CHAPTER 3

3. RESOURCES AND ENVIRONMENTAL IMPACTS

3.1. Introduction

3.1.1. Scope of Environmental Issues

The SCR or NO_xTech systems would physically be a minor addition to an expansive heavy industrial facility having a significant property buffer area. The plant areas proposed for installation of the SCR reactors or NO_xTech equipment, ammonia storage and unloading area, interconnecting ammonia and service water piping, electrical conduits, retention basin, wastewater piping, construction staging area, and temporary or permanent office building, and activities associated with implementation of the potential mitigation have been heavily disturbed by previous plant development activities. Modifications to the existing barge unloading area are not expected to disturb the riverbank below the high-water mark. As a result, the potential would be small for on-site construction impacts to terrestrial ecology, aquatic ecology, land use, air quality, visual aesthetics, and archaeological and historic resources.

Operational impacts are primarily dependent on the engineering features and safeguards of the proposed SCR or NO_xTech systems. These features and safeguards would control the probability and extent of accidental or unintentional releases of anhydrous or aqueous ammonia to the environment. Dependent upon the alternative, these potential releases and attendant impacts would be as listed below.

- Excessive ammonia slip passing through could result in ammonia contamination of the APH wash causing potential algal growth, pH control problems, toxicity, or odor problems with water flowing into Ash Pond 4. If the capacity of Ash Pond 4 to assimilate this ammonia loading were compromised, effluent from Ash Pond 4 could adversely impact Cane Creek and the Tennessee River.

- Additionally, fly ash could become contaminated with ammonia, and storm water runoff from the dry ash stacking area could leach ammonia into the dry stack runoff pond (stilling pool). Preliminary design calculations show potential for unacceptably high ammonia concentrations in the storm water runoff from the dry ash stacking area. These concentrations, if not mitigated, could result in effluent toxicity, pH control problems, increased nutrient loadings, increased biochemical oxygen demand, or odor problems in the storm water effluent from the dry stack runoff pond.

- Accidental releases of anhydrous ammonia to the air from the storage and unloading system or truck causing a potential hazard to plant operating personnel, the public, and the environment.

- Direct accidental releases of anhydrous ammonia or aqueous ammonia to surface water causing damage to aquatic life.

A number of assumptions concerning the proposed SCR and NO_xTech systems and their operations are necessary to establish the basis for analyzing the potential environmental impacts of the proposed action. These assumptions are summarized here and addressed in more detail as appropriate in subsequent sections analyzing specific resource areas.

Some of these assumptions and other measures are also environmental commitments listed in Section 2.6.

3.1.2. Design Construction, and Operational Assumptions

SCR Reactor

1. A 90 percent NO_x removal rate would be achieved throughout the life of the system.

2. The SCRs would operate as needed to meet air quality requirements. Although the SCRs are designed for year-round operation, their operation during the ozone season of May through September is expected to be adequate to address the concerns for ambient air quality with respect to ozone. To be appropriately conservative, analyses in this EA assume constant year-round operation, in case future ambient air quality concerns require operation in this mode.

3. An ammonia slip of 2 ppm would not be exceeded during normal operation of SCRs.

4. Catalyst disposal would be managed by a catalyst contractor in compliance with applicable regulations.

NO_xTech System

1. The NO_xTech system would operate as needed to meet air quality requirements. Although the NO_xTech system is designed for year-round operation, its operation during the ozone season of May through September is expected to be adequate to address the concerns for ambient air quality with respect to ozone. To be appropriately conservative, analyses in this EA assume constant year-round operation, in case future ambient air quality concerns require operation in this mode.

2. An ammonia slip of 5 ppm would not be exceeded during normal operation.

Anhydrous Ammonia System

1. Two 18,000-gallon (nominal) storage tanks would be installed for the SCR Unit 5 only installation (Alternative A). For SCR installation for Units 1 through 5 (Alternative B), four 18,000-gallon tanks would be installed. For the hybrid NO_xTech/SCR installation (Alternative C), as many as six 18,000-gallon tanks would be installed.

2. A water fogging system with both automatic and manual activation would protect both the storage tanks and the truck off-loading area by limiting the hazard from large ammonia leaks or catastrophic tank failure.

3. The proposed ammonia unloading and storage area would drain to a spill retention basin sized to accommodate complete failure of one of the 18,000 gallon tanks, the aqueous ammonia generated by operation of the fogging system, and the 10-year, 24-hour rain event. At a minimum, the ammonia storage and handling area emergency spill retention basin would be lined with compacted in-situ earth or clay liner. Storm water accumulations in the spill retention basin would be sampled after rain events, and then allowed to drain to Ash Pond 4 in accordance with the storm water permit requirements issued by ADEM.

4. The applicable chemical accident prevention measures required under 40 CFR 68 would be implemented prior to filling of the anhydrous ammonia storage system or receipt of ammonia in quantities exceeding 10,000 lbs.

5. Appropriate personal protective equipment (respirator, self-contained breathing apparatus, protective clothing) and training would be provided to operating personnel consistent with Occupational Safety and Health Administration (OSHA) regulations.

