteristics of the Aquatic Environment

1. Substrate

Brunswick
Impacts to the substrate within the 400-acre power block would consist of filling approximately 35 acres of wetlands and 1.8 miles of streambed present within the 400-acre power block. This fill includes 16 acres of tidal wetlands and 1.2 miles of regularly flooded estuarine tidal streambed. The filling of these aquatic resources and elimination of this productive substrate would be an adverse impact for this alternative.

Harris
The impacts to the substrate for the HAR-2 and HAR-3 sites includes impacting approximately 5 acres of wetlands and 0.8 mile of streambed within the 400-acre power block; temporary impacts to wetlands for construction of the 2.6 mile pipeline from the Cape Fear River to Harris Lake; and dredging of an intake structure on the Cape Fear River above the Buckhorn Dam. The filling of wetlands would be an adverse impact for this alternative.

The addition of 20 feet of additional water in Harris Reservoir would inundate areas that are currently located above the normal pool elevation. The inundation of the areas above the current normal pool elevation would likely cause resorting of sediments beneath the water surface and some shoreline erosion due to wave action. These newly inundated areas would be expected to reach steady-state conditions relatively quickly.

2. Currents, circulation or drainage patterns

Brunswick
The NPDES permit for the Brunswick site (NC0007064) limits cooling water flows to 922 cubic feet per second per unit (cfs/unit) over the December-March period and 1,105 cfs/unit over the April-November period, with the stipulation that one unit may increase its flow to 1,230 cfs during the months of July, August, and September (Brunswick ER Section 3.1.2.1). These reduced flows in the winter months are necessary for the additional reductions of the entrainment losses of finfish larvae, particularly winter-

spawning fish such as menhaden, spot, croaker, and flounder. The flows are allowed to increase in the spring. Cooling water for all existing and additional units will flow through a single common intake canal. The additional generating capacity resulting from the added reactors at the Brunswick site will require an increased volume of cooling water to be pumped through the existing canal. The Brunswick site currently operates two units with once through cooling. This cooling water is withdrawn from the Cape Fear River Estuary, provides cooling capacity to the existing units, and is then discharged to the Atlantic Ocean via a 6-mile long discharge canal. Current velocity in the intake canal, with the existing units, is approximately 0.6 feet per second (Brunswick ER Section 3.1.2.1). The two added units would use closed cycle cooling, which will require less water flow than once through cooling, but will result in an overall greater volume of water being necessary to cool the original reactors and provide water for the closed-cycle system that will cool the new reactors. The increased volume of cooling water will require an increase in the velocity of water being pumped through the intake canal. The additional cooling for the new units may result in temporary hydrologic alterations as well as minor changes in circulation of the intake canal. No adverse environmental consequences are anticipated to current, circulation or drainage patterns.

Harris
The filling of wetlands within the HAR-2 and HAR-3 development areas is not expected to have a significant effect on currents or circulation. Drainage patterns within the fill areas will be changed to meet site grading requirements. Drainage of the HAR-2 and HAR-3 development areas will be toward Harris Reservoir and the Auxiliary Reservoir.

The construction of the new makeup water intake structure will have temporary hydrological alterations consisting of sedimentation. Construction areas for the intake will be isolated by dewatering with the water being pumped to a sedimentation basin and allowed to drain back into the river. However, the work will be performed under a sediment and erosion control plan and NPDES permit. The construction of the intake structure would have a temporary adverse environmental consequence for this alternative.

3. Suspended particulates, turbidity

Brunswick
There are no expected long-term effects from suspended particles or turbidity on the wetlands, canals or streams from the construction of the facility. The facility currently operates under an active NPDES permit which would be expanded to include the new development area. Expansion of the necessary transmission line ROWs will require extensive clearing of approximately 1,421 acres of forested wetlands as well as approximately 2,877 acres of upland habitat. Although sedimentation and turbidity during construction will be minimized by performing the work in accordance with an erosion and sediment control plan, the conversion of the forested wetlands will remove or diminish certain wetland functions that help retain sediment and control turbidity in each individual watershed. The results of the NCWAM analysis along representative sections of the Brunswick transmission lines indicate that there will be some relatively minor

functional shifts with regard to water quality; no adverse environmental consequences resulting from suspended particulates or turbidity are anticipated for this alternative.

Harris

There are no expected long-term effects from suspended particulates or turbidity on the freshwater streams, the Cape Fear River or Harris Lake and impoundments. The current facility operates under an NPDES permit and the permit will be revised to include the new HAR-2 and HAR-3 facilities.

A potential source of suspended particles and turbidity for the Cape Fear River would be during construction of PEC's surface water intake near Buckhorn Dam. The increased suspended particles and turbidity during the construction of PEC's surface water intake may have a temporary impact on a canoe input located downstream of Buckhorn Dam. There would be an impact to the Cape Fear River Floodplain during construction of PEC's intake structure. Construction techniques could minimize this impact. Sediment built up as a result of construction activities will be removed. Appropriate USACE Section 404, NCDENR 401 Water Quality Certification, and NPDES permits will be obtained (COLA ER 4.2.1.2 and 4.2.2.1).

Increased suspended particles and turbidity will be expected for Harris Lake and impoundments during construction of HAR-2 and HAR-3. PEC will perform the construction activities in accordance with an erosion and sediment control plan to limit the amount of sediment in stormwater. Water collected during the dewatering of the construction area will be allowed to settle and be filtered before it is returned to Harris Lake or impoundments (COLA ER 4.2.2.2).

Clearing of trees around the Harris Lake prior to raising the water level may have an effect on the amount of sediment runoff entering the reservoir. However, silt fences and other erosion control devices will be used to minimize the impact. The inundation of forested and non-forested wetlands as a result of the reservoir expansion will remove certain water quality functions that are provided by wetlands; primarily the function filtering runoff and reducing suspended sediment. However, the expanded riparian zone that will encompass the new reservoir limits will provide this water quality function along with new non-forested wetlands that will reform in shallow water at the new normal pool elevation.

Approximately 91 acres of forested wetlands and approximately 1,129 acres of uplands will be cleared to allow for transmission line ROW expansion under the Harris alternative. NCWAM identified minimal functional change to the water quality functions of bottomland hardwoods and headwater forest wetlands based on evaluating baseline and post-construction conditions along the ROWs (ESI 2010).

Although there will be some wetland functions lost that help alleviate suspended particles and turbidity; no adverse environmental consequences resulting from suspended particulates or turbidity are anticipated for this alternative.

4. Water quality

Brunswick

Approximately 35 acres of wetlands and 1.8 miles of streambed may be directly impacted by fill within the 400-acre power block under the Brunswick alternative. These impacts in the 400-acre power block, 16 acres of which are to tidal wetland habitats and 1.2 miles are to tidal stream, will eliminate certain water quality functions from the project study area. The tidal stream that will be filled, Nancy's Creek, is designated as High Quality Waters, Primary Nursery Area (NCDMF 2010), is considered Essential Fish Habitat, and together with the brackish/salt marsh that will be filled, also includes several Areas of Environmental Concern designated under the Coastal Area Management Act (CAMA). CAMA was adopted by North Carolina in 1974 to comply with the federal Coastal Zone Management Act of 1972.

Approximately 1,421 acres of forested wetlands to be cleared along the Brunswick transmission lines will also result in diminished water quality functions provided for each affected watershed along the proposed transmission line routes. A specific water quality function of riverine swamp forest and bottomland hardwood wetlands that may be negatively affected according to the NCWAM results includes particulate change, which is the ability of a wetland to remove sediment and insoluble organic matter from the water column (NCWFAT 2010). NCWAM also identifies pollution change as a water quality sub-function that may be negatively affected in both pocosin and pine flat wetlands. The loss of the riverine wetlands in the proposed impact areas will result in a reduction of nitrogen (N) and phosphorus (P) removal capacity provided by these wetlands. Mitch and Gosselink (1986) also credit Yarbro (1979) with documenting that riparian forested wetlands in North Carolina have been shown to remove and immobilize as much as 3.15-7.30 kilograms of P per hectare per year.

The riverine wetlands located along the transmission line routes do not show any notable shift in functional capacity when comparing baseline and post-construction NCWAM water quality ratings; however pocosin and pine flat wetlands (non-riverine) do show a decrease in their overall water quality functional rating (ESI 2010).

The Brunswick site uses a once-through cooling system that withdraws water from the Cape Fear River and discharges the water into the Atlantic Ocean. The Brunswick site operates under a NPDES permit that requires semi-annual temperature readings at the discharge point. The two new units at the Brunswick site would employ a closed cycle cooling system that would draw much less flow than once-through cooling, but would result in incremental increase in the amount of water withdrawn from the river. Based on the ER, potential effects of heat shock caused by the thermal discharge into the Atlantic Ocean are not a significant factor for the Brunswick Site (COLA ER 9.3.2.2.2.5).

Potential contaminants in the Cape Fear River are related to its use for ship traffic to the Port of Wilmington and to the industrial plants located upstream to the north. The FSAR noted that pollution of the river with industrial and sanitary sewage is to such an extent that oysters harvested in the lower river areas are taken by the North Carolina Division of

Fisheries for transplanting in cleaner waters for natural purging prior to human consumption (FSAR 2.4.1.2.3).

Localized adverse environmental consequences to water quality are anticipated for the Brunswick alternative.

Harris

Approximately 5 acres of wetlands and 0.8 to 1.4 miles of streambed may be directly impacted within the 400-acre power block under the Harris alternative. Approximately 0.6 mile of the potential fill in streambed if from a potential road improvement alternative, but if this alternative is not selected, this area is within the area to be flooded. These impacts in the 400-acre power block will eliminate certain water quality functions from the project study area. Approximately 91 acres of forested wetlands to be cleared along the Harris transmission lines will also result in diminished water quality functions provided for each affected watershed along the proposed Harris transmission line routes. Additionally, the Harris alternative will affect approximately 177 acres of forested wetlands and approximately 422 acres of non-forested wetlands as a result of the reservoir expansion. Bottomland hardwood forest is the dominant forested wetland type both along the transmission lines and within the zone of inundation around Harris Lake. Two of the most important water quality functions of southern bottomland hardwood forests include: 1) nutrient (N and P) removal from surface, subsurface, and groundwaters; and 2) export of organic carbon and associated nutrients to downstream aquatic ecosystems (Walbridge and Lockaby 1994). The loss of the bottomland hardwood wetlands from reservoir expansion and from transmission line expansion will result in the loss of notable water quality functions, primarily with regard to particulate change, and may also have an effect on the nutrient cycling capacity of each affected watershed.

Certain water quality functions may also be lost or reduced as a result of flooding non-tidal freshwater marsh wetlands surrounding Harris Lake. Known water quality functions of lake-margin wetlands, such as the non-tidal freshwater marsh areas, include sediment and nutrient retention and removal of sediment and nutrients from inflowing waters (USGS 2010). Due to their high levels of nutrients, freshwater marshes are one of the most productive ecosystems. Non-tidal freshwater marsh wetlands also reduce wave energy reaching the shoreline, thus reducing the amount of erosion. Water quality functions lost by inundation may be at least partially replaced by water quality functions provided by the expanded reservoir and the expanded riparian zone around the new reservoir. EPA defines riparian areas as vegetated ecosystems along a water body through which energy, materials, and water pass. Riparian areas characteristically have a high water table and are subject to periodic flooding and influence from the adjacent water body. These systems encompass wetlands, uplands, or some combination of these two land forms. They will not in all cases have all of the characteristics necessary for them to be classified as wetlands (EPA 1993a), but perform important hydrologic, geomorphic, and biological functions. They are particularly effective in filtering and transforming materials (such as dissolved and particulate nonpoint source pollutants) from hill slope runoff (NRC 2002). Lakes and reservoirs (lentic water bodies) have the

potential to act as important sinks for reactive N as it is transported across the landscape because they offer ideal conditions for N burial in sediments or permanent loss via denitrification. Although reservoirs occupy just 6% of the global lentic surface area, it is estimated that they retain up to 33% of the total N that is removed from the watershed by the lentic system (Harrison *et. al.* 2009). The water retention time is the most critical single factor for removal of N. Thus, lakes remove more N than small wetlands even though the specific N retention (N retention m^2) is generally considerably higher in wetlands (Jansson *et. al.* 1994). Lake and reservoir sediments also serve as P sinks. P-containing particles settle to the substrate and are rapidly covered by sediment. Continuous accumulation of sediment will leave some P too deep within the substrate to be reintroduced into the water column. Thus, some P is removed permanently from bio-circulation (NCSU 2010).

PEC will continue to employ a closed-loop, cooling tower-based, heat dissipation system rather than a once-through system. Therefore, the issue of heat shock should not be a factor in Harris Reservoir (COLA ER 9.4.2.1.2). Because the HAR site is located on a large reservoir system that will provide sufficient heat rejection capacity for the two new units, plant operation is not expected to have significant thermal impacts to aquatic ecology and water quality (COLA ER 5.3.2.1). Additionally, all discharges in the small mixing zone of the reservoir are required to meet the state NPDES requirements.

Based on the COLA ER, it is expected that normal discharges from the Harris site will have negligible effects on surface and groundwater uses and will be in compliance with an approved NPDES permit issued by the North Carolina Department of Environment and Natural Resources (NCDENR). This permit requires that discharges are controlled from systems (such as discharge lines, sewage treatment facilities, radwaste treatment systems, activated carbon treatment systems, water treatment waste systems, facility service water, and stormwater runoff) to Harris Lake. The effect on water quality in Harris Lake due to the operation of the Harris Site will be monitored to ensure compliance with the issued NPDES permits for construction and operation (COLA ER 3.3).

No adverse environmental consequences with regards to water quality are anticipated for this alternative. Many of the water quality functions currently being provided by the wetlands to be inundated will be provided by the expanded reservoir and the riparian area surrounding the reservoir.

5. Flood control functions

Brunswick

The nominal elevation of the existing facility is 20 feet mean sea level (MSL). The elevation of the maximum storm event is expected to reach 22 feet MSL. As such, water levels would be expected at two feet above grade. Buildings at the facility are waterproofed to an elevation of 22 feet MSL. Flood control for the canals is managed by levees located at elevations of 22 feet MSL. There is a potential adverse impact for flooding, but only related to extreme storm events and not under normal weather

conditions. Global climate change is expected to result in sea level rise of approximately 0.5 meter in coastal North Carolina with stronger storms and more intense precipitation events (Shuford et al. 2010). The Brunswick facility will be located on higher ground than the existing facility to account for future sea level rise and potential flooding events.

The necessary ROW expansions for the Brunswick alternative will alter over 1,450 acres of wetlands that currently provide beneficial flood control functions. One of the NCWAM hydrology sub-functions is surface water storage and attenuation. The NCWAM assessment indicates that converting forested wetlands to a maintained ROW will result in a notable decrease in the surface water storage and retention function of both riverine and non-riverine wetlands (ESI 2010). No adverse environmental consequences are expected as a result of this reduced hydrology function along the proposed ROW routes.

Harris

The final floor elevations for HAR-2 and HAR-3 are proposed to be 261 feet National Geodetic Vertical Datum of 1929 (NGVD29). The main plant areas of HAR-2 and HAR-3 calculated Probable Maximum Flood (PMF) elevations are below the proposed final floor elevations (FSAR 2.4.2 and 2.4.3.6.4).

The uncontrolled ogee spillway on the main dam of Harris Lake has a current elevation 220 feet NGVD29, but is proposed to be raised to an elevation of 240 feet NGVD29. The auxiliary reservoir has an elevation of 252 feet NGVD29 and is not proposed to be raised. The main dam of Harris Lake and the auxiliary reservoir both are at elevations of 260 feet NGVD29 (FSAR 2.4.3). Flooding on Buckhorn Creek above the main dam is expected to be controlled by the ogee spillway of the dam. At the PMF elevation, only 16 percent of the Buckhorn Creek drainage basin would be flooded (FSAR 2.4.3 a).

The flood control functions provided by the forested wetlands affected by the Harris alternative are primarily surface and sub-surface storage, which is a hydrology sub-function of NCWAM. Surface storage capacity lost through wetland inundation associated with the expanded reservoir will be replaced by the expanded reservoir due to the larger volumetric capacity. The expanded reservoir's capacity will also serve to attenuate flood waters. These particular hydrology functions will shift from being forested wetland functions to a function that will be provided by the expanded reservoir. The necessary ROW expansions for the Harris alternative will alter over 90 acres of forested wetlands that currently provide beneficial flood control functions. The NCWAM assessment indicates that primarily bottomland hardwood wetlands will incur a notable decrease in hydrology function (ESI 2010). The hydrology function of the wetlands along the proposed Harris ROW routes does not appear to be negatively affected as much as the wetlands along the Brunswick routes; possibly due to the differing ecoregion (coastal plain vs. piedmont).

There are no significant adverse environmental consequences with regards to flood control functions expected to result from the reservoir expansion or the ROW expansions.

6. Storm, wave and erosion buffers

Brunswick

The nominal elevation of the existing facility is 20 feet MSL. The elevation of the maximum storm event is expected to reach 22 feet MSL. As such, water levels would be expected at two feet above grade. Buildings at the facility are waterproofed to an elevation of 22 feet MSL. Wave action from the maximum water depth of two feet would yield a wave height elevation of 25.6 feet MSL (1.6 foot wave run-up has a vertical face of 3.6 feet). All doors are designed to prevent leakage and the buildings are designed as Seismic Class 1 and could withstand the static and dynamic effects of a 1.6 foot wave (FSAR 2.4.5).

Water elevations within the intake and outflow canal during maximum storm events would be expected to be 22 feet MSL. Wave heights are expected to be three feet (25 feet MSL) with a wave run-up height of 25.3 feet MSL. There is a potential adverse impact for storm and wave buffers for this alternative, but only related to extreme storm events and not under normal weather conditions. Global climate change is expected to result in sea level rise of approximately 0.5 meter in coastal North Carolina with stronger storms and more intense precipitation events (Shuford et al. 2010). The Brunswick facility will be located on higher ground than the existing facility to account for future sea level rise and potential flooding events.

Harris

The safety-related structures at the HAR-2 and HAR-3 facilities are protected from high water levels up to elevation 261 feet NGVD29, which is higher than anticipated flood levels due to wave run-up in the reservoirs or direct rainfall at the plant site. The upstream face of the Main Dam and both upstream and downstream faces of the Auxiliary Dam are protected by riprap designed for the worst calculated wave action. The downstream face of the Main Dam is protected by a layer of oversized rock. The backwater effects of Buckhorn Creek on the downstream face of the Main Dam are not expected to be significant. However, protection of the downstream face serves as an additional safety precaution (FSAR 2.4.5.5).

