APPENDIX F

FLOODPLAIN/WETLANDS ASSESSMENT

F.1 INTRODUCTION

Executive Orders 11988 (Floodplains Management) and 11990 (Protection of Wetlands) and U.S. Department of Energy (DOE) regulation "Compliance with Floodplain/Wetlands Environmental Review Requirements" (10 CFR 1022) specify the requirements for a floodplain/wetlands assessment. Pursuant to these requirements, DOE issued a floodplain/wetlands notice on the construction and operation of alternative cooling water systems for the K- and C-Reactors and the D-Area coal-fired powerhouse on March 28, 1986 (51 FR 10654). BC-19

The proposed action and cooling water alternatives discussed in this EIS, except the D-Area direct discharge alternative, do not occur within the base floodplain or wetlands. Consequently, the practicability test for identifying and evaluating alternatives outside the base floodplain is not required except the D-Area direct discharge alternative which is discussed in Section F.4.2. However, the implementation of the cooling water alternatives for K- and C-Reactors and the D-Area powerhouse could potentially impact the base floodplain and wetlands. These impacts are identified and assessed in Chapter 4. The impact identification and assessment requirements for the EIS are applicable and equivalent to the requirements for floodplain/wetlands protection.

This appendix references the EIS wherever possible and addresses only those impacts of the alternative cooling water systems that could affect the base floodplain and wetlands.

One of the primary concerns of the floodplain/wetlands Executive Orders is the protection of lives and properties. Access to the Savannah River Plant (SRP) is strictly controlled. No dwellings, hospitals, schools, nursing homes, or other structures are located within the base floodplain. Therefore, neither individuals nor private property would be affected if the cooling water alternatives were implemented.

Another concern in the floodplain/wetlands Executive Orders is the impact on floodplain values. The cooling water alternatives would have little or no impact on cultural resources, agricultural, aquacultural, or forestry resources as related to floodplain values. Archaeological and historic resource surveys, which are discussed in Appendix E, identified no significant sites requiring impact mitigation. Because of the controlled access to SRP, no agricultural or aquacultural practices exist, and none would be affected by implementation of any of the cooling water alternatives. The implementation of any of the alternatives, except the no-action alternative for K- and C-Reactors, would enhance native plant communities. BC-19

The cooling water alternatives will, however, impact water and biological resources. This appendix discusses positive and negative, direct (concentrated) and indirect (dispersed), and short-term and long-term impacts associated with the construction and operation of the alternatives for each of the floodplain/wetland areas as related to both water and biological resources.

Short-term impacts are temporary changes during and immediately following
BC-23 implementation of an alternative. Impacts related to construction activities such as site clearing and sedimentation runoff are examples of short-term impacts. Long-term impacts can persist for a considerable time, and might
TE continue indefinitely. Loss of mature swamp forest trees because of thermal effluents discharge is an example of a long-term impact. Direct impacts, as used in this EIS, are concentrated at or near the site of the action; indirect impacts occur at a site remote from the action. Impacts can be beneficial (i.e., positive) or harmful (i.e., negative). The alternative cooling water systems for K- and C-Reactors include the construction and operation of once-through cooling towers (gravity feed and natural draft), recirculating
TE cooling towers, and the continuation of direct discharge, or no action. The alternatives considered for the D-Area coal-fired powerhouse include increased flow with mixing, direct discharge to the Savannah River, and continuation of
TE the present operation, or no action. The proposed action and alternatives are discussed in Chapter 2.

F.2 PEN BRANCH (K-REACTOR)

F.2.1 ONCE-THROUGH COOLING TOWER (PREFERRED ALTERNATIVE)

F.2.1.1 Construction Impacts

Water Resources

The principal direct impact to water resources in the Pen Branch floodplain/ wetlands during construction would be on water quality. A negative impact of
BC-19 construction activities would be a temporary increase in suspended solids because of runoff erosion. Temporary measures such as berms, drainage ditches, drains, sedimentation basins, grassing, and mulching would control
TE runoff until permanent erosion-control measures could be implemented. Construction activities would have no measurable effect on groundwater recharge or the ability of the floodplain/wetlands to moderate floods. Water quality impacts are discussed in Chapter 4.