3.2. Air Quality

3.2.1. Resource Description

The air quality in the vicinity of COF is generally good, with the area in compliance with all air quality standards. Regionally, air quality is also generally good. For some urban areas, however, attainment of the 1-hour ozone standard has been difficult. The nearest areas with 1-hour ozone attainment issues are Nashville, Memphis, and Birmingham. These areas, in addition to others, could experience periods when ozone levels will be above the recently adopted 8-hour ozone standard of 80 parts per billion (ppb). In addition, some areas—including Colbert County—could experience periods when fine particulate concentrations will be above the recently adopted annual $PM_{2.5}$ standard.

3.2.2. Impacts of No Action

Under the No Action Alternative, current air quality in the vicinity of COF is expected to continue.

3.2.3. Construction Impacts

Under the Action Alternatives, transient air pollutant emissions would occur during the construction phase of this project. Since the COF site has already been developed as an industrial site, construction-related emissions would be relatively less than for a new site. Construction-related air quality impacts are primarily related to land clearing, site preparation, and the operation of internal combustion engines.

Vehicle Emissions and Excavation Dust

Land clearing, site preparation, and vehicular traffic over unpaved roads and construction sites result in the emission of fugitive dust particulate matter (PM) during site preparation and active construction periods. The largest size fraction (greater than 95 percent by weight) of fugitive dust emissions would be deposited within the construction site boundaries. The remaining fraction of PM would be subject to longer-range transport. If necessary, open construction areas and unpaved roads would be sprinkled with water to reduce fugitive dust emissions by as much as 50 percent.

Combustion of gasoline and diesel fuel by internal combustion engines (vehicles, generators, construction equipment, etc.) would generate local emissions of PM, NO_x, carbon monoxide, volatile organic compounds (VOCs), and SO_2 throughout the site preparation and construction period. The total amount of these emissions would be small and would result in minimal off-site impacts.

Air quality impacts from construction activities would be temporary and dependent on both man-made factors (e.g., intensity of activity, control measures, etc.) and natural factors (e.g., wind speed, wind direction, soil moisture, etc.). However, even under unusually adverse conditions, these emissions would have, at most, a minor, transient impact on off-site air quality that should not exceed or violate any applicable ambient air quality standard. Overall, the air quality impact of construction-related activities for the project would not be significant.

3.2.4. Plant Vicinity Operational Impacts

Operation of the SCR for either of the options under consideration would not adversely impact local air quality. There would be the possibility, however, of slight increases in ammonia concentrations downwind of the plant site. This possibility is discussed below. Overall, SCR operation would improve air quality.

Ozone Scavenging Losses

Ozone concentrations below background levels occur immediately downwind of NO_x sources, such as power plants, due to ozone scavenging, i.e., NO emissions consuming ozone. Significant ozone production does not occur until 20 to 80 kilometers (km) (12.4 to 49.7 miles) downwind of the NO_x source. The reduction of NO_x emissions may reduce the size of the area in which ozone scavenging occurs. While ozone concentrations may increase in areas previously affected by ozone scavenging, they are not expected to increase above background ozone levels.

Plume Opacity and Plume Blight

Plume opacity is determined by the amount of NO_x and PM emitted. Due to the optical properties of NO_x and fine particulate, these pollutants tend to give a plume a slight reddish-brown color when viewed against a clear sky. Since the SCR would greatly reduce NO_x emissions, it is also expected to reduce plume opacity and plume blight. There is a possibility that SCR operation would be accompanied by an increase in SO_3 emissions, which could result in some offset of the plume visibility improvements due to NO_x reduction. Since there is little experience with SCR on large utility boilers, quantification of this potential increase in SO_3 emissions is not possible. The potential exists, however, for minor increases in plume visibility and plume blight under some meteorological and operational conditions.

3.2.5. Regional Operational Impacts

Introduction

The primary purpose of the SCR installation is to reduce emissions of NO_x, a pollutant that can, in combination with VOCs and sunlight, lead to the production of ozone. The purpose of this section is to describe the nature of ozone and the impacts that reducing NO_x emissions from COF would have on ambient ozone levels. In addition, the potential impact of the SCR operation on secondary particulate formation and regional haze is described.

Ozone

Ozone forms in the atmosphere as a result of a mixture of NO_x and VOCs being exposed to sunlight. Both NO_x and VOCs have natural and anthropogenic (man-made) emissions sources. For example, isoprene (a VOC important in ozone formation) is primarily emitted from trees and crops. Other VOCs, however, are emitted into the atmosphere as the consequence of human activity, such as the use of solvents or the operation of motor vehicles. While there are also natural sources of NO_x, they are relatively small compared to the NO_x emitted from motor vehicles and other forms of fuel combustion. Since large utility boilers burn large quantities of fossil fuel, they are a major source of the NO_x emitted into the atmosphere.

Ozone levels in the TVA region have historically been less than the NAAQS (with the exception of a few urban centers). With the recent revision of the ozone standard from a 1-hour average concentration of 120 ppb to an 8-hour average concentration of 80 ppb, more areas in the TVA region are expected to experience ozone concentrations exceeding the standard. Furthermore, it is anticipated that a number of urban areas—even some remote, rural areas in the Appalachian Mountains—which barely met the former 1-hour standard will experience ozone concentrations above the 8-hour standard.

Although it is not possible to quantify the change in ambient ozone concentration (or the frequency of that change) at a specific place due to NO_x emission reductions at COF, it is known from previous modeling and air quality research that the overall effect would be to reduce the amount of ozone produced in the atmosphere. It is also known that the area that would benefit the most would be the area within about 150 km (93.2 miles) downwind from COF.