The reservoir expansion will result in an approximately 61.9 miles of additional riparian shoreline that will serve to buffer the reservoir. Riparian areas are particularly effective in filtering and transforming materials (such as dissolved and particulate nonpoint source pollutants) from hill slope runoff (NRC 2002). The loss of non-tidal freshwater marsh within the existing lake will temporarily remove certain functions that correspond to storm, wave and erosion buffers. Known water quality functions of lake-margin wetlands, such as the non-tidal freshwater marsh areas, include sediment and nutrient retention and removal of sediment and nutrients from inflowing waters (USGS 2010). Non-tidal freshwater marsh wetlands also reduce wave energy reaching the shoreline, thus reducing the amount of erosion. Once the process of raising the reservoir level begins, wetland evolution will also begin. Previous studies suggest shallow water zones can be colonized in as quickly as three years (Reed and Willard 1987). Wetlands expand in reservoirs in the same way river deltas form, as inflowing streams deposit silt (Reed

and Willard 1987). Both non-tidal freshwater marsh and fringe wetlands are expected to reform upon stabilization of the new lake level and those wetland functions temporarily lost should resume. These wetlands originally formed on non-hydric soils and are expected to repeat that process at the new pool elevation. The amount of both non-tidal freshwater marsh and fringe wetlands are expected to be considerably greater that what will be lost through flooding. A study at the newly formed Harris Lake conducted by Carolina Power & Light in 1983 indicated that rising water levels caused many of the terrestrial species to be replaced by emergent aquatic species. This change occurred in a narrow band approximately 2 meters wide adjacent to the shoreline of the lake. Above this band, no changes were observed (CP&L 1984). This describes the formation of what has been described herein, and in previous documents, as the wetland fringe. This same process can also be expected to occur under the proposed reservoir expansion (ESI 2010).

Many specific wetland functions that may be lost or reduced by inundation from reservoir expansion and from other infrastructure improvements will be replaced by the functions that will be performed by the expanded reservoir, the larger riparian zone surrounding the reservoir, and ultimately by the wetlands that will reform over time. There is no expected adverse impact for storm, wave and erosion control buffers for this alternative.

7. Aquifer recharge

Brunswick

The development of the 400-acre power block is not expected to have an impact on aquifer recharge. The surficial aquifer beneath the site has been reported to be located at a depth of between 2 and 10 feet. The localized groundwater flow direction may be impacted due to the construction of the subsurface structures for the reactors; however, due to the sandy nature of surface soils, infiltration in the areas around the reactor units would help minimize the loss of the shallow aquifer area. Small individual potable wells in the area are located in the surficial aquifer. The Castle Hayne Aquifer is the primary drinking water source for the area (community and municipal drinking water wells). There are no known Castle Hayne Aquifer primary recharge areas in the vicinity of the property. As such, the construction of the facility should not have an effect on the recharge for the Castle Hayne Aquifer. No adverse environmental consequences are anticipated for this alternative.

Harris

The construction of HAR-2 and HAR-3 is not expected to have an impact on aquifer recharge. The Harris site is underlain by the surficial aquifer that lies at depths ranging from 2 to 30 feet below the land surface. Rain water percolates through the residual soil and into the surficial aquifer which generally discharges to one of the reservoirs or surface water. The surficial aquifer is underlain by a low permeability bedrock aquifer (FSAR 2.4.13.1.1 and 2.4.12.1.2). Development of the site will have a minor effect on surficial groundwater recharge due to increased impervious area. However, since there is a hydraulic connection between Harris Lake and the surficial aquifer, the overall effect of loss in pervious area should be minimal. The bedrock aquifer has a hydraulic connection with Harris Lake with recharge occurring through bedding plains, fractures and joints

beneath the water surface of the lake. Increased water levels on Harris Lake are not expected to negatively affect aquifer recharge. No adverse environmental consequences are anticipated for this alternative.

8. Baseflow

Brunswick
The base flow of the Cape Fear River in the vicinity of the Brunswick site has been measured at 8,100 to 10,000 cubic feet per second (cfs). The cooling water discharges to the Atlantic Ocean which has no discharge flow constraints (COLA ER 9.3.2.2.3). The increased withdraw of water from the Cape Fear River is not expected to significantly impact the base flow of the Cape Fear River. No adverse environmental consequences are anticipated for this alternative.

Harris
The current normal pool level for the Harris Lake is 220 feet NGVD29 and the auxiliary reservoir is 252 feet NGVD29. The pool elevation of the Harris Lake is proposed to be 240 feet NGVD29 with no change in pool elevation for the auxiliary reservoir (COLA ER Section 2.3).

The current Cape Fear River base flow is 3,384 cubic feet per second (cfs), based on data collected each month between 1924 and 2004, and is not expected to be affected by water withdrawal for the Harris Site (FSAR 2.4.1-204) assuming a maximum withdrawal rate of 133.68 cfs (COLA ER 2.3). The withdraw of makeup water from the Cape Fear River is estimated to be 3.6 percent of the average daily flow reported at the Lillington Gauging Station (COLA ER 9.3.2.2.1.5).

Limited hydrologic alterations will occur on Harris Lake and its tributaries near HAR-2 and HAR-3 and, subsequently, on Buckhorn Creek downstream of Harris Lake. The alterations related to Harris site preparation and construction will generally increase the volume of runoff to the lake and may temporarily alter the quality of runoff to the lake, particularly related to sediment. No adverse environmental consequences are anticipated for this alternative. An in-stream flow study is nearing completion and will determine future releases from Harris dam into Buckhorn Creek if the Harris alternative is permitted. The NCDENR has indicated the results of this study will require a minimum flow release into Buckhorn Creek in addition to a prescribed release schedule based on percentage of inflow. Current water release regulations on Harris dam do not require a minimum flow release, or even a structured release schedule which might benefit ecological features. The minimum flow release and prescribed release schedule would be considered a beneficial effect of this alternative.

9. Mixing zone

Brunswick
Thermal effluent from the Brunswick site discharges through two 13-foot diameter, 2000-foot long submerged pipes that extend into the Atlantic Ocean. Water depth at the point

of discharge is approximately 10 feet. The ocean floor near the discharge pipes is sandy, with no hard bottom outcroppings or attached vegetation that might attract fish. There is a strong westerly tidal and longshore flow in this region. Although aquatic species might use the nearshore area around the discharge location, the slight increase in temperature above ambient ocean temperature is not enough to cause heat shock (COLA ER 9.3.2.2.2.5).

Harris

For the HAR, heated water discharged to Harris Lake will be from blowdown of the two new cooling towers and the service water system to control dissolved solids in the closed cycle system. The cooling tower blowdown water will be discharged into Harris Lake through two new blowdown pipes, one for each of the new cooling towers, installed parallel to the existing discharge pipe for the HNP cooling tower blowdown water. The results of modeling indicate that the discharge plume is approximately 300 feet in diameter. The temperature difference between the plume and ambient water temperature is less than 0.5°F, which meets the NPDES criterion of no increase greater than 5°F (COLA ER 5.3.2.1). Because the HAR site is located on a large reservoir system that will provide sufficient heat rejection capacity for the two new units, plant operation is not expected to have significant thermal impacts to aquatic ecology and water quality (COLA ER 5.3.2.1).

B. Biological Characteristics and Anticipated Changes

1. Special aquatic sites

Aquatic resources identified as subject to potential impact that could result in functional changes as a result of either the Harris or Brunswick alternative were characterized as one of three basic types: wetlands, streams, or non-linear surface waters.

The wetlands identified and classified according to NCWAM for both the Harris and Brunswick alternatives can be divided into two general categories, as defined by NCWAM (NCWFAT 2010): riverine and non-riverine wetlands. Although NCWAM treats tidal wetlands within the riverine wetland category, tidal wetlands are categorized as distinct from non-tidal wetlands by the USACE (33 CFR 328.2), and for the present assessment tidal wetlands are evaluated separately from other NCWAM riverine wetlands. The three general categories of wetlands evaluated are: tidal wetlands, riverine wetlands, and non-riverine wetlands.

- Tidal Wetlands - Tidal wetlands are not present in any areas affected by the Harris alternative, but are present in areas affected by the Brunswick alternative. Tidal wetland types as identified by the NCWAM dichotomous key are wetlands affected by lunar or wind tides, and may include woody areas adjacent to tidal marsh. Under the USACE definition, tidal wetlands are located channelward of the high tide line, which is defined at 33 CFR 328.3.d. Tidal wetlands that were evaluated as part of this study include salt/brackish marsh, tidal freshwater marsh, and estuarine woody wetland.

- Riverine Wetlands - NCWAM defines riverine as a term referring to wetland types typically found in one or more of the following landscape positions: within a geomorphic floodplain or a natural topographic crenulation; abutting/adjacent to natural tributaries, natural water bodies greater than 20 acres or artificial impoundments; or subject to tidal flow regimes. For the purposes of this evaluation, wetlands subject to tidal flow regimes are treated as a separate category (tidal wetlands) for consideration of impacts, functions, and changes in function. Riverine wetlands that were evaluated as part of this study include non-tidal freshwater marsh, bottomland hardwood forest, riverine swamp forest, headwater forest, and floodplain pool.

- Non-riverine Wetlands - Non-riverine wetlands are not in a geomorphic floodplain or topographic crenulation, not associated with a natural lake greater than or equal to 20 acres, or artificial water body, nor subject to tidal flow regimes. Non-riverine wetlands evaluated in this study include pocosin, pine flat, pine savanna, hardwood flat, and basin wetland, and seep.

<u>Stream Types</u>
Four stream types were identified for the Harris and Brunswick alternatives: tidal, perennial, intermittent, and ephemeral. The definition for tidal streams is based on 33

CFR 328.3.f, and perennial, intermittent, and ephemeral streams from the Federal Register 72(47): 11196-11197. Ephemeral streams, as considered here, are stormwater conveyances not meeting criteria necessary to be considered jurisdictional Waters of the United States under Section 404. From a practical standpoint, non-jurisdictional determination for ephemeral streams was made by the USACE for the areas delineated as part of the Harris alternative, and the distinction between perennial and intermittent streams for the areas delineated as part of the Harris alternative was based on the DWQ Stream Identification Form (Version 3.1) completed by CH2M HILL as part of the jurisdictional determination package. For the Brunswick alternative and Harris alternative transmission line upgrade component, the distinction was based on the designation provided by the National Hydrography Dataset. At the request of the USACE and DWQ for streams delineated for the Harris alternative, streams present in the Triassic Basin were evaluated separately from streams not present in the Triassic Basin.

- Tidal Streams – Tidal streams were identified as linear features where tidal waters are present in a defined and identifiable channel. Based on USACE definition, tidal waters rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by hydrologic, wind, or other effects.

- Perennial Streams – Based on USACE definition, a perennial stream has flowing water year-round during a typical year. The water table is located above the stream bed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow.

- Intermittent Streams – Based on USACE definition, an intermittent stream has flowing water during certain times of the year, when groundwater provides water for steam flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.

- Naturalized Ditch/Canal – Naturalize ditches or canals are man-made features that intercept enough groundwater to have either intermittent or perennial flow. These channels have enough flow to support aquatic life and would be considered waters of the United States.

- Ephemeral Streams – Based on USACE definition, an ephemeral stream has flowing water only during and for a short duration after, precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for stream flow. Ephemeral streams are not subject to Section 404 jurisdiction, and were not included in this evaluation.

Non-linear Surface Water Types

Two non-linear surface water types were identified for the Harris and Brunswick alternatives: reservoir and pond.

- Reservoir – Reservoirs were identified as surface water features greater than 20 acres in size formed by impoundment of waters otherwise defined as waters of the United States.

- Pond – Ponds were identified as non-linear, non-wetland, surface water features less than 20 acres in size.

Aquatic resources may be subject to impacts from either the Harris or Brunswick alternative by one of four general actions: filling associated with infrastructure development; flooding from reservoir expansion; trenching for pipelines; or clearing for transmission line upgrades.

Brunswick

The Brunswick site is located on the Lower Cape Fear River estuary, which includes 22,000 acres of salt marsh and 18,000 acres of tidal flats and small tidal streams. This section of the Lower Cape Fear River near the Brunswick site ranges from one to two miles wide and is mostly shallow except for a shipping channel maintained by the U.S. Army Corps of Engineers (Brunswick ER 2.2). The two principal components of the Brunswick alternative for which physical impacts to aquatic resources have been identified include the 400-acre power block and support facilities and transmission line upgrades. Based on review agency concerns for consideration of avoidance and minimization of impacts, as well as consideration for the effects of future potential sea level rise, PEC re-evaluated the initial 400-acre power block area evaluated in the alternatives analysis document. Complete avoidance of impacts to wetlands and streams was not identified as practicable, and the present evaluation is based on minor adjustments resulting from preliminary identification of site constraints as well as avoidance and minimization efforts for sensitive aquatic resources. Construction of the power block and support facilities (including new/relocated roads) will result in fill in wetlands and streams. Transmission upgrades will result in clearing and maintenance of wetland and stream bank habitats to provide the additional required ROW, resulting in conversion of conversion of forested wetland habitats to herbaceous wetland habitats.

Potential impacts have not been evaluated for pipeline construction that may be necessary to provide sufficient treated freshwater for process and service water for the Brunswick alternative. BSEP receives water from Brunswick Public Utilities, and from 1996 to 2001, BSEP's water use ranged from approximately 0.22 mgd to 0.25 mgd, with an average consumption of 0.25 mgd (Brunswick ER 2.9.1). Brunswick Public Utilities does not currently have the necessary capacity to meet the process and service water needs for the two AP1000 units; however, the additional infrastructure requirements and resulting impacts that may be necessary to provide the two AP 1000 units with an average-day use of 1.58 mgd and maximum-day use of 5.8 mgd have not been determined.

Thirteen NCWAM wetland types have been identified as potentially affected by the Brunswick alternative based on a combination of limited field-truthing and GIS-based evaluation: salt/brackish marsh, estuarine woody wetland, tidal freshwater marsh, non-tidal freshwater marsh, riverine swamp forest, headwater forest, bottomland hardwood forest, pocosin, pine flat, pine savanna, hardwood flat, basin wetland, and seep. Streams potentially affected include tidal, perennial, and intermittent reaches, and naturalized ditch/canal. Non-linear surface waters present within the Brunswick alternative include ponds. Table 6 presents the potential physical impacts to aquatic resources by Brunswick alternative actions.

Power Block - The Brunswick alternative would result in greater impact from filling activities than the Harris alternative. The Brunswick alternative may result in fill to nearly 19 acres of tidal wetlands and streams (approximately 16 acres of tidal wetlands and 1.2 miles [2.5 acres] of tidal stream channel) and 19 acres of riverine wetlands.

Water Supply – The water supply scenario for the Brunswick alternative is not expected to directly affect any special aquatic sites through either dredge or fill activities.

Transmission Upgrades - The Brunswick alternative would result in substantially greater clearing impacts for transmission line upgrades than the Harris alternative. Approximately 1,450 acres of wetlands are present within the preliminary alignment evaluated for the expanded Brunswick ROW. The majority of this impact would occur to riverine swamp forest (443ac), pocosin (421 ac) and pine flat (291 ac). The three most prevalent wetland types located along the Brunswick transmission lines total approximately 1,155 acres and will experience considerable functional loss and reduction as a result of the ROW upgrades based on the results of the NCWAM assessment that are provided in the Aquatic Resource Functional Assessment.

The actual clearing impacts for the Brunswick alternative may be higher than those that have been identified. The potential Brunswick impacts are based on the initial siting study which only considered transmission upgrades required for addition of an 1100-MWe generating unit (requiring upgrades to four of eight 230-kV transmission lines). Additional transmission upgrades required for the additional generating capacity provided by construction of two AP1000 reactors (approximately 2,000 MWe) for the Brunswick alternative has not been evaluated and may result in additional impacts. The Brunswick lines ROW expansion would affect approximately 1,450 acres of wetlands.

Table 6. Potential Physical Impacts to Aquatic Resources for Brunswick Alternative.

Aquatic Resource	Impact Type	
	Filling	Clearing
Wetlands (ac)		
Salt/Brackish Marsh	11	3
Estuarine Woody Wetland	5	0
Tidal Freshwater Marsh	0	24
Non-Tidal Freshwater Marsh	0	2
Riverine Swamp Forest	12	443
Headwater Forest	7	127
Bottomland Hardwood Forest	0	93
Pocosin	0	421
Pine Flat	0	291
Pine Savanna	0	37
Hardwood Flat	0	6
Basin Wetland	0	2
Seep	0	<1
Total Wetlands (ac)	**35**	**1,450**
Streams (mi)		
Tidal Stream	1.2	0.2
Perennial Stream	0.2	4.6
Intermittent Stream	0.4	7.1
Naturalized Ditch/Canal	0	0.8
Total Streams (mi)	**1.8**	**12.7**
Non-linear Surface Waters (ac)		
Pond	0	28
Total Non-linear Surface Waters (ac):	**0**	**28**

Harris

The three principal components of the Harris alternative for which physical impacts to aquatic resources have been identified include construction of the 400-acre power block and support facilities area (including new/relocated roads, and raw water line), reservoir expansion, and transmission line upgrades. Wetland and stream fill associated with infrastructure improvements as well as wetland and stream impacts resulting from pipeline construction are part of the overall Harris alternative impact scenario. Roadway improvements may result in fill in an area that would otherwise be subject to affect by reservoir expansion. Until roadway alternatives are fully evaluated and design developed for the selected improvements, these potential impacts can only be shown as "filling or flooding" for this analysis. Reservoir expansion will result in conversion of wetland and stream habitat to non-linear surface water habitats. Pipeline construction will require clearing and temporary excavation for pipeline installation. Wetland habitats and stream banks will be cleared and maintained for additional ROW needed for transmission line upgrades, resulting in conversion of forested wetland habitats to herbaceous wetland

habitats. PEC's Environmental Report for the Shearon Harris Nuclear Power Plant (CP&L, amended 1986) indicates that only 3% of the land inundated for the original reservoir was bottomland hardwood; the majority of the land inundated was upland pine and hardwood forests (75%), with the balance (22%) consisting of cutover and fields.

Five NCWAM wetland types have been identified as potentially affected by the Harris alternative based on a combination of limited field-truthing and GIS-based evaluation: non-tidal freshwater marsh, headwater forest, bottomland hardwood forest, riverine swamp forest, and floodplain pool. Streams potentially affected include perennial and intermittent reaches, and naturalized ditch/canal. Non-linear surface waters present within the Harris alternative include reservoir and ponds. Table 7 presents the potential physical impacts to aquatic resources by Harris alternative actions.

Table 7. Potential Physical Impacts to Aquatic Resources for Harris Alternative.

Aquatic Resource	Impact Type				
	Filling	**Filling or Flooding**	**Flooding**	**Trenching**	**Clearing**
Wetlands (ac)					
Non-tidal Freshwater Marsh	0	0	422 [a]	0	4
Headwater Forest	5 [b]	0	177 [b]	1 [b]	19
Bottomland Hardwood Forest					68
Riverine Swamp Forest					4
Floodplain Pool					0
Total Wetlands (ac):	**5**	**0**	**598**	**1**	**95**
Streams (mi)					
Perennial Stream	0.3	0.4	15.8	0.5	1.5
Intermittent Stream	0.5	0.2	10.9	0.1	3.6
Naturalized Ditch/Canal	0	0	0	0	0.2
Total Streams (mi):	**0.8**	**0.6**	**26.8**	**0.6**	**5.3**
Non-linear Surface Waters (ac)					
Reservoir	0	0	3,321	0	0
Pond	5	0	10	0	23
Total Non-linear Surface Waters (ac):	**5**	**0**	**3,331**	**0**	**23**

[a] emergent wetlands and wetland fringe
[b] forested wetlands
General note: totals may differ based on rounding.