Biological Resources

Construction activities would occur on upland sites and would not directly
TE affect the floodplain/wetlands. The principal indirect impact would be from sediment loading on fish and macroinvertebrates. This short-term impact would be minimal because Pen Branch, in the vicinity of the proposed construction, is uninhabitable by aquatic and semiaquatic biota because of the high water temperatures from reactor operations.

F.2.1.2 Operational Impacts

Water Resources

The principal direct impact to water resources in Pen Branch floodplain/ wetlands during operation would be on water quality. A positive impact would
BC-4 be that water temperatures at the outfall would be reduced from a maximum of 75°C to 30°C in the summer, only 3°C above projected ambient temperatures. In the winter, the discharge temperature would decrease even

more to approximately 26°C (12°C above ambient creek temperature). Lower water temperatures would improve water quality by increasing the dissolved oxygen concentration.

Operation of the once-through cooling tower would reduce both suspended solids and the sedimentation rates of the delta, a positive impact. Some erosion and sedimentation would occur. However, the sedimentation rates of the delta should decrease as plant growth becomes reestablished along the stream banks. This would be a positive impact because of the prevention of further vegetative loss caused by thermal effluents. Operations would have no measurable impact on the ability of the floodplain/wetlands to moderate floods or groundwater recharge. Stream flow would be reduced slightly from 11.3 to about 10.5 cubic meters per second, and should cause a slight reduction in suspended solids concentrations, a positive impact. Water quality and hydrology impacts are discussed in Chapter 4. BC-10 BC-19

Biological Resources

The most significant positive ecological impact would be the enhancement of wetland habitat because of diminished thermal effects of the discharges. Vegetation would become reestablished on portions of the 670 acres of affected wetlands. The vegetation loss rate in the swamp of 26 acres per year because of thermal impacts would be reduced (see Chapter 4). The reduction in stream flow could contribute to a slight reduction in canopy loss from flooding and increased sedimentation, another positive impact. BC-19

Implementation of this alternative should enhance the diversity of plant and animal life over present conditions, a positive impact. Spawning conditions for indigenous and migratory fish species would be greatly improved. Operation of the cooling tower would meet the requirements stipulated for Maximum Weekly Average Temperature (MWAT) for fish survival during a winter shutdown (EPA, 1977; Muhlbaier, 1986); this would be a positive impact. TE

Two species at SRP would be affected positively by this alternative. Because the water temperature would be well below the thermal maximum temperature tolerance of the threatened American alligator (Alligator mississippiensis; classified as "threatened due to similarity of appearance"), additional habitat for it and other aquatic species would be created. TC

Reducing the temperature below the thermal maximum for fish would allow fish to recolonize Pen Branch, a positive impact. The fluctuating water levels could concentrate fish, the principal prey of the endangered wood stork (Mycteria americana). This would be a positive impact because loss of foraging habitat has contributed to the decline of the wood stork (Du Pont, 1985). TE

Based on formal consultation between the U.S. Fish and Wildlife Service (FWS) and DOE on the American alligator, red-cockaded woodpecker, and wood stork, FWS has issued a biological opinion of "no effect" if DOE implements the preferred alternatives (Parker, 1986). TC

Because this alternative would not require any changes in the cooling water intake structures or flow rates, there would be no change in the entrainment or impingement impacts. Consultation between DOE and the National Marine

TE Fisheries Service has determined that SRP operations would have no adverse impacts on the endangered shortnose sturgeon, Acipenser brevirostrum (Oravetz, 1983). Biological impacts are discussed in Chapter 4.

TE Vegetation near the cooling tower would be subject to salt deposition attributable to drift from the tower. Cooling tower drift could cause vegetation stress, either directly by deposition of salts on the foliage or indirectly from excess accumulations of salts in the soil. Salt stress in plants could occur through various mechanisms. This stress includes: (1) increased osmotic potential of the soil solution affecting the availability of soil moisture to the plant; (2) alteration of the mineral nutrition balance in the salt tissue; and/or (3) toxic effects due to specific ion concentrations in the plants (Bernstein, 1975; Hanes, Zelazny, and Blaser, 1970; Allison, 1964; Levitt, 1980).