Secondary Particulate and PM_{10}/$PM_{2.5}$

Operation of an SCR requires the use of ammonia. Although almost all of the ammonia is chemically converted to nitrogen and water in the reactions that are responsible for the reduction in NO_x emissions, there is a possibility that some ammonia would be emitted from the stack. Since ammonia is associated with the formation of particulate in the atmosphere, any ammonia that is emitted has the potential to result in the formation of additional atmospheric particulate. Therefore, allowing ammonia to slip through the system without reacting can lead to the formation of particulate leading to a slight increase in the atmospheric particulate burden. The potential for a small increase in particulate due to ammonia emissions would be more than offset by the decrease in particulate due to NO_x reductions associated with SCR operation (NO_x is a source of secondary particulate).

3.2.6. Cumulative Impacts to Air Quality

Introduction—TVA's Proposed NO_x Control Strategy

TVA has installed, is in the process of installing, or is considering the installation of additional NO_x controls, using SCR technology, at up to six other coal-fired power plants (Allen, Bull Run, Cumberland, Kingston, Paradise, and Widows Creek). Table 3 lists all units being considered including the proposed action at COF. This strategy, which goes beyond current regulatory requirements, would reduce TVA coal-fired power plant NO_x emissions by 75,000 metric tons (83,000 tons) during the ozone season (May to September) beginning in 2005. When combined with other controls already planned to meet the acid rain requirements under the CAA Title IV, the total NO_x reduction during the 2005 ozone season will be 166,000 metric tons (183,000 tons). To meet Title IV requirements, low-NO_x burners have already been installed on 34 TVA boilers; staged over-fire air has been installed on six units; and combustion optimization has been installed on an additional 18 units. The controls would reduce TVA's seasonal NO_x emissions roughly 73 percent below 1990 levels.

Table 3. TVA Fossil Plant Units Planned for Installation of SCR Systems

Unit	State	Generation Capacity (MW)	Year Installed or Estimated to be Completed
Paradise 2	Kentucky	704	2000
Paradise 1	Kentucky	704	2001
Paradise 3	Kentucky	1,050	2003
Allen 2	Tennessee	330	2002
Allen 3	Tennessee	330	2002
Allen 1	Tennessee	330	2003
Widows Creek 7	Alabama	575	2003
Widows Creek 8	Alabama	550	2004
Cumberland 2	Tennessee	1,300	2004
Cumberland 1	Tennessee	1,300	2003
Bull Run	Tennessee	950	2003
Kingston 1-4, 7-8	Tennessee	1,300	2004
Kingston 5-6	Tennessee	400	2005
Colbert 5	Alabama	500	2004
Colbert 1-4	Alabama	800	2005

Because the SCR installations listed in Table 2 would satisfy most if not all of TVA's requirements, there are currently no plans to install SCR systems at other units at Johnsonville, Widows Creek Units 1-6, Gallatin, John Sevier, and Shawnee Fossil Plants. NO_x reduction from these units using SCR systems is more costly and produces less significant environmental benefit than the units identified in Table 2.

The new controls would help reduce local and regional ozone levels, and would help prevent violations of the new more stringent 8-hour ozone standard that was promulgated by USEPA in 1997. The strategy is also consistent with the types of controls that would be needed to comply with USEPA's proposed rule for ozone transport, known as the ozone transport State Implementation Plan call.

NO_x emitted into the atmosphere leads to the formation of ozone and fine particulate and contributes to increased acidity of precipitation. Thus, the cumulative impact on air quality (due to a reduction in NO_x emissions) would be beneficial.

Ozone Reduction

Precise quantification of ozone changes due to the proposed action is not practical or possible due to daily variations in meteorology and operating conditions. It is possible, however, to assess the overall impact of the proposed action in combination with anticipated NO_x reductions at other TVA fossil plants. This assessment is possible by comparing the results of photochemical modeling performed with and without consideration of TVA's overall NO_x reduction strategy. Specifically, modeling was performed as part of the effort of OTAG's work that considered the NO_x and VOC emissions in the eastern half of the United States (U.S.) projected to the year 2007. Photochemical modeling was performed with the OTAG emissions databases modified to reflect the effect of TVA's NO_x strategy. Although modeling was limited to a single 10-day episode in 1995, the results are illustrative of the effect of TVA's NO_x reduction strategy on atmospheric ozone. Within Alabama, Kentucky, and Tennessee, the modeling indicated that TVA's NO_x reduction strategy would decrease the overall peak 1-hour ozone in the ambient atmosphere by 2, 4, and 4 percent, respectively, and the peak 8-hour ozone burden would be decreased by 2, 3, and 4 percent, respectively. It is important to note that the modeling did not account for additional NO_x emission reductions that are likely to occur from other utilities as a consequence of recent USEPA action establishing statewide NO_x budgets in the eastern states.

3.3. Ammonia Storage and Handling Safety

3.3.1. Introduction

Anhydrous ammonia is 99.5 percent commercial grade ammonia (with 0.5 percent water) as compared to aqueous ammonia, which is a solution of ammonia and water. A saturated aqueous ammonia solution is 47 percent ammonia by weight at 32°F and at atmospheric pressure (by comparison, household ammonia is a 5 percent solution). Anhydrous ammonia is very volatile and boils at –33.5 degrees Celsius (°C) under atmospheric pressure. Anhydrous ammonia must be pressurized or refrigerated to be maintained as a liquid. Air mixtures of ammonia are difficult to ignite. The auto ignition temperature is 650°C. The lower explosive level is 16 percent by volume, and the upper explosive level is 27 percent by volume. The reportable quantity under the Comprehensive Environmental Responsibility, Compensation, and Liability Act for release of ammonia is 100 lbs.