The original delineation for the Harris power block and support facilities and reservoir expansion did not differentiate between forested types; all were labeled as forested. The NCWAM evaluation described herein characterizes these wetlands as bottomland hardwood, riverine swamp forest, headwater forest, or floodplain pool. All of these wetlands types are considered to be riverine wetlands. Not every forested wetland area

identified through delineation or GIS-based methods was visited during this phase of the study; therefore certain assumptions were made with regard to assigning NCWAM types to those wetlands that were not specifically visited by ESI. Previous mapping was reviewed along with supplemental data sources to aid in the NCWAM classification. For example, some forested wetlands are classified as being either headwater forest or riverine swamp forest because they occur on 1st order streams or in topographic crenulations without streams. Similarly, some forested wetlands are classified as being riverine swamp forest or bottomland hardwood because of their location on 2nd order or greater streams. However, the exact NCWAM type cannot be determined without visiting and assessing the hydrology of these wetlands, especially the wetland areas influenced by hydrologic conditions in proximity to Harris reservoir, therefore these forested wetlands are treated together for the Harris site and reservoir area impacts in Table 7.

Power Block – The Harris alternative may result in impacts to approximately 5 acres of riverine wetlands. The Harris alternative would result in less fill impacts to stream channel on a linear basis, 0.8 mile compared to 1.8 miles for Brunswick, although the Harris alternative may also result in additional fill of up to 0.6 mile of stream channel for road improvements (this 0.6 mile of stream channel would be subject to flooding from reservoir expansion if the road improvement alternative resulting in fill is not selected).

Water Supply – The Harris alternative would result in flooding approximately 598 acres of riverine wetlands, 26.8 miles of stream (or up to 27.4 miles if road improvement alternatives do not result in fill), and 3,331 acres of non-linear surface waters (primarily deepening of the existing Harris Reservoir). The flooding impacts would result in the conversion of the wetland and stream habitat, as well as upland habitat, to an expanded reservoir and associated habitats.

Transmission Upgrades - ROW expansion impacts will result in a conversion of 91 acres forested wetland habitat to a low-growing, maintained wetland habitat. A total loss will not result from ROW expansion; however, diminished wetland function can be expected based on the NCWAM assessment.

Existing Functions

The field evaluations undertaken for selected wetlands and streams provide a basis for general discussion of functions and relative degree of function provided by the evaluated features. However, not every aquatic resource site identified through delineation or GIS-based methods was visited or evaluated as part of this review. Function can vary among sites of the same aquatic resource type and vary within an individual feature. The information obtained from the NCWAM evaluations undertaken and stream data extracted from Stream Quality Assessment Worksheet (SQAW) forms is presented to provide a summary for some of the existing functions identified for existing wetlands and streams potentially affected by project alternatives. This information is supplemented by additional information obtained from various literature sources on functions expected to be provided by the different aquatic resource types. The detailed functional assessment

results are provided in the Aquatic Resource Functional Assessment in Support of the Harris Advanced Reactor 404(b)(1) Alternatives Analysis (ESI 2010).

Based on the results of the functional evaluation techniques used, the following general observations can be made:

- Wetlands – The majority of wetlands potentially affected by the Harris and Brunswick alternatives rated High based on NCWAM evaluations (77% for both Harris and Brunswick alternatives). Other evaluated wetlands rated medium to poor. Expansion of NCWAM evaluations to all wetland sites potentially affected by either alternative could result in a different distribution of ratings, but based on the relatively undeveloped nature of the potential impact areas, most wetlands are expected to rate high or medium.

- Streams – The majority of streams potentially affected by the Harris reservoir expansion and site construction scored in the middle third of possible maximum points based on use of existing SQAW form results. Triassic Basin streams, which constitute the majority of the streams, tended to score lower than those not in the Triassic Basin. These streams are expected to exhibit functions ranging from low (for relatively unstable reaches) to high (for relatively stable reaches). No evaluation was undertaken for streams along the transmission lines or for the construction portion of the Brunswick alternative. The tidal stream (Nancy's Creek) subject to fill from Brunswick alternative construction activities is classified as HQW and a PNA, and as such is assumed to have high function in the absence of any identifiable disturbance.

- Non-linear Surface Waters – No functional evaluation was undertaken in the field for these waters. A review of existing data summaries from water quality monitoring studies for Harris Reservoir indicates that Harris Reservoir has relatively good water quality and is expected to have relatively good function.

<u>Brunswick Alternative Special Aquatic Site Losses and Functional Changes</u>
The Brunswick alternative is expected to result in:

- Filling of approximately 19 acres of tidal wetlands and streams, 19 acres of forested riverine wetlands, and 1.8 miles of stream (1.2 miles of tidal stream, 0.2 miles of perennial stream, and 0.4 miles of intermittent stream);
- Trenching impacts that may be possible for extension of water lines from Brunswick County Public Utilities (BCPU) source(s) to the site, but which have not been evaluated or quantified; and
- Clearing of approximately 1,450 acres of wetlands for transmission line ROW for upgrade of four lines (27 acres of tidal wetlands, 665 acres of riverine wetlands, and 758 acres of non-riverine wetlands); additional impacts may be possible if upgrades are required for additional lines.

Filling will result in the permanent loss of aquatic function for the affected resources. The Brunswick alternative will result in filling of approximately 19 acres of regularly-flooded tidal wetlands and tidal stream (1.2 miles) which have high function. The tidal stream, Nancy's Creek, is an estuarine water classified as High Quality Waters (HQW) by DWQ. The brackish/salt marsh and Nancy's Creek are considered Areas of Environmental Concern (AECs) per the Coastal Area Management Act (CAMA) and represent a very important coastal resource that provides numerous functions. These areas serve as a nursery area for dozens of marine fish species, as well as multitudes of other types of marine organisms each of which provides a link in the coastal food web. The habitats provided by Nancy's Creek also encompass Essential Fish Habitat that promotes further protection from the Federal and State regulatory agencies. The additional 19 acres of riverine wetlands and 0.6 mile of stream are expected to have high function as well.

Potential trenching impacts have not been determined. However, brackish water available from the intake canal is not suitable for use to meet the average-day requirement of 1.58 mgd and maximum-day requirement of 5.8 mgd of treated freshwater needed for process and service water needs. BCPU, which currently provides an average of approximately 0.22 mgd to BSEP, does not currently have the capacity to provide the additional water. There are no plans to expand the BCPU 211 Water Treatment Plant (Hazen and Sawyer 2006), which currently provides BSEP with water from groundwater sources. Additional capacity of approximately 12 mgd is being added to the BCPU Northwest Water Treatment Plant, which may require a pipeline of approximately 30 miles to BSEP.

Clearing is expected to result in permanent impacts to some wetlands, but not result in any substantial changes in function for streams or non-linear surface waters as a result of ROW clearing and maintenance. The Brunswick lines ROW expansion would affect approximately 1,450 acres of wetlands. Of this total, approximately 1,421 acres of forested wetlands would be converted to open, maintained ROW habitat under the Brunswick alternative. Most of the wetlands subject to clearing were rated as High using NCWAM. NCWAM results indicate that some functional diminishment will occur in approximately 1,405 acres representing all the wetland types except the approximately 45 acres brackish/salt marsh, pine savanna, and basin wetland. Both riverine and non-riverine wetlands demonstrate a decrease in function when comparing the assessment area outside the ROW (baseline) versus inside the ROW (post-construction). Hydrology function is negatively affected on 7 of the 12 wetland types, habitat functions are negatively affected on 6 of the 12 wetland types, and water quality functions are negatively affected on 3 of the 12 wetland types (non-riverine wetlands only). Clearing for ROW is expected to result in an overall decrease in function for 6 of the 12 wetland types totaling approximately 1,381 acres, including bottomland hardwood (93 acres), riverine swamp forest (443 acres), headwater forest (127 acres), pocosin (421 acres), pine flat (291 acres), and hardwood flat (6 acres).

Creation of new ROW for the Brunswick lines, especially in and around wetlands, will promote suitable habitat for several federally protected species such as rough-leaved

loosestrife, Cooley's meadowrue, and golden sedge in those southeastern counties where these species are listed by the U.S. Fish and Wildlife Service. Conversely, the ROW expansion will also negatively impact the beneficial forested wetland habitat utilized by several species of conservation concern, including area-sensitive wetland dependent wildlife species, including many neo-tropical migrant bird species such as prothonotary warbler and Acadian flycatcher. Species adapted to or utilizing edge and early successional wetland habitats, such as red-winged blackbird and brown-headed cowbird, will benefit from the new habitat structure. ROW expansion is expected to result in some degree of functional diminishment in 544 of the 580 acres of wetlands identified within SNHAs within the ROW, and overall functional diminishment in 522 acres of these wetlands.

Harris Alternative Special Aquatic Site Losses and Functional Changes

The Harris alternative is expected to result in:

- Filling of approximately 5 acres of forested riverine wetlands, 0.8 – 1.4 miles of stream (0.6 miles will be subject to flooding if not filled), and 5 acres of non-linear surface water (pond);
- Flooding of 598 acres of riverine wetlands, 26.8 miles of streams, and 3,331 acres of non-linear surface waters (3,321 acres of existing Harris Reservoir and 10 acres of ponds);
- Trenching of up to 1 acre of riverine wetlands and 0.6 miles of stream; and
- Clearing of 95 acres of wetlands for transmission line ROW (91 acres of forested wetlands).

Filling will result in permanent loss of aquatic function for the affected aquatic resources. The wetlands subject to fill are expected to have medium to high function based on NCWAM. The 15 stream segments subject to fill (or potential fill) generally scored in the middle third of possible points on the SQAW form, with 1 stream scoring in the upper third (a Triassic Basin perennial stream), and 2 streams scoring in the lower third (both Triassic Basin, one perennial and the other intermittent).

Flooding is expected to result in some changes of aquatic function through conversion from wetland and stream habitats to reservoir habitats. The expanded reservoir is expected to contain a variety of habitats including open water and shallow littoral habitats. The shallow littoral areas of the expanded reservoir are expected to support submerged vegetation and emergent herbaceous wetlands similar to the ones that have been documented as quickly colonizing the existing reservoir following construction and establishment of normal pool. Wetland functions were determined to be generally high, with a few wetlands identified as having medium function using NCWAM. Streams scored between 18 and 80 using the SQAW form, with most scoring in the middle third of potential points. The non-linear surface water habitat present in existing Harris Reservoir was determined to have relatively good function based on results of DWQ and PEC water quality and biological monitoring studies.

Although some functions may be lost or diminished on a per-unit basis, the inundation of 598 acres of wetlands, 26.8 miles of stream (representing approximately 52 acres of

streambed habitat), and 3,331 acres of non-linear surface waters will be offset by functions provided by the approximately 3,900 acre gain in reservoir habitats.

- The expansion of the reservoir will result in a gain of approximately 61.9 miles of riparian perimeter with forested buffer compared to the existing reservoir. The gain of 61.9 miles of reservoir riparian zone is expected to offset functional losses from clearing and inundation of the existing forested riparian zone (53.6 miles based on 26.8 miles of stream with buffer on both streambanks).

- Reservoir habitats contained within the shallow littoral zone (less than 6.6 feet in depth) will experience a net gain of approximately 430 acres (increasing from 959 acres to 1,389 acres).

No substantial changes in physical or chemical function are expected based on the increase in aquatic area and the functions provided by the expanded reservoir. Loss of specific aquatic habitats and associated habitat specialist species will occur within the affected areas. These habitats will not be lost from the watershed, with approximately 125.7 miles of stream remaining in the Buckhorn Creek watershed above Harris Reservoir, and 29.4 miles of stream remaining in the Buckhorn Creek watershed downstream of the dam. None of the species expected to experience habitat loss is nationally or regionally rare. The increase in reservoir habitat will provide additional habitat for aquatic fauna and waterfowl adapted to reservoir habitats.

- The majority of the wetlands that will be lost consist of artificial or man-induced wetlands associated with the existing Harris Reservoir shoreline. Approximately 405 acres of non-tidal freshwater marsh and wetland fringe (59% of total wetlands) are in this category of man-induced. Currently, the non-tidal freshwater marsh wetlands surrounding the shoreline of Harris Reservoir are of relatively high quality even though non-native, invasive species are dominant in most areas. The reestablishment of non-tidal freshwater marsh, including hydrilla, at the new elevation will replace similar habitat for these fauna lost from initial flooding and will be beneficial to the stabilization of the biologic community in Harris Reservoir. Although non-tidal freshwater marsh wetlands, including hydrilla, provide beneficial functions that will be lost or reduced due to rising lake levels, it is expected that they will reform in the coves and along the shoreline of the expanded reservoir. This wetland type is expected to reform at the new pool elevation although identifying the likely extent of the new coverage is still being evaluated by PEC and will be further addressed through mitigation planning, implementation, and monitoring. These non-native species do not currently pose any problems with regards to operation of the Shearon Harris Nuclear Plant (COLA ER Rev. 2 Section 2.4.2.1.6.1).

- Harris Reservoir has evolved from a moderately productive reservoir with relatively slow-growing game fish in the 1980s into a more productive reservoir with healthy populations of largemouth bass, bluegill, redear sunfish, crappie, and catfish (COLA ER Rev. 2 Section 2.4.2.1.6.2). Although considered noxious

species, hydrilla and water primrose are credited with creating favorable conditions for the world-class largemouth bass fishery by fisherman who use the lake. Harris Reservoir has also been demonstrated to generate over $1 million dollars in revenue for the area over a one year period as a result of fishing activity (NCWRC 2000). Harris Reservoir is regularly reported as one of the best largemouth bass fisheries in the southeastern U.S. by many of the regional and national fishing periodicals.

Trenching is expected to result in temporary impacts to stream channel and wetlands from excavation activities, but stream channel function is expected to return following re-grading and stabilization. Wetland functions will be affected by the permanent clearing and maintenance for ROW, with some diminishment of overall function expected.

Clearing is expected to result in permanent impacts to some wetlands, but not result in any substantial changes in function for streams or non-linear surface waters as a result of ROW clearing and maintenance. The majority of wetlands within the ROW clearing areas rated High using NCWAM. Forested wetlands cleared for ROW construction will lose some functional capacity as a result of conversion. The functions diminished by ROW clearing are considered effectively permanent based on perpetual maintenance activities that will be undertaken by PEC to prevent regrowth of woody vegetation for the duration of transmission service. Only riverine wetlands occur along the proposed Harris transmission line routes that were evaluated. The primary functions that will be lost are related to hydrology and habitat function within the forested riverine wetlands, primarily headwater forest and bottomland hardwoods.

Some of the wetlands affected by ROW expansion are present in identified Significant Natural Heritage Areas (SNHAs). Wetlands within SNHAs are expected to have high function based on identification of their uniqueness. Clearing for new ROW is expected to affect 6 acres of bottomland forest and less than 1 acre of non-tidal freshwater marsh within SHNAs for the Harris alternative. Diminishment of function through clearing of forested areas for ROW expansion is expected for the bottomland forest.

Table 8. Summary of Potential Physical Impacts to Aquatic Resources.

Aquatic Resource	Impact Type									
	Filling		Filling or Flooding		Flooding		Trenching		Clearing	
	Harris	Bruns	Harris	Bruns	Harris	Bruns	Harris	Bruns	Harris	Bruns
Wetlands (ac)										
Tidal Wetlands	0	16	0	0	0	0	0	0	0	27
Riverine Wetlands	5	19	0	0	598	0	1	0	95	665
Non-riverine Wetlands	0	0	0	0	0	0	0	0	0	758
Total Wetlands (ac):	**5**	**35**	**0**	**0**	**598**	**0**	**1**	**0**	**95**	**1,450**
Streams (mi)										
Tidal Stream	0	1.2	0	0	0	0	0	0	0	0.2
Perennial Stream	0.3	0.2	0.4	0	15.8	0	0.5	0	1.5	4.6
Intermittent Stream	0.5	0.4	0.2	0	10.9	0	0.1	0	3.6	7.1
Naturalized Ditch/Canal	0	0	0	0	0	0	0	0	0.2	0.8
Total Streams (mi):	**0.8**	**1.8**	**0.6**	**0**	**26.8**	**0**	**0.6**	**0**	**5.3**	**12.7**
Non-linear Surface Waters (ac)										
Reservoir	0	0	0	0	3,321[a]	0	0	0	0	0
Pond	5	0	0	0	10	0	0	0	23	28
Total Non-linear Surface Waters (ac):	**5**	**0**	**0**	**0**	**3,331**	**0**	**0**	**0**	**23**	**28**

[a] Acreage for open water habitat of Harris Reservoir, does not include wetlands delineated below normal operating pool level (220 ft).
General note: totals may differ based on rounding.

Summary

Overall, the Brunswick alternative would impact a substantially greater amount of wetlands than the Harris alternative, primarily through the conversion of forested wetlands for transmission line upgrades. The Harris alternative would result in lesser total wetland impact including both conversion of forested wetlands for transmission line upgrades and conversion of forested wetlands and herbaceous wetlands to open water lake habitat. Non-tidal freshwater marsh habitat would be expected to become re-established in the shallow portions of the lake and along the normal pool fringe subject to long-term saturation.

The Harris alternative would impact a substantially greater amount of streams through inundation from the reservoir expansion. Inundation results in a conversion from intermittent and perennial stream habitat functions to lake habitat functions. Raising the normal pool of the lake is not expected to result in as great a functional change as that which occurred historically when the original reservoir was created which resulted in the isolation of remaining stream habitats by intervening lake habitat.

Based on the difference in types of impacts and the amount of wetland function lost or reduced, the Brunswick alternative does not unquestionably constitute an alternative demonstrating less adverse impact on the aquatic ecosystem in comparison to the preferred Harris alternative.

2. Habitat for fish and other aquatic organisms

Brunswick

Power Block - The primary habitat types utilized by the aquatic organisms in the vicinity of the Brunswick site include the water column, shell bottom habitat, wetlands, and soft bottom habitat. The Lower Cape Fear River estuary and surrounding marsh and wetlands provide important habitat for fish and other aquatic organisms at various life cycle stages. The major categories of aquatic biota include phytoplankton, zooplankton, larvae and post larvae of fish and shellfish, and juvenile and adult fish and shellfish. The Cape Fear River up to Highway 421 is considered Essential Fish Habitat by the National Marine Fisheries Service (NMFS) for egg, larval, and/or juvenile life stages of the following species: red drum, bluefish, summer flounder, gag grouper, gray snapper, cobia, king mackerel, Spanish mackerel, black sea bass, spiny dogfish, brown shrimp, pink shrimp, white shrimp, plus twelve different shark species (NMFS 2009). This expansion will directly impact sensitive environmental areas consisting of tidal marsh and estuarine woody wetlands that provide habitat for fish and other aquatic organisms ranging from benthic macro invertebrates to finfish and shellfish. Approximately 16 acres of tidal wetlands and 1.2 miles (2.5 acres) of tidal stream will be impacted by fill in the proposed power block area under the Brunswick alternative.