TE Tolerances and susceptibility to salt deposition are highly variable, depending on the plant species and other conditions in the environment. Vegetative studies indicated that thresholds for development of visible salt stress symptoms on the most sensitive species were approximately 83 kilograms (183 pounds) per acre per year of sodium chloride salt (INTERA, 1980). Studies indicate that at sodium chloride deposition rates of about 41 kilograms (90 pounds) per acre per year, agricultural productivity can be reduced (Mulchi and Armbruster, 1981).

TE The drift composition is equivalent to that of the circulating water. The concentration of substances in the circulating water for this alternative is shown in Table 3-3. The substance of particular interest with regard to its potential for damage is the chloride ion. The other constituents in the table are at low concentrations and considered negligible or are potentially beneficial.

TC The implementation of this alternative would result in an estimated total solids deposition of 0.5 kilogram (1.1 pounds) per acre per year within 2 kilometers of the cooling tower. The sodium chloride deposition rates from the cooling tower are much less than the critical values reported by Mulchi and Armbruster (1981), INTERA (1980), and NRC (1979) that can cause reduced productivity of plant species. Therefore, no significant impacts on vegetation are expected with this alternative.

F.2.2 RECIRCULATING COOLING TOWERS

F.2.2.1 Construction Impacts

Water Resources

BC The principal impacts to water resources in the Pen Branch floodplain/wetlands during construction would be similar to those for described the once-through cooling-tower alternative in Section F.2.1.1. Suspended solids because of runoff erosion should be slightly lower, and a projected 50 acres of upland habitat would be disturbed versus 25 acres for the once-through cooling-tower alternative during construction activities.

Biological Resources

Biological resource impacts would be similar to those associated with the construction of the once-through cooling tower (see Section F.2.1.1). TE

F.2.2.2 Operational Impacts

Water Resources

Implementation of this alternative would primarily affect water quality. As with the once-through cooling tower alternative, effluent temperatures would closely duplicate ambient temperatures, a positive impact. Under winter conditions, the average discharge temperature would be about 15°C, about 5°C to 7°C above the ambient stream temperature. Dissolved oxygen levels would improve if this alternative were implemented and would comply with State Class B water classification standards throughout the year, a positive impact. Nutrient concentrations would increase at the tower outfall under this alternative, but total loading (quantity) of nutrients and other chemicals transported to the swamp/river system would not increase. BC-14

Water consumption from the Savannah River would be reduced from about 11.3 cubic meters per second to about 1.7 cubic meters per second, a positive impact.

The implementation of this action would result in greater reductions in suspended solids and the sedimentation rates of the delta than the once-through alternative. The most significant reduction in sedimentation and delta growth rate impacts would be from the reduction in stream flow rates, a positive impact. Under this alternative, discharge flows would decrease from 11.3 cubic meters per second to about 0.6 cubic meter per second, and stream channel depth and width would be reduced substantially. Operations would have no measurable impact on the ability of the floodplain/wetlands to moderate floods or groundwater recharge. TE TE

Biological Impacts

The most significant ecological impact would be the enhancement of wetland habitat because of the reduced flow and thermal effects, a positive impact. Vegetation would become reestablished on about 500 acres of the thermally impacted 670 acres of wetlands and the vegetation loss rate associated with the delta growth (26 acres per year, average 1974-1984) would be substantially reduced. BC-19

Stream flows and temperatures would more closely follow ambient conditions and would facilitate plant and animal diversity over present conditions, a positive impact. Spawning conditions for indigenous and migratory fish species would be greatly improved. With discharge temperatures similar to ambient temperature, there would be no potential for cold shock during a winter reactor shutdown. Changes in flow volumes, when they occur, would be smaller than with other alternatives and would tend to minimize changes in stream morphology. This should stabilize aquatic and wetland habitats.

Two species at SRP would be affected by this alternative. The impact on the American alligator which is classified as "threatened due to similarity of appearance" should be positive (i.e., increased habitat). The decrease in water flow would allow vegetation to become reestablished over a larger area than the once-through alternative.