A typical material safety data sheet (MSDS) for anhydrous ammonia is given in Appendix A. Excerpts from the MSDS concerning the acute and chronic health hazards are as follows:

> *Inhalation: Vapor may cause irritation to the respiratory tract. High atmospheric concentrations in excess of the occupational exposure limit may cause injury to the mucous membranes. Fluid build up on the lung (pulmonary edema) may occur up to 48 hours after exposure to extremely high levels and could prove fatal. The onset of the respiratory symptoms may be delayed for several hours after exposure.*
>
> *Skin Contact: High concentrations of vapor may cause irritation. By rapid evaporation, the liquid may cause frostbite.*
>
> *Eye Contact: The vapor is an irritant, but the liquid is a severe irritant. Liquid splashes or spray may cause freeze burns. May cause severe damage if eye is not immediately irrigated. The full effect may occur after several days.*
>
> *Ingestion: Will cause corrosion of and damage to the gastrointestinal tract.*
>
> *Long-term Exposure: This material has been in use for many years with no evidence of adverse effects.*

Air concentration thresholds have been established for ammonia as guides for purposes of monitoring short-term and long-term occupational exposure, and for the purpose of emergency planning. These threshold concentration values for ammonia vapor, their application, and the reference guideline, standard, or regulation are listed in Table 4.

Table 4. Ammonia Concentration Limits

Concentration	Application	Reference
25 ppm (17.75 mg/m^3)	Recommended exposure limit for 10-hour work day during a 40-hour work week	NIOSH Guide and ACGIH
35 ppm (24.85 mg/m^3)	Short-term exposure limit not to be exceeded in a 15-minute period	NIOSH Guide and ACGIH
50 ppm (35.5 mg/m^3)	Permissible exposure limit	OSHA
197 ppm (140 mg/m^3)	The concentration that defines the endpoint for a hazard assessment of off-site consequences	40 CFR 68
500 ppm (355 mg/m^3)	Concentration that is immediately dangerous to life or health for a worker without a respirator with an exposure time greater than 30 minutes	NIOSH Guide and ACGIH

ppm = Parts per million
mg/m^3 = Milligrams per cubic meter
NIOSH = National Institute for Occupational Safety and Health
ACGIH = American Conference of Governmental Industrial Hygienists
OSHA = Occupational Safety and Health Administration
CFR = Code of Federal Regulations

The toxic endpoint concentration for ammonia, based on Emergency Response Planning Guideline 2 is 197 ppm (140 mg/m^3 [milligrams per cubic meter] or 0.14 milligrams per liter [mg/L]). It was developed by the American Industrial Hygiene Association and is defined as the maximum airborne concentration below which nearly all individuals can be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.

3.3.2. Anhydrous Ammonia Safety

The storage and handling of anhydrous ammonia in large quantities is a potentially significant hazard. This requires attention to the engineered features, control and mitigation safeguards, and operating procedures and training for plant personnel. Applicable guidelines, standards, and regulations related to the use of anhydrous ammonia are listed below.

- American National Standard Institute Standard K61.1 (Compressed Gas Association [CGA] Standard G-2.1)— Storage and Handling of Anhydrous Ammonia
- 29 CFR 1910.38—Employee Emergency Plans and Fire Protection Plans
- 29 CFR 1910.111—Storage and Handling of Anhydrous Ammonia
- 29 CFR 1910.119—Process Safety Management of Highly Hazardous Chemicals
- 29 CFR 1910.1000—Air Contaminants

- 40 CFR 68—Chemical Accident Prevention Provisions
- Pocket Guide to Chemical Hazards—National Institute for Occupational Safety and Health (NIOSH)
- Threshold Limit Values for Chemical Substances—American Conference of Governmental Industrial Hygienists (ACGIH)
- Emergency Response Guidebook—U.S. Department of Transportation

The applicability of standards and regulations are generally triggered by the quantity of ammonia stored. These quantities are called threshold quantities and are listed in Table 5.

Table 5. Regulatory Threshold Quantities for Ammonia

Chemical	Threshold Quantity	Federal Regulation
Anhydrous Ammonia	10,000 lbs	40 CFR 68
Aqueous Ammonia >20%	10,000 lbs	40 CFR 68
Anhydrous Ammonia	10,000 lbs	29 CFR 1910.119
Aqueous Ammonia >44%	15,000 lbs	29 CFR 1910.119

The proposed minimum storage quantity for the COF SCR systems (36,000 gallons or 173,930 lbs) would exceed threshold quantities. In addition to on-site storage, anhydrous ammonia must be transported to the plant site to replenish system storage. The use of trucks with a capacity of 27,249 liters (7,200 gallons) would be the mode of transportation.

3.3.3. Risk Factors

The risk and potential severity of an ammonia storage or handling accident would be influenced by a number of factors including:

- Design of the ammonia storage and handling facility including engineered features and safeguards, and the quantity of ammonia stored.
- Truck transportation for ammonia deliveries and the frequency of deliveries (see Section 3.18).
- Procedures for normal operations.
- Training of operations personnel for normal operations and emergency response.
- Population distribution in the plant vicinity.
- Emergency planning and response procedures.