Water Supply - Cooling water for all existing and additional units will flow through a single common intake canal. The additional generating capacity resulting from the added reactors at the Brunswick site will require an increased volume of cooling water to be pumped through the existing canal. The Brunswick site currently operates two units with once through cooling. This cooling water is withdrawn from the Cape Fear River Estuary, provides cooling capacity to the existing units, and is then discharged to the Atlantic Ocean via a 6-mile long discharge canal. Current velocity in the intake canal, with the existing units, is approximately 0.6 feet per second (Brunswick ER Section 3.1.2.1). The current NPDES permit for the Brunswick site (NC0007064) limits cooling water flows to 922 cubic feet per second per unit (cfs/unit) over the December-March period and 1,105 cfs/unit over the April-November period, with the stipulation that one unit may increase its flow to 1,230 cfs during the months of July, August, and September (Brunswick ER Section 3.1.2.1). These reduced flows in the winter months are necessary for the additional reductions of the entrainment losses of finfish larvae, particularly winter-spawning fish such as menhaden, spot, croaker, and flounder. The flows are allowed to increase in the spring. NCDMF and NCDWQ emphasize the protection of penaid shrimp and blue crab larvae during the spring. Any necessary increase in the flow through the intake canal will require a revised NPDES permit be applied for by PEC.

The two added units would use closed cycle cooling, which will require less water flow than once through cooling, but will result in an overall greater volume of water being necessary to cool the original reactors and provide water for the closed-cycle system that will cool the new reactors. The increased volume of cooling water will require an increase in the velocity of water being pumped through the intake canal. The increase in water flow required as a result of the addition of the closed cycle cooling system, though nominal in comparison to once through cooling systems, could cumulatively increase the entrainment and impingement of aquatic organisms.

Entrainment is the taking in of small organisms with the cooling water. These organisms typically include phyto- and zooplankton, fish eggs and larvae, shellfish larvae, and many other forms of aquatic life. PEC has monitored the entrainment of fish and shellfish at the Brunswick site since 1974 and has made a number of material and operational changes during that time to reduce entrainment, including the installation of 1-mm fine mesh screens and a fish return system (Brunswick ER 4.3). CP&L acknowledged in 1985 that some entrainment of larvae still occurs despite the mitigation measures but noted that populations in the estuarine nurseries have not been affected (CP&L 1985a). However, the additional flow resulting from pulling additional water through the canal for the closed cycle cooling system will expose smaller aquatic organisms in this nursery area to increased risk of entrainment, which is a much harder issue to minimize and may result in a negative impact on the aquatic environment. As these entrained organisms pass through the facility they are subjected to many sources of damage including mechanical damage from pumps, pipes, or condensers; shear damage due to complex water flows; thermal damage due to elevated temperatures; and toxicity damage caused by the addition of biocides that prevent condenser fouling (EPA 1977). Those organisms that survive the passage through the plant under the existing once through cooling scenario may experience delayed mortality upon entering the outfall canal. Those organisms that are entrained in the closed cycle cooling system will, in all likelihood, experience mortality in the closed system before being discharged. More than 70% of estuarine animals have planktonic eggs and larvae (Marcy *et. al.* 1978). The estuary surrounding the Brunswick site, and the Cape Fear River itself, is identified as essential fish habitat by NMFS for many regulated species during their egg and larval life stage. Available information indicates that entrainment mortality of fish larvae in power plant intakes is high {40-100%} (Kelso and Leslie 1979).

Impingement occurs when an organism is trapped against the screen or diversion structure due to the force of the intake water. A fish diversion structure located at the mouth of the intake canal and fine-mesh traveling screens plus a fish return system have been installed to reduce the impingement of aquatic organisms. The design of the fish diversion structure was engineered for the existing two operating units only. The make-up water for two additional units could challenge the integrity of the diversion structure resulting in damaged diversion screens and extensive maintenance activities. Repairs are completed as quickly as possible. Larval shrimp and blue crab exhibit high fine-mesh screen efficiencies and consistently high survival on the screens and in the fish return system. The fine-mesh screen efficiencies and survival of finfish larvae are more variable and are not as good as those demonstrated for shrimp and crab larvae. As a result higher

cooling water flow is permitted from April through November with flow reductions during December through March. Additional units will further increase the flows currently mandated by the NPDES permit and studies will be necessary to determine the flow rates to minimize impacts.

Increased cooling water flow rates may also jeopardize cooling water system reliability depending on the magnitude of the increase. Past operating experience has shown that increased velocity in the intake canal associated with sedimentation increases the occurrences of fine-mesh screen clogging events. In addition there are significant environmental challenges to plant operation in this estuarine setting that do not exist for the location of the Harris site. These include intake blockage resulting from large volumes of marine algae, dense concentrations of marine zooplankton, and the large bio-fouling community associated with marine waters (PEC 2009a). The marine algae *Gracillaria vermiculophylla* is a non-native species introduced from Southeast Asia that is very prevalent in the Cape Fear River estuary. This non-native species has been identified as a major fouling organism on the Brunswick Nuclear Power Plant's cooling water and diversion and intake screens (COLA ER 9.3.2.2.2.5). This macroalgae currently causes significant screen fouling issues at the entrance to the intake canal and has caused blow-outs of the diversion structures when too much of the material has accumulated.

The additional cooling water will also result in additional discharge through the existing pipes that extend into the Atlantic Ocean. The ocean floor surrounding the discharge pipes is sandy with no hard bottom outcroppings. This additional thermal discharge is expected to have a minimal effect on habitat for fish and other aquatic organisms due to the strong westerly and long shore flow in this area.

In summary, additional entrainment impacts are more likely to result from increasing the flow through the intake canal than impingement impacts, which will be minimized by the existing diversion structures. Although some additional impingement may result from adding new units to the Brunswick site, the NRC concluded that there would be no discernible adverse effect on aquatic organisms because of the very small volume of water used by the plant compared with the total volume of available water at the site (COLA ER 9.3.2.2.5). The higher flows may also increase blockages due to *Gracillaria vermiculophylla* that clogs the screens and diversion structures. Increased blockages could pose significant health and safety issues for the plant and surrounding area (PEC 2009a).

Transmission Upgrades - With regard to the conversion of forested wetlands to maintained ROW, notable habitat for wetland and aquatic dependant species will be transformed to a low-growing wetland type with little to no vertical relief. The conversion of these forested wetlands along the expanded ROWs will likely affect the ecological cycle of numerous trophic levels beginning at the bottom of the food web. Riverine wetlands, such as headwater forest, bottomland hardwood forest, and riverine swamp forest are typically net importers of inorganic forms of nutrients and net exporters of organic forms (Mitch and Gosselink 1986). The loss of the riverine forested wetlands

will reduce the amount of organic material, resulting from decomposition in the forested wetlands, from entering the downstream aquatic habitats. Mitch and Gosselink (1986) also report on a study by Mulholland (1979) that shows North Carolina floodplain swamps have been shown to contribute as much as 523 grams of litter fall per square meter per year. This litterfall is an important component of the detritus cycle that forms the basis for many food webs. The results of the NCWAM assessment indicate a negative shift in the habitat function of 6 of the 12 wetland types occurring along the Brunswick lines, including the three most prevalent wetland types. These include riverine swamp forest, pocosin, pine flat, headwater forest, bottomland hardwoods, and hardwood flat (ESI 2010). In addition to the habitat loss resulting from the conversion of forested wetlands, the proposed transmission line upgrades for the Brunswick alternative will cross over fifty significant natural heritage areas (SNHA) totaling approximately 1,033 acres. Of this total acreage within these SNHAs, approximately 589 acres of jurisdictional wetlands are present and may be impacted. The sites included on this list are the best representatives known of the natural diversity of the State and therefore deserve priority for protection (NCNHP 2009).

Harris

Power Block - An ecological study conducted on the Harris site in 2006 identified no significant aquatic habitat within the footprint of the proposed HAR-2 and HAR-3 facilities. Approximately 5 acres of wetlands would be filled as part of the power block construction.

Water Supply - Although inundation is not a direct discharge of dredge or fill material it does represent a loss of functional value of those streams and wetlands affected and a conversion of aquatic habitat types does occur. As such, quantifying this loss is required under Section 404. Aquatic habitat loss will occur to approximately 422 acres of non-tidal freshwater marsh wetlands located below the 220-foot contour (*i.e.,* emergent wetlands and aquatic beds) and along the shoreline of the lake (wetland fringe). Although not quantifiable in extent or timing of re-establishment, similar habitats will likely re-establish in areas with suitable conditions at the higher pool elevation and represent, at least in part, only a temporary loss of aquatic habitat. The succession of the aquatic vegetative communities was monitored by PEC immediately after Harris Lake started to fill. In 1983 a total of 25 aquatic vegetative species were observed. In 1984 the total had increased to 58 aquatic vegetative species and large quantities of floating leaf and submerged vegetation had developed in the shallows. Additionally, by 1984, many of the terrestrial woody vegetation occurring at the normal pool elevation had died and were being replaced with herbaceous shoreline vegetation. It is this evolution that resulted in the wetland fringe present around the shoreline today. In 1986 a total of 70 aquatic vegetative species were documented and all areas of Harris Lake less than 3 meters in depth supported submersed vegetation. Hydrilla was discovered in the White Oak Creek arm of the reservoir in 1988, and by 1990 was the dominant aquatic plant of the littoral zone, displacing several native species. Creeping water primrose, another non-native species, appeared a year or so later and quickly established itself in Harris Lake (COLA ER Rev. 2 Section 2.4.2.1.6.1). Harris Lake has evolved from a moderately productive reservoir with relatively slow-growing game fish in the 1980s into a more

productive reservoir with healthy populations of largemouth bass, bluegill, redear sunfish, crappie, and catfish (COLA ER Rev. 2 Section 2.4.2.1.6.2). Although considered noxious species, hydrilla and water primrose are credited with creating favorable conditions for the world-class largemouth bass fishery by fisherman who use the lake. Harris Lake has also been demonstrated to generate over $1 million dollars in revenue for the area over a one year period as a result of fishing activity (NCWRC 2000).

In the years prior to completing the construction of Harris Lake, as many as 53 species of fish were collected from streams that were to be flooded in order to construct the reservoir (CP&L 1978). In comparison, 46 fish species were collected from streams above the proposed 220-ft normal pool elevation during this same period. During the first five years after construction was considered complete, as many as 46 species of fish were collected from within the reservoir (CP&L 1984, 1985b, 1986, 1987, 1990). Sampling conducted in 2008 identified a total of 20 fish species within the reservoir along with 3 genera not identified to species (PEC 2009d). Most noticeable absent from the reservoir in recent collection efforts are the American eel along with several intolerant fish species such as smallfin redhorse, sawcheek darter, and piedmont darter. There is also a reduction in the overall number of species of suckers and minnows collected. An August 2006 sampling event produced a combined total of 21 fish species and 1 hybrid species from the seven sampling stations representing a combination of tolerant and intermediately tolerant species (CH2M HILL 2006). Sampling of fish species via electro-shocking revealed a similar range of poor to good for the seven sampling sites. The number of fish species both within the existing reservoir and within the streams flowing into the reservoir differs by only one species based on the most recent data, and the number of species identified in both categories (reservoir and streams above reservoir) has decreased over the years. The overall diversity of fish within the Harris Lake watershed appears to have decreased since the dam was completed and filling began in 1980. Fish representing the omnivore, piscivore, and herbivore trophic guilds, do however; continue to be represented in recent stream and reservoir sampling.

As with fish species, benthic macroinvertebrates were also sampled in the streams that were to be flooded by the original reservoir construction as well as those streams that would remain above the 220-ft normal pool elevation. Prior to any construction, the streams located above the 220-ft contour line appear to have contained a higher overall diversity of benthic macroinvertebrate species, including a higher number of species from the Ephemeroptera, Plecoptera, and Trichoptera (EPT) orders. This greater diversity of species is likely because more intermittent streams would be expected higher in the watershed, whereas the main streams to be inundated likely consisted primarily of larger perennial channels. During the construction and early filling of the reservoir, both the streams directly affected by the reservoir and those above the 220-ft contour showed a spike in overall diversity of species, particularly in the EPT orders. Recent sampling within the reservoir reveals a greater diversity of aquatic worms and aquatic insects within the Orders Odonata and Lepidoptera. These orders contain tolerant species that are more indicative of lakes and other slow moving waters with decreased dissolved oxygen. A 2006 study by CH2M HILL sampled seven sites along the larger streams within the Harris Lake expansion area NCDENR sampling protocols. The benthic

macroinvertebrate results indicate a range of ecological conditions in the sampled streams. Only one station (Buckhorn Creek) scored Good-Fair based on the bioassessment scores. Two sites scored Fair and four sites scored Poor (CH2M HILL 2006). It should be noted that at the time of sampling, the central Piedmont area of North Carolina was in a state of 'moderate drought' with corresponding reduction in stream flow; many of the aquatic taxa quantified in these assays require well-oxygenated flowing water and thus the drought may have temporarily depressed the abundance of these organisms.

Other appurtenant facilities do not incur any significant loss of aquatic habitat, however the intake structure and pipeline that will supply makeup water to Harris Lake does have the potential to affect resident fish species in the Cape Fear River such as bluehead chub (*Nocomis leptocephalus*), bluegill (*Lepomis macrochirus*), redbreast sunfish (*L. auritus*), white shiner (*Luxilus albeolus*), and other common species. The impact on native fish resulting from the intake structure and makeup water line is expected to be minimal.

In summary, the increased surface area of Harris Lake will result in the conversion of significant stream and wetland habitat to a lentic system due to inundation, however, this impact should not result in any detrimental ecological effects to their receiving waters; Harris Lake, Buckhorn Creek, or the Cape Fear River. A minimum flow into Buckhorn Creek below the dam will be maintained in order to maintain and improve the in-stream aquatic habitat.

Transmission Upgrades - The transmission line upgrades will result in wetland conversion due to ROW expansion; however, the overall loss of aquatic habitat is expected to be minimal. In addition to the habitat loss resulting from the conversion of forested wetlands, the proposed transmission line upgrades for the Harris alternative will cross over fourteen significant natural heritage areas (SNHA) totaling approximately 36 acres. Of this total acreage within these SNHAs, approximately 7 acres of jurisdictional wetlands or surface waters are present and may be impacted. The sites included on this list are the best representatives known of the natural diversity of the State and therefore deserve priority for protection (NCNHP 2009).

Summary

Both sites will incur impacts to aquatic habitat resulting in some notable functional loss either through direct conversion of habitat through transmission line upgrades or through inundation (Table 9). However, the potential effect on aquatic organisms as a result of increased water flow through the Brunswick site may result in greater detrimental effects on the aquatic ecosystem as a whole based on the diversity and value of estuarine organisms that may be affected compared to the more limited diversity and value of freshwater organisms at the Harris site. Compliance with CWA 316 should avoid significant impacts and NRC has indicated that the additional flow through the intake canal will not result in significant environmental consequences. The loss of approximately 422 acres of non-tidal freshwater marsh habitat and 183 acres of forested wetland habitat at the Harris site is expected to be offset through mitigative measures as well as replacement of lost or reduced functions via new habitat types. Aquatic bed

habitat and nontidal freshwater marsh wetlands, similar to those becoming established in Harris Lake following construction and inundation of the original reservoir, are expected to become re-established over time at suitable elevations within the expanded reservoir.

Fish sampling conducted over the years from pre-construction to recent times indicates that the overall diversity of fish species in the Harris Lake watershed has decreased and stabilized. The most recent biological sampling by PEC identified 23 species in the reservoir and 22 species in those streams flowing into the reservoir. The proposed reservoir expansion is not anticipated to result in a notable decrease in fish diversity in the watershed.

Table 9. Impacts to Fish and Other Aquatic Organisms.

Alternative	Potential Impact				
	Power Block	Water Supply			Transmission Upgrades
	Wetland Fill	Essential Fish Habitat	Primary Nursery Areas	Entrainment/ Impingement Issues	Forested Wetland Conversion
Brunswick	Yes	Yes	Yes	Yes - higher impacts	Yes 1,421 ac
Harris	Yes	No	No	Yes - lower impacts	Yes 91 ac

3. Wildlife habitat

Brunswick

Power Block – Facility expansion at the Brunswick site would utilize previously disturbed portions of the site as well as undisturbed forested habitat. Special aquatic sites, including tidal marsh and other wetland types, would also be affected by site expansion. Each of these habitat types support a variety of wildlife species adapted to specific conditions. The forested uplands would support species typically adapted fragmented landscapes and agricultural settings. Wetland and aquatic dependant species would be impacted through the loss of the special aquatic sites occurring within the power block area. Numerous terrestrial and avian species utilize the open water and marsh habitats occurring within the power block as foraging areas. Although this type of habitat is abundant in the vicinity of the Brunswick Plant, impacts to these habitats resulting from site expansion would remove a source of food for many species of wildlife.

Water Supply – The Brunswick alternative is not anticipated to have any negative impacts to wildlife habitat with regards to the water supply.

Transmission Upgrades – With regards to the wetland habitat functions reduced or lost as a result of ROW expansion; a negative shift of the wetland habitat function was seen in 6 of 17 (35%) of the areas assessed and occurred in six of the twelve wetland types occurring along

the proposed Brunswick lines (ESI 2010). Impacts to wildlife habitat resulting from the transmission line upgrades could involve an estimated 4,360 acres of new ROW required, including 1,033 acres that are part of existing SNHAs. The new Brunswick lines are anticipated to be located adjacent to existing transmission line ROWs and impacts to most wildlife habitat would be considered minimal and impacts to wildlife would likely be temporary for those species adapted to fragmented and successional habitats. Although some detrimental impacts to wildlife are unavoidable with transmission upgrades, the cleared corridors are also beneficial to the terrestrial ecosystem in several ways. The corridors act as valuable edge habitat and wildlife corridors (COLA ER 5.6.1).

Harris

Power Block - There will be little wildlife habitat impact arising directly from the footprint of HAR-2 and HAR-3. HAR-2 will be built on a primarily paved and gravel-covered area vegetated with non-native grasses. HAR-3 will be built on an area recently clear cut and replanted with loblolly pine (*Pinus taeda*) [COLA ER 4.3.1.1.1). The saplings are less than 10 years old. Because of the low habitat quality, low vegetative diversity, and ongoing timber management within the Harris site, conversion of these areas to HAR-2 and HAR-3, with their supporting infrastructure, should have minimal effects to wildlife habitat. The North Carolina Wildlife Resources Commission (NCWRC) "Guidance Memorandum to Address and Mitigate Secondary and Cumulative Effects to Aquatic and Terrestrial Wildlife Resources and Water Quality" will be used when developing sediment and erosion plans and to manage buffer zones following construction.