Fish and other vertebrates would be able to inhabit the stream channel, providing potential foraging habitat for the endangered wood stork. Fluctuations in water levels would decrease compared to those from the once-through alternative. Consequently, the potential for fish populations becoming concentrated in small pools, providing foraging habitat for the wood stork, would decrease.

Through natural vegetative succession, a large area of the impacted floodplain/wetlands should eventually return to a closed-canopy forest, thereby providing food and cover for numerous species of wildlife.

Because the rate of entrainment for fish eggs and larvae is directly proportional to the water intake flow rate, entrainment losses would be proportionally reduced (approximately 85 percent). Estimated impingement losses would also be reduced by a similar amount. Biological impacts are discussed in Chapter 4.

TC Implementation of this alternative would result in an estimated total solids deposition of about 22.7 kilograms (50 pounds) per acre per year within 0.5 kilometers. At 2 kilometers, the predicted solids deposition is calculated to be about 2.2 kilograms (5.0 pounds) per acre per year. Because the deposition rates at 2 kilometers are much less than the critical values reported (see Chapter 4), no significant impacts on vegetation are expected at or beyond this distance with this alternative.

F.2.3 NO ACTION - EXISTING SYSTEM

F.2.3.1 Operational Impacts

Water Resources

The impacts on water resources of the No-Action alternative are mostly negative. The annual average flow in Pen Branch below the K-Reactor cooling water discharge point would continue to be about 11.8 cubic meters per second, 11.3 cubic meters per second above natural stream flow. The thermal maximum temperature tolerance for most aquatic and terrestrial species would continue to be exceeded. The dissolved oxygen levels would continue to fall below minimum South Carolina water classification standards during the summer. Suspended solids and sedimentation rates for delta expansion would continue. Stream morphology has been permanently altered because of approximately 30 years of discharge at 11.3 cubic meters per second. Because of this alteration, continued operations would have little impact on the ability of the Pen Branch floodplain/wetlands to moderate floods. Continued operations would have little impact on the ability of the swamp floodplain/wetlands adjacent to Pen Branch to moderate floods because this is controlled by the Savannah River (483 cubic meters per second of flow during flood stage). Groundwater recharge in this area is primarily controlled by the Savannah River. Water quality and hydrology impacts are discussed in Chapter 4.

Biological Resources

The impacts on biological resources of the no-action alternative are negative. The flora along the creek would continue to be sparse, reflecting the harsh temperature regime. Most aquatic invertebrates would remain absent from the creek. Fish would not be able to inhabit the creek where their thermal maximum temperature tolerance is exceeded, and the fish fauna above the thermal discharge point would continue to be depauperate in number and diversity. Limited use by threatened and endangered species in Pen Branch would continue under existing conditions. Entrainment and impingement rates would remain at the present level. Biological impacts are discussed in more detail in Chapter 4.

F.3 FOUR MILE CREEK (C-REACTOR)

F.3.1 ONCE-THROUGH COOLING TOWER (PREFERRED ALTERNATIVE)

F.3.1.1 Construction Impacts

Water Resources

The types of construction impacts of the once-through cooling tower for C-Reactor on water resources and biological resources in Four Mile Creek would be similar to those described for K-Reactor on Pen Branch (see Section F.2.1.1 and Chapter 4).

F.3.1.2 Operational Impacts

Water Resources

The operational impacts of the once-through cooling tower for C-Reactor on water resources would be similar to those described for K-Reactor on Pen Branch (see Section F.2.1.2 and Chapter 4).

The cooling effect would be the same as that projected for Pen Branch in that temperatures would meet the 32.2°C Class B water classification standard, but would be 10°C to 13°C above ambient creek temperature at the point of discharge during the winter. BC-14

Biological Resources

Operational impacts of the once-through cooling tower for C-Reactor on biological resources would be similar to those described for K-Reactor (see Section F.2.1.2 and Chapter 4). Vegetation would become reestablished on portions of the 1147 acres of affected wetlands, and the vegetation loss rate in the swamp of 28 acres per year due to thermal impacts would be reduced, a positive impact. BC-19 The implementation of this alternative would further enhance foraging habitat for wood storks, a positive impact. The cooling tower would be designed and operated to meet the requirements stipulated for MWAT for fish survival during a winter shutdown (EPA, 1977; Muhlbaier, 1986); this would be a positive impact.