- Probability of events, such as earthquakes and tornadoes, that could initiate a worst-case release.

3.3.4. Engineered Features and Safeguards

Properly engineered features and safeguards as well as adequate operating and maintenance procedures and training should make accidents unlikely and limit their consequences. Adherence to standards such as CGA G-2.1 or OSHA 29 CFR 1910.111 can result in safe equipment design. Compliance with 40 CFR 68 and 29 CFR 1910.119 ensures proper hazard assessment, operating procedures, employee training, and emergency planning have been provided.

A primary feature for limiting the potential hazard from an ammonia leak would be a water deluge (fogging) system with both automatic and manual actuation to protect both the storage tank area and unloading area. A deluge system applies a fog blanket of small water droplets to wash ammonia vapor from the air, combining with the ammonia to form liquid aqueous ammonia, which would drain to the ammonia storage area emergency spill retention pond and then to Ash Pond 4. As discussed in the Wastewater and Groundwater Quality Sections (3.14 and 3.16) below, preliminary site evaluations indicate that the emergency spill retention pond would at a minimum be lined with clay or compacted in-situ soil and that the assimilative capacity of Ash Pond 4 would be adequate to treat worst-case scenario tank failure and fogging system water. This would prevent uncontrolled discharge of aqueous ammonia to surface waters, which would kill aquatic life.

To be effective, a deluge system must, at a minimum, deliver a uniform spray of fine droplets over the surface of an ammonia spill at a rate that exceeds the mass transfer (boil-off) of anhydrous ammonia by a factor of at least 3.5. This accounts for the fact that a saturated aqueous ammonia solution at 100°F (summer design condition) is about 29 percent ammonia by weight. Thus, 3.5 pounds of water must be combined with each pound of ammonia vapor boiling off of a spill simply to achieve a saturated solution. The deluge system would limit the impact of an ammonia leak but may not entirely mitigate the impact on surface water of the worst-case failure of a storage tank or other catastrophic release. Because of the low probability of a worst-case failure, this impact is not considered significant.

3.4. Accidental Release of Anhydrous Ammonia

The worst-case scenarios for accidental release of ammonia would be the sudden and complete failure of a storage tank or tanker truck resulting in the release of a full tank of ammonia. A storage tank failure could result in the release of up to 18,000 gallons and a tanker truck failure could result in the release of up to 7,200 gallons of ammonia. Alternate release scenarios include events with a higher likelihood of occurrence, but much smaller volume of released ammonia. A one-fourth-inch-diameter hole in the storage tank or tanker truck, such as a rupture of a gasket or a pump seal leak, could release about 3,600 pounds of ammonia at a release rate of 120 pounds per minute for 30 minutes. A leak from a 2-inch-diameter hole in the storage tank or tanker truck, such as a transfer hose failure or sudden uncoupling, could cause a release of 2,380 pounds of ammonia at a release rate of 238 pounds per minute for 10 minutes. A leak in the supply line connecting the storage tanks to the vaporizers, caused by a 2.5-inch-diameter hole, could release 2,540 pounds of ammonia at a rate of 254 pounds per minute for 10 minutes. The duration of these tank leaks and process line leaks are based on the assumed time required for employees to isolate and contain the leak.

Catastrophic releases of ammonia, such as by storage tank failure or tanker truck failure, could be caused by a major earthquake or a tornado. To judge the risk of these accidents, the probability of major earthquakes and tornadoes were evaluated.

3.4.1. Evaluation of Seismic Hazard

COF is located within the Highland Rim section of the Interior Low Plateau physiographic province (Szabo, et al., 1988). Bedrock beneath most of the COF site including the footprint for this project is the Tuscumbia Limestone of Mississippian age. The Tuscumbia Limestone is a gray, fine to coarse-grained, cross-bedded, fossiliferous limestone with layers of cherty limestone (Lindquist, et al., 1994). The Tuscumbia Limestone is underlain by residual and alluvial soils that range from 0.5 to 24 meters thick. The site lies within a karst terrain. The top of rock is an irregular surface with numerous pinnacles and swales caused by differential weathering of the underlying Tuscumbia Limestone (Lindquist, et al., 1994).

The rock layers beneath the site are essentially flat. No significant faulting has been noted at the site; however, fractures are common within the Tuscumbia Limestone. Most of these fractures have horizontal orientations. An evaluation (Lindquist, et al., 1994) of non-horizontal joints and photo lineaments revealed a pattern of two major joint orientations: (1) N40°W to N50°W, and (2) N40°E to N50°E.

The primary source of earthquake hazard to the COF site is the New Madrid Seismic Zone (NMSZ) in the central Mississippi Valley. The main segments of the NMSZ are outlined by concentrations of earthquakes along the Blytheville Arch in northeastern Arkansas and by a heavy concentration of seismicity in northwestern Tennessee and southeastern Missouri. The NMSZ has produced damaging earthquakes in historical time including at least three earthquakes estimated to have had moment magnitudes of 8.0 or greater in the 1811-12 sequence (Johnston, et al., 1994).

Given the relatively shallow average depth to bedrock (approximately 3 to 4 meters [10-13 feet]), structures at this site will likely be founded either on shallow, firm soils or bedrock. Therefore, the effect of soils on earthquake ground motion is negligible. Assuming that structures are built away from areas underlain by liquefaction-susceptible alluvial deposits, there appears to be no possibility of earthquake-induced liquefaction affecting these structures. Portions of pipeline routes that traverse drainage areas would be more likely to encounter areas underlain by alluvial deposits.