Water Supply – Increasing the pool elevation of Harris Lake will expand the lake to approximately 7,575 acres by inundating approximately 3,900 acres of upland and wetland habitats. The land surrounding Harris Lake between the 220 and 240-foot elevation contour consists primarily of forested land, with minor open areas for boat access and existing transmission ROWs (CH2M HILL 2006). None of the impacted forest types (as identified in the 2006 field study) are considered uncommon in the North Carolina Piedmont. Historically, all of the areas have been harvested or cleared. PEC has indicated its intent to maintain uncut buffer zones of approximately 100' along the reservoir edge and along stream courses, where possible; these areas can serve as important migratory corridors for the movement of motile terrestrial species out of the impacted area. Approximately 13,227 acres of PEC land around Harris Lake has been enrolled in the North Carolina Game Land Program (COLA ER 4.3.1.2.1). Additional undeveloped land adjacent to the PEC property will provide habitat outside the affected area, but some species may ultimately overpopulate the area. Adverse effects will be most evident for less mobile species that cannot easily relocate. Possible actions to reduce mortality of these species include the timing of construction activities to accommodate life cycles of less mobile species. There is evidence of a blue heron (*Ardea herodias*) rookery in the southeastern portion of the reservoir; this species is not endangered but is protected under the Migratory Bird Treaty Act. PEC has outlined protective measures in the Harris ER that will minimize adverse effects to the rookery including establishment of a buffer zone, timing of construction, and timing of rise in

pool elevation (COLA ER 4.3.1.2.2). Because riparian areas are located at the convergence of terrestrial and aquatic ecosystems, they are regional hotspots of biodiversity and often exhibit high rates of biological productivity in marked contrast to the larger landscape (NRC 2002). The larger riparian zone that will surround the expanded reservoir will provide beneficial habitat for both terrestrial and wetland/aquatic dependant species. Other wildlife species may also be temporarily displaced by the project but are expected to utilize the remaining several thousand acres of PEC-controlled property that will surround the expanded reservoir.

The increase in normal pool elevation will also replace up to approximately 24.40 miles of lotic habitat (*i.e.*, streams) with lentic habitat (*i.e.*, lake) and replace approximately 136 acres of forested wetlands consisting of NCWAM types bottomland hardwood forest, headwater forest, and riverine swamp forest, with lentic habitat. Additionally, approximately 422 acres on non-tidal freshwater marsh will be impacted as a result of increasing the normal pool elevation. Beneficial habitat functions provided by non-tidal freshwater marsh areas, that will be temporarily lost as a result of reservoir expansion, include primarily waterfowl feeding and nesting habitat and fish spawning/nursery areas. Noxious aquatic species such as the non-native invasive creeping water primrose (*Ludwigia hexapetala*) and hydrilla have become well established in Harris Lake (ESI 2010). These noxious species have a detrimental effect to the native aquatic vegetation in these marsh areas although they do provide valuable water quality and habitat functions. As water levels rise in Harris Lake as a result of this project, much of the existing hydrilla beds will be inundated by up to 20 feet of additional water and will likely die off. However, hydrilla is very resilient and will likely reestablish itself once the lake level reaches its new elevation. Hydrilla has been found to be beneficial to some sport fish, such as largemouth bass, and is eaten by waterfowl (Langeland 1996). The temporary loss of hydrilla will result in the temporary loss of habitat and food sources for some fish and waterfowl. Subsequent mapping of hydrilla has been suspended in Harris Lake and it is now just monitored for presence or absence (ESI 2010).

A significant amount of new aquatic habitat, both open water and vegetated shallows, will be provided by the expanded lake providing beneficial habitat functions for fish and other wildlife. The terrestrial animal species utilizing the existing wetlands that will be displaced by inundation will be replaced by a suite of aquatic species including fish and aquatic macroinvertebrates. The expanded reservoir will also provide more aquatic habitat that can be utilized by various species of ducks and wading birds. Most of the major groups (taxa) of biota are represented in the biological communities that occur in lakes and reservoirs, from one-celled algae to the birds and mammals that rely on aquatic ecosystems for food and habitat (EPA 1993b).

Transmission Upgrades - Impacts to wildlife habitat resulting from the transmission line upgrades could involve an estimated 1,248 acres of new ROW required, of which approximately 90 percent is either agricultural or undisturbed. NCWRC indicates that part of the proposed transmission line upgrades will cross a Significant Natural Heritage Area known as Buckhorn Bluffs and Levees. With regards to the wetland habitat functions reduced or lost as a result of ROW expansion; a negative shift of the wetland

habitat function was seen in 5 of 9 (55%) of the areas assessed and occurred in all of the riverine forested wetland types occurring along the Harris lines. As discussed under the Brunswick alternative scenario, the conversion of these forested wetlands along the expanded ROWs may affect the ecological cycle of numerous trophic levels beginning at the bottom of the food web (ESI 2010).

Summary – Both the Harris and Brunswick alternatives will result in a permanent loss of wildlife habitat and also conversion of habitat type. The Brunswick alternative will result in the loss of coastal marsh due to additional construction inside the power block. Harris power block impacts are notably less; however the Harris alternative does include some additional wetland and upland habitat losses resulting from infrastructure improvement and the water line construction. Water supply for the Brunswick alternative is not expected to result in any habitat loss. The Harris alternative's water supply will involve raising the existing reservoir and as a result, flooding both forested wetlands and non-forested wetlands along with perennial and intermittent streams.

4. Endangered or threatened species

Species with the federal classifications of Endangered (**E**), or Threatened (**T**), are protected under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). The bald eagle was officially delisted and removed from the federal Endangered Species List on August 9, 2007, but is still protected under the Bald and Golden Eagle Protection Act (BGEPA) and the Migratory Bird Treaty Act (MBTA). Table 10 documents the occurrences that have been recorded in areas that will be affected by the Brunswick and Harris alternatives and also estimates the overall effect of either alternative on threatened or endangered species or their habitat.

<u>Brunswick</u>
The Brunswick alternative, including the proposed transmission upgrades involves the following nine counties: Brunswick, Columbus, Bladen, Cumberland, New Hanover, Pender, Onslow, Duplin, and Sampson. Each county maintains a separate list of those federally threatened or endangered species that may occur within its boundaries.

Power Block – There are no USFWS designated critical habitats occurring within the 400-acre power block. However, the potential impacts to special aquatic sites, including the tidal creeks and marsh, will create a loss of habitat that could be utilized by federally threatened or endangered species such as green sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, and West Indian manatee. Significant foraging and nesting habitat for the bald eagle, which is also federally protected, would be lost as a result of additional construction in the power block under the Brunswick alternative. Other threatened or endangered species that could potentially be affected by future facility expansion include the red-cockaded woodpecker, Cooley's meadowrue, and rough-leaved loosestrife. Nesting habitat for the red-cockaded woodpecker does not occur on the plant site, but the birds may forage on the site.

Water Supply – The design of the fish diversion structure in the intake canal was engineered for the existing two operating units only. The make-up water for two additional units could challenge the integrity of the diversion structure resulting in damaged diversion screens and extensive maintenance activities. Repairs are completed as quickly as possible. However, past data have indicated the temporary openings provide entry points for larger aquatic organisms including endangered and threatened species such as loggerhead, green, and Kemp's ridley sea turtles. In addition to the possibility of increased impingement rates this increases the risk of more incidental takes of sea turtles.

The National Marine Fisheries Service (NMFS)-Southeast Region issued their Biological Opinion regarding the operation of the existing Brunswick site on January 20, 2000. The 20 January 2000 Biological Opinion is valid for 20 years and resulted from a re-initiation of a prior consultation that was completed for the Brunswick plant on 30 April 1999. This Biological Opinion is based on the current generating capacity and intake water flow at the Brunswick plant. The Incidental Take Statement (ITS) of the April 1999 opinion anticipated that 50 loggerheads, 5 green, and 8 Kemp's ridley sea turtles would be incidentally taken, but released without harm on a biennial basis at the Brunswick plant. The April 1999 ITS also anticipated the incidental take by injury or mortality, on a biennial basis, of 1 hawksbill or leatherback, 6 loggerheads, 2 greens, and 2 Kemp's ridleys during Brunswick plant operations. Between 30 April 1999 and 14 September 1999, the Brunswick plant documented the mortality of 2 endangered Kemp's ridleys, thus meeting the level of anticipated incidental take (NMFS 2000). This action along with new information on how dead sea turtles were being washed into the intake canal from surrounding areas triggered the need for re-initiation of formal consultation. The April 2000 NMFS Biological Opinion suggests that it is NMFS's opinion that the operation of the water intake system at the Brunswick plant is not likely to jeopardize the continued existence of the loggerhead, leatherback, green, hawksbill, or Kemps ridley sea turtles. The conclusion was based on the proposed action's anticipated effects on each of these species being limited to the incidental take, through death or injury, of a small number of mostly immature sea turtles over the next 20 years. NMFS also concluded that incidental take of sea turtles at the Brunswick plant intake have not jeopardized the continued existence of these species. NMFS also commented in the April 2000 Biological Opinion that the likelihood for shortnose sturgeon to be adversely affected by the proposed action (intake water canal) is low enough to be considered discountable. Therefore, NMFS has determined that it is unlikely that a shortnose sturgeon would be adversely affected by the operation of the Brunswick plant. This biological opinion was based on the NMFS review of the cooling water intake system at the Brunswick site for the next 20 years. It does not take into account possible changes to the cooling water intake system that would result from additional reactors and cooling water needs. A new biological opinion from NMFS would be required to formally document the effect on protected sea turtle and shortnose sturgeon if additional cooling water capacity is required based on additional reactors.

An increase in cooling water flow needed for any new reactors to provide additional generation has the potential to result in additional sea turtle takes due to the unavoidable

changes in the water flow regimes and possibly the intake structure itself. Any deviation from the current generating capacity and water flows at the Brunswick site will require re-initiation of formal consultation with NMFS to evaluate the potential effect on sea turtles resulting from increased water flow into the intake canal. Likewise, if the currently authorized level of incidental take is exceeded; such incidental take represents new information requiring re-initiation of consultation and review of reasonable and prudent measures. Incidental take data provided by PEC documents that a total of 221 sea turtles (loggerhead, Kemp's and green) were entrapped between 1994 through 2008 under the current generating capacity (PEC 2009b). This resulted in 31 mortalities. As with the sea turtles, a new opinion on the potential effect on the shortnose sturgeon will be necessary if the intake water flow increases as a direct result of an increase to generating capacity at the Brunswick plant.

Transmission Upgrades – The proposed upgrades and expansions of certain transmission lines that will serve the Brunswick alternative, have the potential to affect threatened or endangered species though habitat conversion or loss. Cooley's meadowrue and rough-leaved loosestrife occur along existing PEC transmission line ROWs. Golden sedge (*Carex lutea*), which is not listed for Brunswick County, also occurs in PEC transmission lines in Pender and Onslow Counties (Brunswick ER 2.5). PEC typically manages the suitable habitat for protected plant species that occur in their powerline corridors per USFWS and NCWRC guidelines. In 1993, PEC signed a Memorandum of Agreement with NCDENR to preserve and protect rare, threatened, and endangered species and sensitive natural areas occurring on transmission ROWs. PEC also follows best management practices for the ongoing management of rare plants on its ROWs (Brunswick ER 2.5).

Expansion of existing transmission line rights-of-way by an additional 100 feet to accommodate each new Brunswick transmission line may result in adverse impacts where the new transmission lines may pass through red-cockaded woodpecker (RCW) habitat, particularly where two or three of the new lines share a common route, resulting in anticipated new clearing of 200 and 300 feet respectively for new ROWs. RCW nesting habitat consists of primarily old-growth pine forest with relatively open understory, but they forage in pine stands as young as 30 years within 0.5 mile of the nesting cavity trees. Gaps in suitable habitat, particularly openings greater than 200 feet separating RCW habitat are considered a barrier for RCWs and the USFWS considers creation of such gaps to be an adverse impact within occupied habitat due to higher risk of predation. The RCW is listed for Brunswick County and also for the counties into which new transmission lines would be built. NCNHP data indicates that 46 RCW occurrences have been documented within approximately 1.0 mile of the new transmission line routes. The preliminary routes identified for three of the new lines would be co-located along an existing transmission line ROW from the Brunswick substation to a point north of the Sutton substation where one line would continue on to the Clinton substation and the other two would continue co-located along existing right-of-way to the Jacksonville substation, where one terminates and the other continues on to the Wommack substation. NCNHP data indicates that up to 39 RCW occurrences may be present along the new transmission line routes where two or three of the new lines

would follow a similar route requiring the anticipated additional clearing of 200 or 300 feet, respectively, of forested habitat adjacent to the existing transmission line ROW. Detailed assessments would be required to determine if these, or any previously undocumented RCW cavity trees, are located within 0.5 mile of the new transmission lines and whether adverse impacts would result from clearing for new ROWs.

Harris

The Harris alternative, including the proposed transmission upgrades involves the following four counties: Wake, Chatham, Harnett, and Cumberland. Each county maintains a separate list of those federally threatened or endangered species that may occur within its boundaries. Table 10 documents the occurrences that have been recorded in areas that will be affected by the Harris alternative.

Power Block – No USFWS designated critical habitats occur in the power block area of in any area proposed for infrastructure improvements (COLA ER 5.6.2).

Water Supply – The Cape Fear shiner likely does not occur in the vicinity of the proposed water intake structure, given the limited distribution of the species and the lack of habitat at the proposed structure location. The Cape Fear shiner is not known to exist in the portion of the Cape Fear River from Buckhorn Dam to Lock and Dam 3, and is thought to be extirpated in this area. The dwarf wedgemussel is not known to occur in the Cape Fear basin, and it is likely that this mussel would not occur in this area. The intake in the Cape Fear River should not adversely affect the Cape Fear shiner or dwarf wedgemussel due to the lack of suitable habitat in the area of the proposed structure. There are known occurrences of bald eagles from Harris Lake and Jordan Lake, as well as nesting bald eagles along the Cape Fear River near the Agape Lutheran Camp (5-6 miles downstream). NCWRC indicates that the new shoreline of Harris Lake will move within the secondary management zone of a bald eagle nest near Avent Ferry Road. These eagles, including breeding pairs, likely use Harris and Jordan Lakes as a food source. The proposed action should not adversely affect bald eagles other than temporarily removing potential perching locations along Harris Lake in the zone between the existing and proposed pool elevations. Trees that can be utilized for perching will remain intact at and above the 240 foot NGVD29 contour. Additionally, the surface area of the reservoir will be greatly expanded along with the shoreline. The increased shoreline will provide a much greater area for bald eagle perching and nesting and the expanded reservoir will provide greater foraging opportunities. PEC has procedures in place if threatened or endangered species are discovered on a site or on a transmission line corridor (COLA ER 9.3.2.2.1.4).

Transmission Upgrades – The proposed upgrades and expansions of certain transmission lines that will serve the Harris alternative, have the potential to affect threatened or endangered species though habitat conversion or loss. RCWs are known to occur in mature longleaf pine forests crossed by the Harris-Fayetteville transmission corridor (COLA ER 5.6.1.1); NCNHP data show that eight RCW clusters have been documented within 1.0 mile of the transmission line on Fort Bragg. The RCW population on Fort Bragg is one of twelve primary core populations listed in the RCW Recovery Plan

(USFWS 2003) as critical for the survival and recovery of the species. Any activities involving the removal of pines for new ROW on Fort Bragg will require surveys for this species as well as a foraging habitat assessment to ensure that no birds or cavity trees are impacted and that foraging habitat is not adversely impacted. NCNHP data also document three RCW records in Wake County within 1.0 mile of the transmission lines; however, two of these occurrences were reported as destroyed and the other as historic (last seen more than 20 years ago). The new Harris transmission lines each are anticipated to require clearing of 100 feet of new ROW adjacent to existing transmission line ROWs. None of the new Harris transmission lines share a common route for all or part of their routes as do those projected for three of the new Brunswick lines that would be required.

NCNHP data documents two other federally endangered species in or within 500 feet of the new potential transmission line corridors. Two records, one historic (Neuse River), for dwarf wedgemussel are documented in NCNHP data within streams crossed by a new transmission line. Avoiding in-stream work and minimizing clearing of streambank vegetation would minimize potential impacts to this species. Adverse impacts would not be expected for the other species, rough-leaved loosestrife, for similar reasons identified for the Brunswick site.

Michaux's sumac is also known to occur in disturbed areas along existing ROWs elsewhere in the area, however ROW expansion should not negatively impact this species as said expansion will open up more potential habitat for Michaux's sumac in certain areas. A research plot containing Michaux's sumac is adjacent to PEC property within the Harris Research Tract. This research area will not be impacted by any activities associated with the HAR project.

Summary – Both alternatives will directly or indirectly affect both plant and animal species that are protected by the Endangered Species Act. However, it appears as though the Brunswick alternative has the potential for greater impact to federally threatened and endangered species than the Harris alternative due to potential increase in incidental take of sea turtles, and greater potential adverse impact to RCWs through loss of habitat along the new transmission lines (Table 10). Impacts to tidal wetlands and waters within the Brunswick power block will also remove species specific habitat that could be utilized by listed species, but should not result in significant effects on those protected species known to occur in the area. With proper best management practices and protection during construction, no adverse impacts to the plants or other aquatic animals within the transmission line upgrade areas are expected for the Brunswick lines. The Harris alternative will temporarily remove nesting and foraging habitat for the bald eagle during the initial period of reservoir expansion. However, the expanded reservoir will provide a much larger surface area and larger riparian area that should prove beneficial to the bald eagle population that frequents Harris Lake and nearby Jordon Lake. The Harris lines could affect potential habitat for Michaux's sumac and pondberry; however no occurrences of these species are known from along the proposed routes.

Table 10. Federally protected species listed for counties containing Brunswick and Harris alternatives.