Deposition of cooling tower drift would be similar to that projected for the once-through cooling tower alternative for K-Reactor [i.e., 0.5 kilogram (1.1 pounds) per acre per year within 2 kilometers]. Because these deposition rates are much less than the critical values (see Chapter 4), there would be no impacts on vegetation with this alternative.

F.3.2 RECIRCULATING COOLING TOWERS

F.3.2.1 Construction Impacts

Water Resources

The construction impacts of recirculating cooling towers for C-Reactor on water resources and biological resources would be similar to those described for K-Reactor on Pen Branch (see Section F.2.3.1). Sedimentation runoff
BC-19 impacts should be similar (short-term) because projected disturbances (60 acres) approximate those for the K-Reactor recirculating cooling tower (50 acres).

F.3.2.2 Operational Impacts

The operational impacts of recirculating cooling towers for C-Reactor on water resources and biological resources would be similar to those described for
BC-19 K-Reactor on Pen Branch (see Section F.2.2.2 and Chapter 4). It is estimated that approximately 1000 acres of the thermally impacted 1147 acres of wetland vegetation would become reestablished, a positive impact.

The implementation of this alternative would result in an estimated total sol-
TC ids deposition of 2.2 kilograms (4.8 pounds) per acre per year within 2.0 kilometers of the cooling towers. Because this rate at 2 kilometers is much less than the critical threshold values reported that can cause reduced productivity of plant species (see Section F.2.1.2 and Chapter 4), no significant impacts on vegetation are expected with this alternative.

F.3.3 NO ACTION - EXISTING SYSTEM

F.3.3.1 Operational Impacts

The operational impacts of the no-action alternative on water resources and biological resources are similar to those described for K-Reactor on Pen Branch (see Section F.2.3 and Chapter 4).

F.4 BEAVER DAM CREEK (D-AREA POWERHOUSE)

F.4.1 INCREASED FLOW WITH MIXING (PREFERRED ALTERNATIVE)

F.4.1.1 Construction Impacts

Existing structures would be used for increasing flow. Consequently, there would be no construction or short-term impacts associated with this alternative.

F.4.1.2 Operational Impacts

Water Resources

Water quality monitoring studies have shown that temperature is the only Class B water classification standard not currently being met and that the thermal limits are exceeded only during the late spring and summer months (Du Pont, 1985). During summer extremes, discharges to the creek presently range from 32°C to 34°C. Implementation of this alternative would reduce these effluent temperatures sufficiently to meet State Class B water classification standards. Potential impacts that could occur include small increases in stream suspended solids caused by intermittently increased stream flow (i.e., increases in flow with average increments from 2.7 cubic meters per second to 4.0 cubic meters per second), depending on the number of additional pumps needed to meet temperature requirements (see Chapter 2). Operations under this alternative would have little impact on the ability of the floodplain/wetlands to moderate floods or groundwater recharge, because these activities are predominantly influenced by the Savannah River (Du Pont, 1985). BC-14 BC-10

Biological Resources

Mean water temperatures at the mouth of Beaver Dam Creek would be about 4°C and 1°C above ambient creek temperatures in the spring and summer, respectively. Water temperatures would be about 7°C above ambient during the winter. Increased flow during the spring and summer months would increase aquatic habitat and should increase the abundance and diversity of fish and macroinvertebrates. However, wildlife habitat would be temporarily reduced during periods of increased pumping. BC-14

The increased flow would cause temporary increases in stream channel erosion and would increase siltation. This increased siltation would generally occur after peak spawning in May and June. However, during some years increased flow could be required as early as May or June, a potentially negative impact. Any increase in vegetation loss due to delta growth should be minimal and offset by vegetation reestablishment and succession on previously impacted thermal areas. A reversal in the pattern of the canopy loss is already being observed. It is thought this pattern is because of a reduction in effluent temperatures that began in 1978 and has continued (Du Pont, 1985).