The earthquake hazard at a site can be modeled probabilistically by considering all seismic source zones around a site and the probability that these source zones will produce earthquakes of various sizes. The United States Geological Survey (USGS) performed probabilistic seismic hazard analyses throughout the United States to prepare the 1996 national seismic hazard maps (USGS, 1996). The USGS's analysis assumes that foundation conditions correspond to National Earthquake Hazard Reduction Program B-C site conditions. The hardest rock conditions are category A and the softest soils fall in category F on this scale.

Table 6 presents the USGS's seismic hazard values for a location (34.7°N-87.9°W) that is very near COF. The USGS expresses seismic hazard as the minimum horizontal ground motion that would be expected to occur during three time spans (return periods): 475, 950, and 2,375 years. The ground shaking is computed at four different frequencies of motion: peak ground acceleration, 5.0, 3.3, and 1.0 hertz. In the same way that the "100- or 500-

year flood" means the level of flooding expected to occur at least once during those periods of time, ground shaking return periods refer to the minimum level of ground shaking expected during the specified time. In this case, Table 6 shows that at a frequency of 1.0 hertz, the ground should shake with a force of at least 4.4 percent g once in 475 years (g is the acceleration of a falling object due to gravity). The 475-year return period is equivalent to a 1-in-10 chance that the ground shaking will be exceeded in only 50 years.

Table 6. Probabilistic Ground Motion Values

	Ground Accelerations in %g		
Ground Motion Frequency (hertz)	10% Probability of Exceedance in 50 years	5% Probability of Exceedance in 50 years	2% Probability of Exceedance in 50 years
	(475-year return period)	(950-year return period)	(2,375-year return period)
Peak Ground Acceleration	4.4	7.2	13.3
5.0	11.1	17.9	32.5
3.3	9.5	16.0	28.2
1.0	4.4	7.9	14.4

%g means that motion is measured in acceleration (length/time squared). One "g" equals 980 centimeter/sec-sec. Numbers are the percentage of 1.0 g.
Source: USGS, 1996

The earthquake hazard to ordinary buildings at the proposed project site will be addressed through adherence to the seismic provisions of the Uniform Building Code (for example, ICBO 1997). The earthquake hazard at the COF relative to other locations in the United States is low (zone 1 on a scale of 0 to 4 with 4 being highest hazard) based on the 1997 Uniform Building Code (ICBO, 1997). Special structures that house hazardous processes or sensitive equipment may require additional considerations. Storage of hazardous substances (e.g., ammonia) or transportation of such substances through underground or aboveground piping may require special designs and selective siting to address seismic hazards. Compliance with appropriate construction codes would make potential environmental impacts due to the effect of seismic activity on the ammonia storage system insignificant.

3.4.2. Evaluation of Tornado Risk

There are excellent records of the occurrence of tornadoes in populated areas of the United States. One source used for nuclear plant siting applications is *Tornado Climatology of the Contiguous United States* (Nuclear Regulatory Commission, 1986). To determine the probability of a tornado affecting COF, a study area was defined as a box of one degree of latitude by one degree of longitude containing the plant site (87°W to 88°W by 34°N to 35°N). This resulted in a study area of approximately 3,931 square miles, which is equivalent to a square with sides about 63 miles in length.

The average tornado path affects an area of 2.82 square miles (Thom, 1963). As an example, this would be equivalent to a tornado with a path width of 0.25 mile and a travel distance of 11.28 miles (0.25 mile x 11.28 miles = 2.82 square miles). For the study area, 57 tornadoes occurred during the 30-year period 1954 to 1983. This results in a tornado frequency of 1.90 tornadoes per year (57 tornadoes/30 years = 1.90). The annual probability of affecting a particular site in the study area, such as COF, may be calculated as follows:

$$\text{ANNUAL PROBABILITY} = \frac{(1.90\, tornadoes/year)\times(2.82\, square miles affected/tornado)}{(3{,}931\, square miles study area)}$$

$$= 0.00136 \textit{ per year}.$$

In other words, there is a 0.136 percent chance each year of a tornado affecting a particular site in the study area. This is approximately one-tenth of 1 percent chance per year. Another way to express risk is to calculate how often, on average, a tornado may affect a particular site. This may be calculated by:

RECURRENCE INTERVAL = 1/(0.00136 *per year*) ~ 735 *years*

So, on average, a tornado would be expected to affect COF once every 735 years. Additionally, the probability of Class F stability occurring is about 0.1 to 0.15. Further, the probability of occurrence of Class F stability immediately after a tornado is even lower. The resulting probability of both a tornado and Class F stability in the study area is about 2.04×10^{-4}. This low probability means the likelihood of a tornado causing a catastrophic ammonia release at COF is insignificant.