Common Name	Scientific Name	Alternative	Status [a]	Potential Effect
American alligator	*Alligator mississippiensis*	Both	T(S/A)	➢ Conversion of swamp habitat from ROW clearing, no adverse effect expected
Bald eagle	*Haliaeetus leucocephalus*	Both	BGEPA	➢ Loss of foraging habitat at Brunswick site ➢ Expansion of nesting and foraging habitat at Harris site from larger surface area and expanded shoreline
Eastern puma	*Puma concolor couguar*	Brunswick	E	➢ Believed extirpated from North Carolina, no adverse effect expected
Green sea turtle [b]	*Chelonia mydas*	Brunswick	T	➢ Potential for impingement; incidental take ➢ New Biological Opinion will be required from NMFS
Kemp's ridley sea turtle [b]	*Lepidochelys kempii*	Brunswick	E	➢ Potential for impingement; incidental take ➢ New Biological Opinion will be required from NMFS
Leatherback sea turtle [b]	*Dermochelys coriacea*	Brunswick	E	➢ Potential for impingement; incidental take ➢ New Biological Opinion will be required from NMFS
Loggerhead sea turtle [b]	*Caretta caretta*	Brunswick	T	➢ Potential for impingement; incidental take ➢ New Biological Opinion will be required from NMFS
Piping plover	*Charadrius melodus*	Brunswick	T	➢ No habitat present
Red-cockaded woodpecker	*Picoides borealis*	Both	E	➢ Loss of habitat from ROW clearing for Brunswick ➢ 46 occurrences along Brunswick lines [c] ➢ Loss of habitat from ROW clearing from Harris ➢ 11 occurrences along Harris Lines [c]
Shortnose sturgeon	*Acipenser brevirostrum*	Brunswick	E	➢ Potential for impingement; incidental take ➢ New Biological Opinion will be required from NMFS ➢ 1 occurrence along Brunswick lines [c]
West Indian manatee	*Trichechus manatus*	Brunswick	E	➢ Loss of habitat from tidal creek impacts ➢ 1 occurrence along Brunswick lines [c]
Wood stork	*Mycteria americana*	Brunswick	E	➢ Loss of foraging and potential nesting habitat from tidal marsh fill and riverine forest clearing activities
Waccamaw silverside	*Menidia extensa*	Brunswick	T	➢ No habitat present

Common Name	Scientific Name	Alternative	Status [a]	Potential Effect
Cape Fear shiner	*Notropis mekistocholas*	Harris	E	➢ No habitat present
St. Francis' satyr butterfly	*Neonympha mitchelli francisci*	Harris	E	➢ No habitat present
Dwarf wedgemussel	*Alasmidonta heterodon*	Harris	E	➢ No habitat present ➢ 2 occurrences along Harris lines [c]
Cooley's meadowrue	*Thalictrum cooleyi*	Brunswick	E	➢ Potential for habitat enhancement from ROW clearing ➢ 3 occurrences along Brunswick lines [c]
Rough-leaved loosestrife	*Lysimachia asperulaefolia*	Both	E	➢ Potential for habitat enhancement from ROW clearing ➢ 8 occurrences along Brunswick lines [c] ➢ 2 occurrences along Harris lines [c]
Seabeach amaranth	*Amaranthus pumilus*	Brunswick	T	➢ No habitat present
American chaffseed	*Schwalbea americana*	Both	E	➢ Possible loss of habitat from ROW clearing
Golden sedge	*Carex lutea*	Brunswick	E	➢ Potential for habitat enhancement from ROW clearing ➢ 2 occurrences along Brunswick lines [c]
Michaux's sumac	*Rhus michauxii*	Harris	E	➢ Potential for some habitat loss resulting from upland construction ➢ Potential for habitat enhancement resulting from expanded successional uplands
Harperella	*Ptilimnium nodosum*	Harris	E	➢ Habitat limited to mid-channel bars in larger creeks and rivers; no impacts expected
Sensitive joint-vetch	*Aeschynomene virginica*	Brunswick	T	➢ Potential habitat loss; limited to areas influenced by tides.
Pondberry	*Lindera melissifolia*	Both	E	➢ Potential habitat loss; limited to Carolina bays with extended hydrology regimes

[a] BGEPA – Bald and Golden Eagle Protection Act; E – Endangered under ESA; T – Threatened under ESA; T(S/A) – Threatened due to Similarity of Appearance, does not require Biological Opinion.
[b] 31 mortalities among loggerhead, green and Kemp's ridley sea turtles between 1999-2008.
[c] RCW element occurrences within 1 mile; all other element occurrences within 500 feet.

5. Biological availability of possible contaminants in dredge or fill material

Brunswick

Power Block - The source of fill material to be placed in wetland and streams has not been clearly defined. Per the 404(b)(1) guidelines, the fill will be free of petroleum products and hazardous substances as well as free from chemical, biological, and other pollutants.

Water Supply – No adverse environmental consequences are anticipated as a result of the water supply.

Transmission Upgrades - No adverse environmental consequences are anticipated as a result of the transmission upgrades.

Harris

Power Block - Onsite material from grading of HAR-3 may be used as a source for fill material. Per the 404(b)(1) guidelines, the fill will be free of petroleum products and hazardous substances as well as free from chemical, biological, and other pollutants. The Harris site provides more opportunity for use of fill from onsite sources than does the Brunswick site.

Water Supply – The make-up water line, which will originate in the Cape Fear River, will incur some incidental dredge material due to the intake. Also, additional intake capacity within Harris Lake will also be required to supply the cooling water to the facility. However, no adverse environmental consequences are anticipated as a result of the water supply make-up line intake or the intake within Harris Lake.

Transmission Upgrades - No adverse environmental consequences are anticipated as a result of the transmission upgrades.

C. Human Use Characteristics and Impacts

Sections IV.C.1 through IV.C.5 are evaluated pursuant to 40 CFR 230: Section 404(b)(1) Guidelines for Specifications of Disposal Sites for Dredged or Fill Material. Sections IV.C.6 through IV.C.29 are evaluated pursuant to 33 CFR 320: General Regulatory Policies and may be considered supplemental information pertaining to the public interest review and may aid in the evaluation of the two alternatives.

1. Existing and potential water supplies; water conservation

Brunswick

Power Block - The Brunswick site only uses one on-site water supply well at the biology lab; all other potable water for the facility is supplied by Brunswick County Public Utilities (BCPU). According to the ER, the Brunswick site uses 1 percent of the treated water production capacity of Brunswick County and 2 percent of actual production. Uses of potable water provided by the Brunswick County water system to the Brunswick site do not stress system's capacity to supply water to residents and businesses (Brunswick ER 4.15). The businesses and residents in the vicinity of the Brunswick site use either water from wells or municipal water. In the vicinity of the site, shallow wells in the surficial aquifer are adequate for small potable water supplies, but for larger water yields the Castle Hayne Aquifer is the most important aquifer. The Castle Hayne Aquifer provides water to the Sunny Point Military Ocean Terminal and to the municipalities of Long Beach and Southport. Residents of New Hanover County get their drinking water primarily from water wells with the exception of the City of Wilmington that gets its water from the lower Cape Fear River. Wells in New Hanover County used for domestic purposes are in the surficial sand aquifer and for larger yields, are located in the Castle Hayne (Brunswick ER 2.3).

Due to the salinity of the water in the Cape Fear River downstream of the Brunswick site, there are no withdrawals of water from this area as a water supply. No adverse environmental consequences are anticipated for this alternative.

Water Supply –Cooling towers will be utilized for the two new units, with cooling water obtained from the intake canal for cooling tower makeup water. Additional considerations for cooling water are also required for the Brunswick alternative. The two new AP1000 units will also require an average-day use of 1.58 million gallons per day (mgd) and maximum-day use of 5.8 mgd of treated freshwater for process and service water needs. The brackish water obtained from the intake canal is unsuitable for this purpose and the freshwater requirements will require a different source, either through additional capacity obtained from BCPU, groundwater, or a combination of both means. BCPU, which currently provides an average of approximately 0.22 mgd to BSEP, does not currently have the capacity to provide the additional water. There are no plans to expand the BCPU 211 Water Treatment Plant (Hazen and Sawyer 2006), which currently provides BSEP with water from groundwater sources. Groundwater withdrawal has not been evaluated, but may not provide a reliable source to meet freshwater needs. Global climate change is expected to result in sea level rise of approximately 0.5 meter on the

North Carolina coast (CIER 2008), which is expected to lead to saltwater intrusion into groundwater supplies (Shuford et al. 2010). Additional capacity of approximately 12 mgd is being added to the BCPU Northwest Water Treatment Plant, which may require a pipeline of approximately 30 miles to BSEP. Environmental consequences have not been fully evaluated, but obtaining adequate freshwater may result in additional impacts if a pipeline alternative is selected.

Transmission Upgrades - No adverse environmental consequences are anticipated as a result of the transmission upgrades.

Harris

Power Block - Groundwater will not be used for the facility operation. The subsurface geology consists of Triassic aged sedimentary rocks with well yields of between 10 and 25 gallons per minute. Use of groundwater in the vicinity of the site is restricted as PEC owns most properties within a 2-mile radius. A well survey performed by PEC indicated that the closest water supply well to the HAR site is located 1.2 miles to the north-northwest. The private wells identified were noted as being 75 to 360 feet deep and cased in the bedrock aquifer. Only two communities within 5 miles of the Harris Site use groundwater as a source of drinking water (New Hill and Fuquay-Varina). The Fuquay-Varina community is located in Wake County and is located in the Carolina Slate Belt (COLA ER 2.3.2.2). Potable water for the Harris site comes from and will come from the reservoir. No adverse environmental consequences are anticipated for this alternative.

Water Supply – No adverse environmental consequences are anticipated as a result of the water supply.

Transmission Upgrades - No adverse environmental consequences are anticipated as a result of the transmission upgrades.

2. Recreational or commercial fisheries

Brunswick

Power Block - The Cape Fear River, up to Highway 421, is considered Essential Fish Habitat by the NMFS for egg, larval, and/or juvenile life stages of the following species: red drum, bluefish, summer flounder, gag grouper, gray snapper, cobia, king mackerel, Spanish mackerel, black sea bass, spiny dogfish, brown shrimp, pink shrimp, white shrimp, plus twelve different shark species (NMFS 2009). The Magnuson-Stevens Fishery Conservation and Management Act is the primary law governing marine fisheries management in United States federal waters. The Act was first enacted in 1976 and amended in 1996. The 1996 amendments focused on rebuilding depleted fisheries, protecting essential fish habitat, and reducing bycatch. The primary habitat types utilized by the aquatic organisms in the vicinity of the Brunswick site include the water column, shell bottom habitat, wetlands, and soft bottom habitat. Direct impacts to aquatic habitat resulting from the construction in the power block area are expected to be small.

Water Supply - The increased volume of cooling water necessary to operate the new reactors at the Brunswick site could result in increased rates of entrainment and impingement, which could have the potential to affect commercial and recreational fisheries stocks. The current NPDES permit for the Brunswick site (NC0007064) limits cooling water flows to 922 cubic feet per second per unit (cfs/unit) over the December-March period and 1,105 cfs/unit over the April-November period, with the stipulation that one unit may increase its flow to 1,230 cfs during the months of July, August, and September (Brunswick ER Section 3.1.2.1). These reduced flows in the winter months are necessary for the additional reductions of the entrainment losses of finfish larvae, particularly winter-spawning fish such as menhaden, spot, croaker, and flounder. The flows are allowed to increase in the spring. NCDMF and NCDWQ emphasize the protection of penaid shrimp and blue crab larvae during the spring. Larval shrimp and blue crab exhibit high fine-mesh screen efficiencies and consistently high survival on the screens and in the fish return system. The fine-mesh screen efficiencies and survival of finfish larvae are more variable and are not as good as those demonstrated for shrimp and crab larvae. As a result higher cooling water flow is permitted from April through November with flow reductions during December through March. Additional units will further increase the flows currently mandated by the NPDES permit and studies will be necessary to determine the flow rates to minimize impacts to commercial and recreation fisheries.

In summary, additional entrainment impacts are more likely to result from increasing the flow through the intake canal than impingement impacts, which will be minimized by the existing diversion structures. Although some additional impingement may result from adding new units to the Brunswick site, the NRC concluded that there would be no discernible adverse effect on aquatic organisms because of the very small volume of water used by the plant compared with the total volume of available water at the site (COLA ER 9.3.2.2.5).

Transmission Upgrades - No adverse environmental consequences are anticipated as a result of the transmission upgrades.

<u>Harris</u>
Power Block – No adverse environmental consequences are anticipated as a result of the power block.

Water Supply - There is no known commercial fishing industry on Harris Lake. Recreational fishing opportunities should be enhanced with the larger impoundment resulting from the expansion of Harris Lake. Harris Lake has evolved from a moderately productive reservoir with relatively slow-growing game fish in the 1980s into a more productive reservoir with healthy populations of largemouth bass, bluegill, redear sunfish, crappie, and catfish (COLA ER Rev. 2 Section 2.4.2.1.6.2). Although considered noxious species, hydrilla and water primrose are credited with creating favorable conditions for the world-class largemouth bass fishery by fisherman who use the lake. Although there will be a period when the existing non-tidal freshwater marsh habitat will be lost through flooding, this wetland community, along with the hydrilla, is expected to

return to the shallow water areas of the expanded reservoir. Harris Lake has also been demonstrated to generate over $1 million dollars in revenue for the area over a one year period as a result of fishing activity (NCWRC 2000). No adverse environmental consequences are anticipated as a result of the water supply.

Transmission Upgrades - No adverse environmental consequences are anticipated as a result of the transmission upgrades.

3. Other water related recreation

Brunswick
Power Block – No adverse environmental consequences are anticipated as a result of the power block.

Water Supply - There is no public access for the intake canal for the Brunswick site. No adverse environmental consequences are anticipated as a result of the water supply.

Transmission Upgrades - No adverse environmental consequences are anticipated as a result of the transmission upgrades.

Harris
Power Block – No adverse environmental consequences are anticipated as a result of the power block.

Water Supply - The reservoir is utilized by the public for numerous water related recreation activities such as water skiing, wake boarding, swimming, bird watching, nature study, sailing, and power boating. Displacement of public boat ramps and public access areas will result in temporary impacts to the public users of the reservoir; however, replacement ramps and access areas at higher elevations will be built to continue to provide public access to the reservoir. The expanded reservoir will offer the public a larger area on which to pursue their water related recreational interests. No adverse environmental consequences are anticipated as a result of the water supply.

Transmission Upgrades - No adverse environmental consequences are anticipated as a result of the transmission upgrades.

4. Aesthetics of the aquatic ecosystem

Brunswick
Power Block - Because the new reactors would be placed near the existing units with substantial buffer of land controlled by PEC, no changes in existing aesthetics of nearby aquatic ecosystems would be expected. No adverse environmental consequences are anticipated as a result of the power block.

Water Supply - No adverse environmental consequences are anticipated as a result of the water supply.

Transmission Upgrades – ROW expansion is expected to result in clearing of approximately 580 acres of wetlands within identified Significant Natural Heritage Areas (SNHAs) crossed by the routes. Clearing a large acreage of forested wetlands within SNHAs is expected to be an adverse environmental consequence on aesthetics as a result of the transmission upgrades.

Harris

Power Block - No adverse environmental consequences are anticipated for this alternative. The HNP uses vegetation as a visual screen or buffer from surrounding land uses so construction and operational activities will not be visible to area residences. Because the HAR sites will be screened by the existing HNP from the main portion of the reservoir, individuals pursuing water-based activities on Harris Reservoir will have minimal exposure to construction activities (COLA ER 10.3.1.10.2). No adverse environmental consequences are anticipated as a result of the power block.

Water Supply - There will be temporary impacts to aesthetic views along the lake perimeter during site clearing that will be undertaken prior to raising the water level. No adverse environmental consequences are anticipated as a result of the water supply.

Transmission Upgrades - ROW expansion is expected to result in clearing of approximately 6 acres of bottomland forest and less than 1 acre of non-tidal freshwater marsh within identified SNHAs crossed by the routes. Clearing 6 acres of forested wetlands within SNHAs is expected to be an adverse environmental consequence on aesthetics as a result of the transmission upgrades, but is substantially less than the 580 acres of wetlands within SNHAs affected by the Brunswick alternative.

5. Parks, national and historic monuments, national seashores, wild and scenic rivers, wilderness areas, research sites, etc.

Brunswick

No parks, national and historic monuments, national seashores, wild and scenic rivers, wilderness areas, or research sites are present on the Brunswick site. Approximately 249 acres of state Gamelands have been identified as subject to clearing for ROW expansion. Many game species benefit from edge habitat created or expanded by ROW. No adverse environmental consequences are anticipated.

Harris

The Harris Lake County Park would be impacted by construction at the Harris site, specifically by the raising of the pool level of Harris Lake (COLA ER 4.1.1.2.1.3, 4.4.2.6). These impacts would include the flooding of approximately 279 acres within the current park boundaries as well as the displacement of other amenities. However, PEC is committed to working with Wake County Parks Department to relocate park services affected by the increased water level. Numerous additional facilities are located within a 50-mile radius of the Harris site that would offset temporary displacements during construction. Approximately 95 acres of state game lands have been identified as

subject to clearing for ROW expansion. Many game species benefit from edge habitat created or expanded by ROW.

6. Traffic/transportation patterns

Brunswick
The proposed Brunswick site is located near the City of Southport and the site is accessed by local roads. State Highways 87, 133, and 211 provide access to the area, and feed into U.S. Highway 17 (COLA ER 9.3.2.2.2.7). Temporary access road and additional plant roads have not been fully assessed, but are expected to be similar in nature to those required at the Harris site.

On-site railroad access is already provided in the immediate vicinity of the proposed site, but an additional 0.1 mile of rail would be needed to connect to the existing rail line (COLA ER 9.3.2.2.2.7).

No significant adverse environmental consequences are anticipated.

Harris
Roads and highways in the vicinity will not be adversely impacted by operation of the new facility; because most of the operational workers are expected to already live within a 50-mile radius of the plant site, traffic would be divided over the two primary access routes, U.S. Highway 1, and Old U.S. Highway 1, as well as supported by the proposed Western Wake Parkway when this controlled access parkway is completed (COLA ER 5.8.2.8).

A new interchange on U.S. Highway 1 and Shearon Harris Road may be required to support construction and operation of the HAR; additional plant roads will be constructed prior to HAR construction (COLA ER 5.1.1.1.2). PEC has initiated discussion with NCDOT regarding county and state roadway impacts due to increased lake levels in the Harris Reservoir required for operations of the HAR. The rise in reservoir elevation will require enhancements to existing roads affected by the increased lake level; in-use roadways, along with associated infrastructure, will be reconstructed in their current locations to accommodate the rise in the reservoir's elevation (COLA ER 5.1.1.2.2.4).

On-site railroad access is already provided in the immediate vicinity of the proposed site, but an additional 0.2 mile of rail would be needed to connect to the existing rail line (COLA ER 9.3.2.2.1.7).

No significant adverse environmental consequences are anticipated.

7. Energy consumption or generation

Brunswick
The addition of two Westinghouse AP1000 units will provide an electrical output of at least 2000 megawatt electric (MWe) (COLA ER 1.1.3). Four new 230-kV transmission

lines would be required for the addition of a single advanced reactor at the Brunswick site; these transmission lines are identified as the new Brunswick to Cumberland 230-kV, new Brunswick to Clinton 230-kV, new Brunswick to Jacksonville 230-kV, and new Brunswick to Wommack 230-kV lines (PEC 2006). Routing studies have not been completed, but routes are expected to be adjacent to or within existing ROWs where possible. The total length for four new transmission lines is approximately 360 miles. Potential impacts to natural resources are described in appropriate sections of this document.