The alligator, which is classified as "threatened due to similarity of appearance," and the endangered wood stork could be affected by this alternative. The Beaver Dam Creek area supports a large population of alligators, and the mild thermal effluent during the winter probably enhances the survivability of juvenile alligators. Implementation of this alternative would have no impact on winter thermal effluent. Therefore, it should have no impact on winter alligator populations. Intermittently increased flows during the spring and summer would cause the water level in Beaver Dam Creek to alternately rise and fall 12 to 19 centimeters (see Chapter 4). Water-level increases less than or equal to 35 centimeters are not expected to affect alligator nesting sites (Specht, 1985). TC

Wood storks frequently forage in the Beaver Dam Creek swamp, although feeding habitat is marginal quality when compared to other areas at SRP (Du Pont, 1985). An increase in water levels of 12 to 19 centimeters could be too deep at times for foraging activities. Conversely, increased water levels could prevent or delay potential foraging areas from drying up during droughts because the Beaver Dam Creek foraging sites are not associated with the more permanent wetlands found along primary and secondary creeks.

Entrainment losses would be approximately 2.0 x 10^6 fish eggs and larvae if this alternative were implemented. Entrainment of the eggs and larvae of the
BD-5 endangered shortnose sturgeon should not occur. This is due to the demersal and adhesive nature of their eggs, as well as to the time of year shortnose sturgeon spawn (February-March). Fish impingement on the 5G intake screens would increase by 113 fish per year or to 1831 total fish per year. Biological impacts are discussed in Chapter 4 and Appendix C.

F.4.2 DIRECT DISCHARGE TO SAVANNAH RIVER

F.4.2.1 Direct Impacts to Floodplains/Wetlands and Practicable Alternatives

Implementation of this alternative would temporarily disturb approximately 1 acre of floodplain/wetlands during construction. The overall operational impact would be to return Beaver Dam Creek to its approximate original status as an intermittent stream. Implementing this action would reduce floodplain/wetland values because current operations enhance certain wildlife values (see Section F.4.3.1 and Chapter 4).

An alternative action that would achieve the intended thermal performance standards but would minimize harm to or within the floodplain/wetlands is described in Section F.4.1; the no-action alternative is described in Section F.4.3. Because public access to and use of SRP are strictly controlled, no individual or private property would be affected by this alternative. In addition, no impact would directly or indirectly support floodplain development. Neither would there be an impact on cultural resources, agriculture, aquaculture, nor forestry resources as they relate to floodplain values.

F.4.2.2 Construction Impacts

Water Resources

The principal direct impact to water resources in the Beaver Dam Creek floodplain/wetlands during construction would be on water quality. A pipeline would be constructed parallel to the existing intake pipe. This pipeline would run from the D-Area powerhouse across the Beaver Dam Creek swamp to a discharge point on the Savannah River below the cooling water intake structure. The pipeline would cross approximately 1 acre of floodplain/wetlands. The construction activities would result in a temporary increase in turbidity and suspended solids. Construction impacts would have no measurable effect on groundwater recharge or on the ability of floodplain/wetlands to moderate floods.

Biological Resources

The principal indirect impact would be from sediment loading on fish and
TE micro-invertebrates in Beaver Dam Creek. When construction activities cease, suspended solids levels should return quickly to ambient conditions. Wildlife

might be disturbed by the noise associated with construction activities. This disturbance is short-term and noncumulative. TE

F.4.2.3 Operational Impacts

Water Resources

The principal direct impact to water resources in the Beaver Dam Creek floodplain/wetlands would be to the decrease in stream flow from the present average of 2.7 cubic meters per second to only 0.2 cubic meter per second. Beaver Dam Creek and the adjacent swamp would essentially return to their approximate original conditions, a wetland with an intermittent stream. Periodic flooding would depend entirely on natural flooding from the Savannah River and storm runoff after rains. Based on pump test data (Specht, 1985), any flooding of Beaver Dam Creek because of storm runoff would have a short duration. The water level in Beaver Dam Creek swamp would return to its original level approximately 24 hours after the rainfall stopped.

Biological Resources

The most significant ecological impact would be a loss of nesting and foraging habitat for wildlife. The implementation of this alternative would decrease or eliminate nesting habitat for the American alligator and any thermal refugia that might have existed during the winter months. Foraging habitat for the wood stork would be significantly decreased or eliminated. Beaver Dam Creek would return to its approximate original condition as an intermittent stream (Moyer, 1985), thus negatively impacting aquatic organisms.