3.5. Wetlands

3.5.1. Affected Environment

Two potential wetland areas (W1, W2) were identified in the project area during ground surveys in August 2002. These areas comprise a total acreage of less than one-tenth of an acre. Both areas are dominated by wetland indicator plant species (Reed, 1997) and demonstrate wetland hydrology indicators (Environmental Laboratory, 1987). Both areas are significantly disturbed or atypical situations. Area W1 is a shallow, isolated depression at the edge of a gravel staging or parking lot next to the area known as the “Frog Pond.” This area is approximately 60 feet long by 10 feet wide. The water appears to come entirely from rainfall. It was not possible to determine if the soils in this area are hydric due to coal dust mixed into the soil to a depth of more than 14 inches. The second area (W2) is a concrete-lined ditch containing 2 inches of eroded sediment from an adjoining hillside, and is located along the road on the western boundary of the site. This area is approximately 465 feet long by 2 feet wide. Water appears to come entirely from steam plant outfall. Descriptive data for the potential wetland areas (W1, W2) are provided in the Routine Wetland Determination Forms presented in Appendix C.

3.5.2. Environmental Consequences

Based on the insignificant size of the potential wetland areas (less than one-tenth acre), as well as the existing high level of disturbance to them, impacts to wetlands resulting from the proposed project are anticipated to be insignificant.

3.6. Managed Areas and Ecologically Significant Sites

3.6.1. Affected Environment

Activities related to the operation and construction of any system under the three Action Alternatives would take place within a specific project area at COF, which is located on the southern shore of the Tennessee River about two-tenths mile from the main river channel. The Seven Mile Island State Wildlife Management Area (WMA) is situated directly across the river from COF, extending from the main channel of the Tennessee River to an average of one-fourth mile beyond the northern shoreline. The 4,685-acre WMA is part of the Pickwick Reservoir Reservation. Waterfowl and small game hunts are administered by the Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries.

A 12-mile reach of the Tennessee River immediately downstream of Wilson Dam has been given nonessential experimental population status by the USFWS for 16 federal-listed endangered and threatened mussel species and one federal-listed endangered snail species. This area terminates at TRM 246.0, three-fourths mile upstream from the project area at COF (see Section 3.8.)

The Key Cave National Wildlife Refuge and Key Cave Aquifer Hazard Area are located 3 miles upstream of the project area at COF. Both areas provide recharge for the Key Cave aquifer. Key Cave contains habitat for two federal-listed endangered species, one Alabama state-listed protected species and two Alabama state-listed special concern species. The national wildlife area is managed by the USFWS for the protection of these species and to promote wildlife diversity.

3.6.2. Environmental Consequences

<u>No Action Alternative</u>

Under the No Action Alternative, no NO_x reduction system would be installed on any unit at COF. No impacts would occur to Managed Areas and/or Ecologically Sensitive Sites located in the vicinity of COF as a result of reduction system construction and operation. However, present levels of NO_x emissions would continue to affect the quality of wildlife habitat and visitor experience in these areas.

<u>Action Alternatives</u>

A. SCR Installation on Unit 5
B. SCR Installation on Units 1 through 5
C. SCR installation on Unit 5 and NO_xTech installation on Units 1 through 4

Under the Action Alternatives, a reduction system would be installed on Unit 5 of COF or on Units 1 through 5 of COF. Although the Seven Mile Island WMA is located directly adjacent to the plant, the distance to the main channel from the project site (two-tenths mile) is sufficient to avoid significant impacts to the WMA. During the construction phase of the project, Best Management Practices (BMPs) would be implemented, protecting wildlife habitat on the river. Although the number of barges to the plant would increase during construction (to deliver heavy equipment), no impacts to wildlife habitat are anticipated because this increase represents a temporary increase to the existing volume of river traffic. Operation of the reduction systems are not expected to negatively affect surrounding areas, but rather would reduce NO_x emissions, resulting in possible benefits for visitors and wildlife within the WMA and the surrounding area.

A nonessential experimental population, the Key Cave National Wildlife Refuge and the Key Cave Aquifer Hazard Area are located within 3 miles of the project area. Because of their distance to the project site (0.75 and 3.0 miles) and relative upstream location, no impacts to these areas are expected from the installation of reduction systems at COF. Operation of reduction systems reduces NO_x emissions, a potentially beneficial result for wildlife in these and surrounding areas.

3.7. Terrestrial Ecology

3.7.1. Affected Environment

Vegetation

As mentioned in Section 3.4.1, COF occurs in the Interior Low Plateau physiographic province (Fenneman, 1938). Botanically, the project area occurs in the Mississippian Plateau section of the Western Mesophytic Forest region according to Braun (1950).

The area in and around COF has been heavily impacted and altered as a result of the construction and operations of the facility. Field inspections of areas associated with the three proposed alternatives reveal that few natural plant communities remain. Vegetated areas consist of lawns, early successional thickets, and young-mid age (estimated 30-40 years) forests. Lawns are typically dominated by one or a mixture of grass species including Bermuda grass (*Cynodon dactylon*), Dallis grass (*Paspalum dilatatum*), Johnson grass (*Sorghum halepense*), and crab grass (*Digitaria sanguinalis*). Early successional thickets include a mixture of herbaceous and woody vegetation (estimated age 8-15 years) including ragweed (*Ambrosia* species), evening primrose (*Oenothera biennis*), crab grass, sericea (*Lespedeza sericea*), wild cherry (*Rhacoma crossopetalum*), black locust (*robinia pseudoacacia*), sweet gum (*Liquidambar styraciflua*), sycamore (*Platanus occidentalis*), and green ash (*Fraxinus pennsylvanica subintegerrima*). A young-mid aged forest occurs along the barge unloading area and along the slopes adjacent to the existing road leading to this site. Common canopy species in these roadside forests include sassafras (*Sassafras albidum*), box elder (*Acer negundo*), sycamore, southern red oak (*Quercus falcata)*, green ash, and autumn olive (*Elaeagnus umbellata*). Water oak (*Quercus nigra*) and scattered loblolly pine (*Pinus taeda*) occur on wetter sites. One sparsely vegetated limestone bluff area occurs adjacent to an existing road. Rock cress (*Arabis* species) and Japanese honeysuckle (*Lonicera japonica*) are the dominant plant species in this area. The proposed project areas also include a variety of nonvegetated sites ranging from gravel and paved parking lots to existing infrastructure. The project would impact 7.6 acres or less of vegetation, all of which is widespread and common in the state. No uncommon communities or otherwise sensitive vegetation occurs on or immediately adjacent to the project areas associated with any of the three proposed Action Alternatives.