Harris
The addition of two Westinghouse AP1000 units will provide an electrical output of at least 2000 megawatt electric (MWe) (COLA ER 1.1.3). Seven 230-kV transmission lines currently connect the existing Harris Nuclear Plant (HNP) to the PEC electric grid system, with an eighth line planned for 2011. These transmission lines will also connect HAR-2 through the HNP common expanded switchyard to the PEC electric grid. HAR-2 will connect to the PEC grid utilizing existing towers, lines, and ROWs that currently support HNP operations (COLA ER 3.7.1.1). Three new 230-kV transmission lines will connect the HAR-3 switchyard to the PEC electric grid. The proposed routing of the three new transmission lines for HAR-3 is being evaluated to be adjacent to or within the existing ROWs. These three transmission lines will be connected to the existing Fort Bragg Woodruff Street Substation, Erwin Substation, and Wake Substation. The total length of the three new transmission lines is approximately 103 miles. Potential impacts to natural resources are described in appropriate sections of this document.

8. Navigation

Brunswick
Although the Cape Fear River adjacent to the Brunswick site constitutes navigable waters, the intake canal is restricted with no public access. No adverse impacts to navigation are anticipated for this alternative.

Harris
The Cape Fear River at this stretch and Buckhorn Creek are not currently used as navigable waters. Expanding the reservoir will increase the surface area available for recreational watercraft. No adverse impacts to navigation are anticipated for this alternative.

9. Safety

Brunswick
The NRC performs safety evaluations of operating and prospective nuclear sites. Safety related to seismic activity is considered to be a low level of concern at the Brunswick Site. Five low magnitude earthquakes were recorded for the period from 1860 to the present, but there was no significant damage noted (FSAR 2.5.2.1). No adverse environmental consequences are anticipated for this alternative.

Harris
The NRC performs safety evaluations of operating and prospective nuclear sites. The COL Application document noted that review of geological, seismological, geophysical, and geotechnical data for the Harris Site did not identify anything that would preclude the safe operation of the proposed facilities (COLA ER 2.5.0.1.2). No adverse environmental consequences are anticipated for this alternative.

10. Air quality

Brunswick
The Brunswick site would use saltwater for cooling which would result in cooling water salt drift (COLA ER 10.4.1.3). Since the construction of the facility would constitute a major modification under Environmental Protection Agency (EPA) guidelines and could result in a significant increase in particulate emissions due to salt drift, the facility may be required to obtain a Prevention of Significant Deterioration (PSD) air quality permit (40 CFR § 52.21).

A small increase in air emissions may occur during construction of the proposed Brunswick site. During construction activities at the Brunswick site, controls will be implemented to mitigate potential air emissions from construction sources. The small increase in emissions during construction is not expected to pose a significant adverse environmental consequence for the site and will comply with the State Implementation Plan.

Harris
The Harris site uses fresh water from Harris Lake for use in cooling. The use of fresh water for cooling would not be expected to cause a significant increase in particulate emissions and may indicate that a PSD air quality permit would not be required for the Harris site. The Harris site would be required to comply with an emissions permit (COLA Application 9.3.2.2.1.2). The construction of the proposed facility is not expected to pose a significant environmental consequence for the facility or surrounding area.

A small increase in air emissions may occur during timber removal, and HAR site preparation activities required for the Harris Reservoir perimeter, transmission corridors, pipeline corridor, and/or installation of the intake structure and pump house. During construction activities at the HAR site, controls will be implemented to mitigate potential air emissions from construction sources (COLA ER 10.3.1.4). The small increase in emissions during construction is not expected to pose a significant adverse environmental consequence for the site and will comply with the State Implementation Plan.

11. Noise

Brunswick
There were no significant noise concerns noted in the ER or FSAR for the Brunswick Site. Temporary increases in noise levels are expected during construction. Noise levels

will be controlled by following Occupational Safety and Health Administration (OSHA) regulations, Federal noise pollution control regulations and applicable local noise ordinances. The construction of the facility is not expected to pose a significant adverse environmental consequence related to noise.

Harris
Temporary increases in noise levels are expected during construction of HAR-2 and HAR-3. The temporary noise increases can be expected due to clearing of trees prior to raising the reservoir level, during grading, and the actual construction of the HAR-2 and HAR-3 facilities. Noise levels will be controlled by following Occupational Safety and Health Administration (OSHA) regulations, Federal noise pollution control regulations and applicable local noise ordinances. The construction of the facility is not expected to pose a significant adverse environmental consequence related to noise.

12. Historic properties

The *National Historic Preservation Act* (NHPA) requires that projects subject to Federal permitting be evaluated with respect to their potential impact to historic and archaeological sites listed in or eligible for listing in the *National Register of Historic Places* (National Register). The Area of Potential Effect (APE) for a project is determined in consultation with the State Historic Preservation Office (SHPO).

Brunswick
No coordination has occurred to date with the North Carolina SHPO regarding potential expansion of the Brunswick site. However, when the existing site was permitted, coordination with the North Carolina Department of Arts, Culture, and History and the NRC occurred, which resulted in a conclusion that the construction of the original Brunswick site would not impact National Register properties (Brunswick ER 2.11, 4.19).

Additionally, no archaeological survey has been conducted of the approximately 400-acre area at the Brunswick site. However, the uplands within this area have been previously disturbed during construction of the current nuclear facility, including construction that began, but was ceased, on cooling towers that were determined to not be necessary to the operation of the facility (Personal communication, Linda Hickok, 4 May 2009). As such, this area has a low potential to contain intact archaeological sites eligible for listing in the National Register. It would be expected, but cannot be stated, that the NC SHPO would recommend no archaeological survey for the Brunswick site based on previous disturbance.

No properties listed in or eligible for listing in the National Register are located on the proposed construction areas at the Brunswick site. While there are properties listed in the National Register, eligible for listing in the National Register, or potentially eligible for listing in the National Register within a 10-mile radius of the site, none of these properties would be directly or indirectly impacted (Brunswick ER 2.11, 4.19; NC SHPO, Records on file).

Harris
No adverse environmental consequences are anticipated. Coordination with the North Carolina SHPO pursuant to Section 106 of the NHPA has been conducted by PEC for the HAR site (COLA ER 2.5.3.2, 4.1.3). This coordination resulted in the recommendation by the NC SHPO for an archaeological survey of the APE, defined as the approximately 400-acre proposed HAR site as well as the proposed reservoir expansion area and the associated water make-up line. These surveys were conducted in 2007-2009 (Espenshade 2007; Espenshade et al. 2007). None of these archaeological surveys encountered any archaeological sites that could be considered eligible for listing in the National Register. A management summary for the Phase I archaeological survey of the proposed reservoir expansion area has been submitted to the SHPO.

No properties listed in or eligible for listing in the National Register are located at the HAR site. While there are properties listed in the National Register, eligible for listing in the National Register, or potentially eligible for listing in the National Register within a 10-mile radius of the site, none of these properties will be directly or indirectly impacted by construction activities or newly constructed structures (COLA ER 2.5.3.1). No impacts to historic properties are anticipated for the site.

13. Land use classification

Brunswick
The Brunswick site is on land already owned by PEC and is already zoned for uses compatible with the development of new units (COLA ER 9.3.2.2.2.1). No adverse environmental consequences are anticipated.

Harris
The HAR site is on land that is already owned by PEC and is already zoned for uses that are compatible with the development of new reactor units (COLA ER 9.3.2.2.1.1). No adverse environmental consequences are anticipated.

14. Economics

With the PEC service area, the Annual Peak demand increased by 24.6 percent and the Annual Load increased by 18.1 percent from 1997-2006, indicative of the growing need for electrical power with the PEC service area. On average within that 10 year time span, the need for power within the PEC service area increased by nearly 900 megawatts every four years. From the year 2007-2008 to 2021-2022, PEC anticipates load to increase by 24.7 percent (PEC 2006). Construction at either site would help maintain an adequate supply to load ratio and reliable electrical service to commercial customers, which would help maintain and support growth of economic activity within the PEC service area.

Brunswick
No adverse environmental consequences are anticipated. It is anticipated that construction of two units at the Brunswick site would create a maximum of 3,150 jobs in

the construction sector over the 7 year construction period (COLA ER 4.4.2.1), as well as approximately 773 jobs to operate the new facilities (COLA ER 5.1.1.1.2). Given the anticipated 2010 population of the four-county region surrounding the site of 437,592 (PEC 2006, Attachment V Criterion P3), the effect on the local and regional economies from construction and post-construction employment at the site would be considered small.

Harris
No adverse environmental consequences are anticipated. Construction of two units at the Harris site would create a maximum of 3,150 jobs in the construction sector over the 7 year construction period (COLA ER 4.4.2.1), as well as approximately 773 jobs to operate the new facilities (COLA ER 5.1.1.1.2). Given the anticipated 2010 population of the five-county region surrounding the site of 1,532,854 (PEC 2006, Attachment V Criterion P3), the effect on the local and regional economies from construction and post-construction employment at the site would be considered small (COLA ER 4.4.2.1).

15. Property values

A study on the effect of nuclear facilities on the value of surrounding property found that the presence of a nearby nuclear facility did not negatively impact property values (Bezdek and Wendling 2006).

Brunswick
No adverse environmental consequences are anticipated. The Brunswick site is an existing nuclear power plant site; no negative impacts to adjacent property values are anticipated.

Harris
No adverse environmental consequences are anticipated. The Harris site is an existing nuclear power plant site; no negative impacts to adjacent property values are anticipated.

16. Regional growth

Brunswick
No adverse environmental consequences are anticipated. From 2000 to 2010, it is projected that the population of the four-county region consisting of Brunswick, Columbus, New Hanover, and Pender counties will grow by 32.9 percent to approximately 437,592 (PEC 2006, Attachment V Criterion P3, 1.2.1, 3.1). It is anticipated that the population in Brunswick County and surrounding areas will continue to grow at a similar rate. Construction at the site would not be a catalyst for significant in-migration to the region over and above that which is already anticipated, as the peak construction workforce is anticipated to be approximately 3,150 (COLA ER 4.4.2.1).

Harris
No adverse environmental consequences are anticipated. From 2000 to 2010, it is projected that the population of the five-county region consisting of Chatham, Durham,

Harnett, Orange, and Wake counties will grow by 38.1 percent to approximately 1,532,854 (PEC 2006, Attachment V Criterion P3, 1.2.1, 3.1). It is anticipated that the population in Wake County and surrounding areas will continue to grow at a similar rate. Construction at either site will not be a catalyst for significant in-migration to the region over and above that which is already anticipated. Construction at the site would not be a catalyst for significant in-migration to the region over and above that which is already anticipated, as the peak construction workforce is anticipated to be approximately 3,150 (COLA ER 4.4.2.1).

17. Tax revenues

Post-construction property tax revenues in the counties in which the additional facilities would be placed would increase based on the increase in property value resulting from the construction of high value nuclear facilities. Also, increases in sales tax revenue would be expected from construction at either site resulting from the local purchase of construction materials or goods and services by temporary construction workers. As it is anticipated that most workers at the site would come from within North Carolina, it is anticipated that the effect to income tax revenues would be small (Brunswick ER 2.7, 4.17.2; COLA ER 4.4.2.2).

Brunswick
No adverse environmental consequences are anticipated.

Harris
No adverse environmental consequences are anticipated.

18. Employment

Construction of two units is anticipated to require a peak construction labor force of approximately 3,150 people (COLA ER 4.4.2.1). It is anticipated that 2,362, or 75 percent, of the estimated peak of 3,150 construction force would live in the region, with the other 25 percent relocating to the region. It is anticipated that an additional 773 full-time or contract employees will be required for the operation of two additional reactors (COLA ER 5.1.1.1.2).

Brunswick
No adverse environmental consequences are anticipated. The construction employment would consist of approximately 15.1 percent of the four-county regional construction labor pool (Brunswick, Columbus, New Hanover, and Pender counties) for the Brunswick site, and 2.1 percent of the total regional labor pool, based on year 2000 numbers (PEC 2006, Attachment V Criterion 3.1). The region around the Brunswick site will be able to supply and/or absorb the necessary number of workers for construction and operation of the units.

Harris
No adverse environmental consequences are anticipated. The construction employment would consist of approximately 6.3 percent of the five-county regional construction labor pool (Chatham, Harnett, Durham, Orange, and Wake counties) for the Harris site, and 0.1 percent of the total regional labor pool, based on year 2000 numbers (PEC 2006, Attachment V Criterion 3.1). The region around the Harris site will be able to supply and/or absorb the necessary number of workers for construction and operation of the units.

19. Public facilities and services

Brunswick
The Brunswick site contains two existing nuclear power plants. Public services are expected to be adequate and expected to expand to meet the demands in a similar fashion as those already provided. Wastewater treatment at the Brunswick site is provided by a 0.055 MGD domestic wastewater treatment plant (Brunswick ER Appendix B). Other public facilities (parks, transportation, water supply) are addressed elsewhere in this document. No adverse environmental consequences are anticipated.

Harris
The Harris site contains an existing nuclear power plant. The projected capacity of the public services is adequate and expected to expand to meet the demands of a slight population growth in the area (COLA ER 2.5.2.7). Wastewater treatment at the Harris site is provided by the HNP wastewater treatment plant, which is located in the exclusion area boundary (COLA ER 2.5.2.7). Other public facilities (parks, transportation, water supply) are addressed elsewhere in this document. No adverse environmental consequences are anticipated.

20. Business activity

The anticipated maximum number of construction workers at either site is 3,150, and it is anticipated that most workers would come from the surrounding region (COLA ER 4.4.2.1). It is anticipated that 2,362, or 75 percent, of the estimated peak of 3,150 construction force would live in the region, with the other 25 percent relocating to the region. For either alternative, 773 full time employees would be needed for operation of the new plants (COLA ER 5.1.1.1.2). Increases in business sales could be expected from construction at either site resulting from the local purchase of construction materials or goods and services by temporary construction workers (Brunswick ER 2.7, 4.17.2; COLA ER 4.4.2.2).

Brunswick
No adverse environmental consequences are anticipated. Given that the anticipated 2010 population of the four-county region surrounding the site is 437,592 (PEC 2006, Attachment V Criterion P3), the effect on local and regional business activity from construction and post-construction employment at the site would be considered positive, but small.

Harris
No adverse environmental consequences are anticipated. Given that the anticipated 2010 population of the five-county region surrounding the site is 1,532,854 (PEC 2006, Attachment V Criterion P3), the effect on local and regional business activity from construction and post-construction employment at the site would be considered positive, but small (COLA ER 4.4.2.1).

21. Prime and unique farmland

Brunswick
The Brunswick site includes no prime farmland soils within the 400-acre power block, but a small amount of Baymeade fine sand (Loamy, siliceous, semiactive, thermic Arenic Hapludults, map symbol BaB) a soil considered a farmland of statewide importance. The transmission line upgrades will cross agricultural areas, some of which may contain prime or unique farmland. No adverse environmental consequences are anticipated for this alternative.

Harris
The Harris site includes former areas of prime farmland within the 400-acre power block. Creedmoor sandy loam, 2 – 6% slopes (Fine, mixed, semiactive, thermic Aquic Hapludults, map symbols CrB and CrB2) is the only prime farmland soil series mapped within the power block. However, the soils were mapped before the development of the site and it is doubtful they still exist without considerable alteration. The transmission line upgrades will cross agricultural areas, some of which may contain prime or unique farmland. No adverse environmental consequences are anticipated for this alternative.

22. Food and fiber production

Brunswick
The transmission line upgrades associated with the Brunswick site will cross agricultural lands that are used for crop production. However, the overall affects are expected to be small. No adverse environmental consequences are anticipated for this alternative.

Harris
The transmission line upgrades associated with the Harris site will cross agricultural lands that are used for crop production. However, the overall affects are expected to be small. No adverse environmental consequences are anticipated for this alternative.

23. Water quantity

Brunswick
The Brunswick Site is located 9,000 feet west of the Cape Fear River. The Cape Fear River has a daily freshwater discharge rate of between 8,100 and 10,000 cfs. The Brunswick Site is considered to have sufficient water quantity and impacts are expected

to be small. The ER did not identify any significant issues with water quantity for the Brunswick Site.

Harris
The Harris Site will use surface water from Harris Lake for domestic, process and cooling tower makeup water. The normal water withdraw from Harris Lake is 93.74 cfs and the normal consumptive water use is 62.66 cfs. The normal water return rate after use in HAR-2 and HAR-3 is expected to be 31.09 cfs. Makeup water will be obtained from the Cape Fear River near the Buckhorn Dam to maintain the proposed operating water level of 240 feet NGVD29. According to the COLA ER document, the water supply was adequate to support plant operation, including the makeup water from the Cape Fear River even under severe drought conditions.

24. Mineral needs

Brunswick
No significant differences identified between the two alternatives since PEC owns all the properties and their mineral rights. No adverse environmental consequences were identified for this alternative.

Harris
No significant differences identified between the two alternatives since PEC owns all the properties and their mineral rights. There are no known mineral resources of economic significance on the HAR property. Oil and gas exploration of the Triassic Basin in the 1980s identified no oil or gas (COLA ER 2.5.0.1.2). No adverse environmental consequences were identified for this alternative.

25. Consideration of private property

Brunswick
No adverse environmental consequences are anticipated. All proposed construction or related impacts at the site will occur completely on property currently owned by PEC (PEC 2006, Attachment V Table 3-1, Criterion P10, 4.3.2).

Harris
No adverse environmental consequences are anticipated. All proposed construction or related impacts at the site will occur completely on property currently owned by PEC (PEC 2006, Attachment V Table 3-1, Criterion P10, 4.3.2).

26. Community cohesion

It has been determined that there are no significant health and safety impacts related to the construction of additional nuclear facilities at either site (PEC 2006, Attachment V 3.3). As all construction activities would take place on property owned by PEC, there would be no displacement of minority or low-income groups (PEC 2006, Attachment V Table 3-1, Criterion P10, 4.3.2). As the anticipated maximum number of construction

workers at the site is 3,150, and as it is anticipated that most workers would come from the surrounding region, the effects on the social structure of the region from construction at either site would be small (COLA ER 4.4.2). As such, the effects of construction at the site on community cohesion would be no less than anticipated due to normal population growth.

Brunswick
No adverse environmental consequences are anticipated. In the year 2000, within a 50-mile radius of the Brunswick site, the low-income population was 48,233, or 14.6 percent of the total area population, while the minority population was 76,393, or 23.3 percent of the total area population. Of 257 United States Census block groups within a 50-mile radius of the Brunswick site, 3 exceeded the threshold for low-income populations, while 41 exceeded the threshold for aggregate minority populations. No minority or low-income populations are located in immediate vicinity of the Brunswick site (Brunswick ER 2.6.2).

Harris
No adverse environmental consequences are anticipated. In the year 2000, within a 50-mile radius of the Harris site, the low-income population was 113,905, or 10.3 percent of the total area population, while the minority population was 358,446, or 32.3 percent of the total area population. Of 1,144 United States Census block groups within a 50-mile radius of the Harris site, 58 exceeded the threshold for low-income populations, while 253 exceeded the threshold for aggregate minority populations. No minority or low-income populations are located in immediate vicinity of the Harris site (COLA ER 2.5.4).