Because the thermal effluent would be pumped directly to the Savannah River, there would be a small thermal plume at the outfall structure. Because of the small volume of mildly thermal effluent and the large volume of ambient river water, there would be no thermal impact outside the mixing zone. There would be a large zone of passage for all fish species, including the endangered shortnose sturgeon. There would be no impact on the shortnose sturgeon from entrainment and impingement with implementation of this alternative. TE

F.4.3 NO ACTION - EXISTING SYSTEM

F.4.3.1 Operational Impacts

Water Resources

The flow of 2.7 cubic meters per second would continue. Water temperatures in the creek and delta could reach 34°C under extreme summer conditions. BC-14 Concentrations of dissolved oxygen would be somewhat lower than those in unimpacted streams. Continued operations would have no measurable impact on the ability of the floodplain wetlands to moderate floods or groundwater recharge. Water resource impacts are discussed in Chapter 4.

Biological Resources

The aquatic and terrestrial ecology of the creek would continue to be affected by the thermal effluent but to a much lesser extent than that of Pen Branch or

Four Mile Creek. Portions of Beaver Dam Creek would continue to show evidence of revegetation and succession due to a slight decline in water temperatures that began in the 1970s. The area around the creek would continue to provide habitat for a dense population of alligators and foraging habitat for the wood stork.

REFERENCES

Allison, L. E., 1964. "Salinity in Relation to Irrigation," Advances in Agronomy, Vol. 16, pp. 139-180.

Bernstein, L., 1975. "Effects of Salinity and Sodicity on Plant Growth," Annual Review of Phytopathology, Vol. 13, pp. 295-312.

Du Pont (E. I. du Pont de Nemours and Company), 1985. Comprehensive Cooling Water Study - Annual Report, DP-1697, Volumes 1-11, J. B. Gladden, M. W. Lower, H. E. Mackey, W. L. Specht, and E. W. Wilde (editors), Savannah River Plant, Aiken, South Carolina.

EPA (U.S. Environmental Protection Agency), 1977. Temperature Criteria for Freshwater Fish: Protocol and Procedures, EPA-600/3-77-061, Duluth, Minnesota.

Hanes, R. E., L. W. Zelazny, and R. E. Blaser, 1970. Effects of Deicing Salts on Water Quality and Biota, National Cooperative Highway Research Program Report 91, Highway Research Board, National Academy of Sciences, Washington, D.C.

INTERA Environmental Consultants, Inc., 1980. Remote Sensing for the Detection and Monitoring of Salt Stress on Vegetation: Evaluations and Guidelines, Nuclear Regulatory Commission report NUREG/CR-1231.

Levitt, J., 1980. Responses of Plants to Environmental Stresses, Academic Press, New York.

Moyer, R. A., 1985. "Direct Discharge D-Area Cooling Water to Savannah River." Letter to O. M. Morris, E. I. du Pont de Nemours and Company, Savannah River Laboratory, Aiken, South Carolina.

Muhlbaier, D. B., 1986. "Thermal Mitigation Project - Cooling Tower Design to Prevent Cold Shock to Fish," letter to R. A. Moyer, E. I. du Pont de Nemours and Company, Savannah River Plant, Aiken, South Carolina.

Mulchi, C. L., and J. A. Armbruster, 1981. "Response of Corn and Soybean to Simulated Saline Aerosol Drift from Brackish Water Cooling Towers," Journal of Environmental Quality, Vol. 10, pp. 541-547.

Oravetz, C. A., (Chief, Protected Species Branch, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Administration), 1983. Letter to M. J. Sires, Assistant Manager, Health, Safety and Environment, U.S. Department of Energy, Savannah River Operations Office, F/SERV 23:AM:CF, St. Petersburg, Florida.

Parker, W. T. (Field Supervisor, Endangered Species Field Station, Fish and Wildlife Service, U.S. Department of the Interior), 1986. Letter to C. G. Halsted (Assistant Manager, Health, Safety, and Environment, U.S. Department of Energy, Savannah River Operations Office), Log No. 4-2-86-204, Asheville, North Carolina.