27. Community growth and development

As the anticipated maximum number of construction workers at the site is 3,150, and as it is anticipated that most workers would come from the surrounding region, the effects on community growth and development from construction at the site would be small (COLA ER 4.4.2). For either alternative, 773 full time employees would be needed for operation of the new plants (COLA ER 5.1.1.1.2).

Brunswick
No adverse environmental consequences are anticipated. From 2000 to 2010, it is anticipated that the population of the four-county region consisting of Brunswick, Columbus, New Hanover, and Pender counties will grow by 32.9 percent to approximately 437,592 (PEC 2006, Attachment V Criterion P3, 1.2.1, 3.1).

Harris
No adverse environmental consequences are anticipated. From 2000 to 2010, it is anticipated that the population of the five-county region consisting of Chatham, Durham, Harnett, Orange, and Wake counties will grow by 38.1 percent to approximately 1,532,854 (PEC 2006, Attachment V Criterion P3, 1.2.1, 3.1).

28. Relocations (business, homes, etc.)

Brunswick
No adverse environmental consequences are anticipated. The Exclusion Area Boundary (EAB) for the Brunswick site would include only property currently owned by PEC (Brunswick ER 2.1; PEC 2006, Attachment V Table 3-1, Criterion P10, 4.3.2). No residential or commercial relocations would be necessary at the site.

Harris
No adverse environmental consequences are anticipated. The Exclusion Area Boundary (EAB) for the Harris site would be within the current EAB for the existing reactors (COLA ER 1.1.2, 3.1; PEC 2006, Attachment V Table 3-1, Criterion P10, 4.3.2). No residential or commercial relocations would be necessary at the site.

29. Recreation

Brunswick
No adverse environmental consequences are anticipated. The Brunswick site does not contain any recreational facilities that would be impacted by plant construction.

Harris
The Harris Lake County Park would be impacted by construction at the Harris site, specifically by the raising of the pool level of Harris Lake (COLA ER 4.1.1.2.1.3, 4.4.2.6). These impacts would include the flooding of approximately 279 acres within the current park boundaries, as well as the displacement of other amenities. However, PEC is committed to working with Wake County Parks to relocate the park facilities affected by the increased water level. Numerous additional facilities are located within a 50-mile radius of the Harris site that would offset temporary displacements during construction. The larger lake would offer more opportunities for water-based recreation, offsetting loss of terrestrial gamelands.

D. Summary

PEC has evaluated a number of alternatives for achieving new baseload generation that is reliable and proximate to PEC's major customer base. The no-action alternative would not meet the stated purpose and need and was eliminated from consideration. Non-nuclear alternative energy sources were evaluated and found to not meet the stated purpose and need and were eliminated from further consideration. PEC evaluated 11 sites for potential use for adding the nuclear baseload required to meet purpose and need; 7 of these sites were eliminated through exclusionary criteria during the siting study. Of the four carried forward for further consideration, the Harris site was selected as the applicant's preferred alternative based on results of PEC's technical evaluation, strategic considerations, and preliminary transmission study.

Review of potentially adverse impact on the aquatic ecosystem indicated that the Marion site and Robinson site both would result in substantially greater impacts to wetlands and streams compared to the preferred alternative, the Harris site, both for construction of drought mitigation reservoirs and for transmission line upgrades. Neither the Marion site nor the Robinson site constitutes an environmentally preferred alternative to the Harris site based on the greater environmental impacts to the aquatic ecosystem. The Marion and Robinson sites were dropped from further evaluation.

The Brunswick alternative would result in greater impact to wetlands through filling activities for the power block and support facilities, and through conversion of forested wetlands to herbaceous wetlands along the new transmission line upgrades than the Harris alternative would for either of these activities. The Harris alternative would result in inundation and conversion of wetland and stream habitats to reservoir habitats through reservoir expansion and conversion of forested wetlands along the new transmission line upgrades. Because neither alternative provided a clearly preferable environmental alternative based on potential impacts to the aquatic ecosystem, the Brunswick site was carried forward for more detailed evaluation against the Harris site.

Dredge and fill activities are considered to be loss of Waters of the United States. The U.S. Army Corps of Engineers and U.S. Environmental Protection Agency also consider inundation of wetlands and streams to be losses for permitting and mitigation consideration; however, aquatic functions are not permanently lost as they are through filling activities, but may be altered by conversion of existing wetlands and streams to non-linear surface waters. Although clearing for additional rights-of-way for required transmission line upgrades is not a dredge and fill activity or inundation impact, the clearing of wetland community types, particularly forested habitats, will result in some aquatic resource functional diminishment. The following is a summary of potential losses based on magnitude and function for the Brunswick and Harris alternatives (also refer to Table 11):

- The Brunswick alternative will result in more fill than the Harris alternative in special aquatic sites, including approximately 16 acres of estuarine tidal wetlands and 2.5 acres of associated estuarine tidal streams (1.2 miles total length), as well

as 19 acres of forested riverine wetlands and a total of 1.8 miles of stream. The tidal stream and wetlands are part of Nancy's Creek, which is designated as a High Quality Water and Primary Nursery Area, and contains Essential Fish Habitat and comprises several Areas of Environmental Concern under the Coastal Area Management Act. The Harris alternative may result in fill to approximately 5 acres of forested riverine wetlands and 0.8 to 1.4 miles of stream.

- The Harris alternative may result in inundation of approximately 598 acres of riverine wetlands and 26.8 miles of stream, as well as 3,331 acres of non-linear surface waters (existing Harris Reservoir and 10 acres of ponds). The expansion of the reservoir by approximately 3,570 acres will result in a gain of approximately 61.9 miles of riparian perimeter with forested buffer compared to the existing reservoir. The gain of 61.9 miles of reservoir riparian zone is expected to offset functional losses from clearing and inundation of the existing forested riparian zone (53.6 miles based on 26.8 miles of stream with buffer on both streambanks). Reservoir habitats contained within the shallow littoral zone (less than 6.6 feet in depth) will experience a net gain of approximately 430 acres (increasing from 959 acres to 1,389 acres).

- The Brunswick alternative will result in clearing of approximately 1,450 acres of wetland habitats for transmission line upgrades, of which 580 acres are within areas identified as Significant Natural Heritage Areas (SNHAs). The Harris alternative will result in clearing of approximately 95 acres of wetland habitats for the Harris alternative, of which 6 acres are within areas identified as SNHAs.

- No other significant adverse environmental consequences were identified among the other public interest factors for either the Harris or Brunswick sites, other than for potential for impacting endangered and threatened species. The Brunswick alternative has greater potential adverse impacts to habitat for the federally endangered red-cockaded woodpecker along the new transmission line upgrades, and potential adverse impacts through increased incidental take of federally threatened and endangered sea turtles within the intake canal as flows are increased to provide water for the new units.

Although the Harris alternative has more impacts through filling and flooding combined in comparison to the Brunswick alternative, the Brunswick alternative will result in more adverse impacts to aquatic resources and aquatic resource functions through filling, forested wetland clearing, and degradation of wetlands identified as Significant Natural Heritage Areas. Brunswick also has the potential for more adverse impacts to federally Endangered and Threatened species. Based on the difference in types of aquatic ecosystem impacts and the difference in functions lost or gained, the Brunswick alternative does not constitute an alternative demonstrating less adverse impact on the aquatic ecosystem in comparison to the preferred alternative, the Harris site. Because the Harris site has the least overall impact on the aquatic environment and no other significant adverse environmental consequences, the Harris site has been identified as the

applicant's preferred alternative, and it is believed that the Harris site is also the least environmentally damaging preferred alternative.

Table 11. 40 CFR 230 Evaluation Criteria for Brunswick and Harris Alternatives

Physical/Chemical Characteristics		
Evaluation Factor	**Brunswick Alternative**	**Harris Alternative**
Substrate	Filling of 35 acres of wetlands and 1.8 miles of streambed, including 16 acres of tidal wetlands and 1.2 miles of tidal stream.	Filling of 5 acres of wetlands and 0.8 mile of streambed for power block and support facilities; potential for additional fill of 0.6 mile of streambed for roadway improvements. Temporary disturbance to 1 acre of wetlands and 0.6 mile of streambed through trenching for pipeline.
Currents, circulation or drainage patterns	No adverse environmental consequences are anticipated. (See Endangered and threatened species).	Temporary adverse environmental consequence anticipated for construction of intake structure.
Suspended particulates, turbidity	No long-term adverse environmental consequences anticipated. Temporary impacts may result from construction. NPDES regulations will apply.	No long-term adverse environmental consequences anticipated. Temporary impacts may result from construction. NPDES regulations will apply.
Water quality	Localized impacts to water quality may result from forested wetland clearing due to ROW expansion and 35 acres of wetland fill and 1.8 miles of streambed fill in the power block.	Localized impacts to water quality may result from forested wetland clearing due to ROW expansion and 5 acres of wetland fill and 0.8 mile of streambed fill in the power block. Expanded reservoir and its increased riparian zone will offset some water quality functions lost or reduced.
Flood control functions	Flood control functions of 1,450 acres of wetlands altered through ROW clearing for expanded transmission lines. Tidal and non-tidal wetlands will also be permanently lost as a result of power block construction. No adverse environmental consequences are expected as a result of this reduced hydrology function.	Flood control functions of 95 acres of wetlands altered through ROW clearing for expanded transmission lines. Expanded reservoir will replace flood control functions lost through forested wetland inundation. No significant adverse environmental consequences are expected to result from the reservoir expansion or ROW expansion.
Storm, wave and erosion buffers	Potential adverse impact for storm and wave buffers for this alternative, but only related to extreme events and not under normal weather conditions.	No adverse environmental consequences anticipated.
Aquifer recharge	No adverse environmental consequences anticipated.	No adverse environmental consequences anticipated.
Baseflow	No adverse environmental consequences anticipated.	No adverse environmental consequences anticipated. Minimum flow release and prescribed release schedule that will be required for Buckhorn Creek by NCDENR would be a beneficial effect.
Mixing zone	No adverse environmental consequences anticipated.	No adverse environmental consequences anticipated.

Biological Characteristics		
Evaluation Factor	**Brunswick Alternative**	**Harris Alternative**
Special aquatic sites	Permanent loss of aquatic resource function from fill of 16 acres tidal wetlands, 19 acres riverine wetlands, 1.2 miles tidal stream, 0.2 mile perennial stream, and 0.4 mile intermittent stream. Undetermined impacts may result from obtaining sufficient freshwater for service and process water. No substantive change in function from new transmission line ROW clearing for 0.2 mile tidal stream, 4.6 mile perennial stream, 7.1 mile intermittent stream, 0.8 mile naturalized ditch/canal, or 28 acres pond. Permanent diminishment of some function for most forested wetland types for 665 acres riverine wetlands and 758 acres of non-riverine wetlands cleared for new transmission line ROW. Decrease in overall function for 6 of 12 wetland types totaling approximately 1,381 acres.	Permanent loss of aquatic resource function from fill of 5 acres riverine wetlands, 0.3 mile perennial stream, 05 mile intermittent stream, and 5 acres pond. Additional 0.4 mile perennial stream and 0.2 mile intermittent stream subject to potential fill if roadway improvement alternative selected, or flooding if not. Variable functional change from flooding for 598 acres riverine wetlands, 15.8 mile perennial stream, 10.9 mile intermittent stream, 3,321 acres reservoir, and 10 acres pond. Some functions of wetlands and streams provided by expanded reservoir habitats. Loss of specific aquatic habitat types but gain in other aquatic habitat types. No aquatic habitat types expected to be lost from watershed and overall biodiversity expected to be maintained in the watershed. Gain of approximately 3,900 acres of reservoir habitats. Gain of approximately 61.9 miles riparian forested buffer around new reservoir perimeter. Gain of approximately 430 acres of shallow littoral zone. Permanent changes to wetland function resulting from clearing 1 acre riverine wetlands for ROW for new water pipeline. Temporary loss of stream function for 0.5 mile perennial stream and 0.1 mile intermittent stream from trenching for pipeline. No substantive change in function from new transmission line ROW clearing for 1.5 miles perennial stream, 3.6 miles intermittent stream, 0.2 mile naturalized ditch/canal, or 23 acres pond. Permanent diminishment of some function for most forested wetland types for 95 acres riverine wetlands cleared for new transmission line ROW.

Biological Characteristics cont.		
Evaluation Factor	**Brunswick Alternative**	**Harris Alternative**
Habitat for fish and other aquatic organisms	Loss of aquatic habitats through fill (see Special aquatic sites). Potential entrainment and impingement concerns for estuarine fish and shellfish from increased flow through intake canal.	Loss of aquatic habitats through fill (see Special aquatic sites). Loss of stream and wetland habitats by reservoir expansion, gain in reservoir habitats. No aquatic habitat types expected to be lost from watershed and overall biodiversity expected to be maintained in the watershed.
Wildlife habitat	Loss of wetland habitats through fill and construction of powerblock and support facilities (see Special aquatic sites). Approximately 4,360 acres of new ROW required, which will result in clearing and conversion to maintained ROW. Approximately 1,033 acres of SNHAs subject to clearing for new ROW. Loss of habitat for forest-dependent species, gain of habitat for species utilizing forest edge and disturbed habitats.	Loss of wetland habitats through fill and construction of powerblock and support facilities (see Special aquatic sites). Approximately 1,248 acres of new ROW required, which will result in clearing and conversion to maintained ROW. Approximately 35 acres of SNHAs subject to clearing for new ROW. Loss of habitat for forest-dependent species, gain of habitat for species utilizing forest edge and disturbed habitats.
Endangered or threatened species	Potential adverse effect on sea turtles and shortnose sturgeon through water flow increases in intake canal will require new Biological Opinion from NMFS. Potential adverse effects to red-cockaded woodpeckers through ROW clearing (46 occurrences near ROW expansion routes) will require consultation with USFWS. Loss of potential foraging habitat for bald eagle and wood stork from tidal marsh and tidal stream fill. Anticipated beneficial effects for several listed plants through habitat enhancement resulting from ROW expansion.	No adverse effects anticipated. Anticipated beneficial effect to bald eagle foraging opportunities through increase in reservoir size and shallow littoral zone. Anticipated beneficial effects for several listed plants through habitat enhancement resulting from ROW expansion.
Biological availability of possible contaminants from dredge/fill material	No adverse environmental consequences anticipated.	No adverse environmental consequences anticipated.

Human Use Characteristics		
Evaluation Factor	**Brunswick Alternative**	**Harris Alternative**
Existing and potential water supplies; water conservation	BSEP currently obtains average of 0.22 mgd from BCPU. An additional 1.58 mgd to 5.8 mgd of freshwater will be needed for process and service water needs. Additional capacity not currently available through BCPU. Obtaining this water may require additional impacts that have not yet been fully evaluated.	No adverse environmental consequences anticipated.
Recreational or commercial fisheries	Primary nursery area and essential fish habitat comprising 16 acres of tidal wetlands and 1.2 miles of tidal stream permanently lost from power block and support facilities construction. Additional larval entrainment from increased water flow through intake canal also anticipated.	No adverse environmental consequences anticipated. Expected increase in recreational fishing opportunities for freshwater game fish as a result of increasing Harris Reservoir by approximately 3,570 acres.
Other water related recreation	No adverse environmental consequences anticipated.	No adverse environmental consequences anticipated. Temporary displacement of public boat ramps and public access areas for Harris Reservoir. Expanded reservoir will provide the public a larger area on which to pursue water-related recreational interests.
Aesthetics of the aquatic ecosystem	Clearing 580 acres of wetlands for ROW expansion within Significant Natural Heritage Areas considered a widespread adverse effect on aesthetics.	Clearing 6 acres of forested wetlands for ROW expansion within Significant Natural Heritage Areas considered a localized adverse effect on aesthetics.
Parks, national and historic monuments, national seashores, wild and scenic rivers, wilderness areas, research sites, etc.	249 acres of state game lands are subject to clearing from ROW expansion. No adverse environmental consequences anticipated.	95 acres of state game lands are subject to clearing from ROW expansion. 279 acres within Harris Lake County Park lost due to inundation. PEC is committed to working with Wake County Parks Department to relocate park services affected by the increased water level. No adverse environmental consequences anticipated.

V. Summary of Secondary and Cumulative Impacts

NEPA defines secondary impacts as those impacts caused by the proposed action or alternatives and are later in time or farther removed in distance, but are still reasonably foreseeable. Cumulative impacts result from the incremental impact of the proposed action or alternatives when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions (Duke University 2002).

Examples of secondary impacts include growth inducing effects or changes in land use patterns that themselves cause changes in air, water, or other natural systems. Construction of the HAR-2 and HAR-3 units at the Harris site is not expected to result in any significant growth inducing effects. Population growth is coming to this part of the state regardless of the proposed action at the Harris site. The land use at the Harris site is already conducive to construction of the new units. Necessary infrastructure such as roads, railways and line corridors are in place. PEC owns a vast amount of property surrounding the Harris site, much of which will remain undisturbed except for what is affected by the rise of the normal pool elevation of Harris Lake. The expansion of the transmission lines identified earlier in this document will convert existing land cover as a result of ROW clearing. Forested land will be converted to herbaceous or successional communities and forested wetlands will be converted to low-growing wetland habitats. PEC uses all applicable best management practices to protect sensitive areas, including wetlands and streams, when constructing or expanding ROWs.

Cumulative effects result from the spatial and temporal crowding of environmental perturbations. The effects of human activities will accumulate when a second perturbation occurs at a site before the ecosystem can fully rebound from the effect of the first perturbation (CEQ 1997). In the case of the preferred alternative, the increased capacity of Harris Lake to supply reliable cooling water during drought conditions will be the primary ecosystem perturbation resulting from the project. This assertion is based on the analysis of anticipated effects to the aquatic ecosystem associated with the HAR project that is contained herein. One effect that is reasonably foreseeable may result from the replacement of public access areas, including boat ramps, around Harris Lake that will be lost as a result of inundation. However, these areas will be constructed using applicable best management practices to prevent adversely affecting the water quality of Harris Lake.

Existing wetland habitat within and along the lakeshore fringe of Harris Lake will be lost to inundation. Natural establishment of wetlands may occur in the shallows and along the shoreline at the new lake elevation. In addition, stream habitats and associated wetlands will also be inundated; however it is not expected to have any detrimental effect on downstream water quality nor is there expected to be any additional impacts from reservoir expansion after this action is complete. PEC will be required to mitigate for unavoidable losses of wetland and streams. Fish habitat and surface area that is usable for aquatic recreation will actually be increased by the reservoir expansion. Land clearing associated with the reservoir expansion is not expected to result in any

detrimental habitat fragmentation. The structure of the human environment surrounding the Harris site is not expected to be negatively affected by the construction of the HAR project. There should be no changes in community dynamics or loss of neighborhoods or community character as a result of the HAR project.

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