The proposed project activities at COF are part of TVA's systemwide goals to reduce emissions of sulfur (SO_x) and NO_x at its coal-fired power plants. Emissions of SO_x and NO_x contribute to acid deposition, which has been implicated in the decline of forest health in the United States (National Acid Precipitation Assessment Program [NAPAP], 1998). Although this trend is well documented in the high elevation spruce-fir forests of the northeastern states and the southern Appalachians, the majority of forest ecosystems in the eastern United States are not currently known to be significantly affected by sulfur (or nitrogen) deposition (NAPAP, 1998; USDA Forest Service, 2001). However, these less sensitive forests are currently exhibiting gradual losses of soil nutrients due to acid deposition, which could reduce the health of these forests over the long term (NAPAP, 1998).

Animals

Much of the areas within COF have been heavily impacted and altered as a result of construction and operation of the existing facility. A small section of riparian forest along the northwest periphery of the fossil plant is less disturbed than other areas within the vicinity. This section, which extends to the barge unloading area, is transected by an existing road that is proposed for expansion. Locally, common terrestrial animals may find suitable habitat in this area and the adjoining forest that continues northwest of the facility. Most of the areas within the plant boundaries, however, are heavily disturbed and consequently offer very limited wildlife habitat.

3.7.2. Environmental Consequences

Vegetation – Potential Impacts

No Action Alternative

If the No Action Alternative were selected, no immediate attempts to reduce NO_x emissions would be undertaken at COF. As stated in Section 3.7.1, emissions of NO_x contribute to acid deposition, which in turn has the potential to impact forest ecosystems and other forms of vegetation throughout the region.

Emissions from COF have not been directly linked to any local or regional trends of declining forest health. However, emissions at COF contribute to regional patterns of acid deposition, which could result in cumulative, adverse impacts to vegetation (particularly forest ecosystems) over the long term.

Alternatives A, B, and C

Alternative A

Construction of Alternative A would involve grading and clearing of trees along the road from the barge unloading area to the construction site. In addition, the laydown areas, which are currently covered by grass and weeds, would be graded and graveled. This loss of vegetative cover in these areas would be less than 7.6 acres. The direct loss of this amount of common vegetation would be an insignificant adverse impact to the vegetation of the state.

Selection of Alternative A would reduce NO_x emissions from COF Unit 5 by 90 percent at full load conditions, through the installation of SCR systems. As stated above, acid deposition caused (in part) by nitrogen emissions has been linked to the decline of some high elevation forest communities in the southern Appalachians (NAPAP, 1998). Reductions in nitrogen emissions at coal-fired power plants throughout the TVA Power Service Area would be expected to reduce impacts to these plant communities. However, the majority of forest communities in the surrounding vicinity of COF are not currently known to be significantly threatened by acid deposition (NAPAP, 1998; USDA Forest Service, 2001). The proposed reductions in nitrogen emissions that would accompany Alternative A would therefore not be expected to result in measurable benefits to these forests over the short term. However, current rates of sulfur and nitrogen emissions are considered likely to result in cumulative, adverse impacts to forests throughout the region over the long term (NAPAP, 1998). The reduced emissions that would accompany Alternative A would contribute toward an overall reduction in emissions' rates at TVA's coal-fired power plants throughout the TVA Power Service Area. The combined results of this and similar proposals would be expected to benefit the forest ecosystems of the region.

Because no uncommon plant communities are known from the immediate vicinity of COF, no adverse direct or indirect impacts to such communities are expected as a result of the proposed Action Alternative. With respect to vegetation, no significant, adverse impacts would be expected to the terrestrial ecology of the state or region.

Alternative B

As with construction of Alternative A, construction of Alternative B would involve grading and clearing of trees along the road from the barge unloading area to the construction site. In addition, the laydown areas, which are currently covered by grass and weeds, would be graded and graveled. This loss of vegetative cover in these areas would be less than 7.6 acres. The direct loss of this amount of common vegetation would be an insignificant adverse impact to the vegetation of the state.

Alternative B calls for the installation of SCR systems on Units 1 through 5 at COF, and would therefore result in greater emissions reductions than Alternative A. To the extent that these reductions in NO_x emissions also reduce impacts to the forests of the region that result from acid deposition, selection of this alternative would result in greater benefits than Alternative A. As with Alternative A, with respect to vegetation, selection of Alternative B would not be expected to result in significant, adverse impacts to the terrestrial ecology of the state or region.

Alternative C

If Alternative C were selected, SCR systems would be installed on Unit 5 and NO_xTech on Units 1 through 4 at COF. With respect to vegetation, impacts to the terrestrial ecology of the region would be equivalent to those described above under Alternative B.

Animals

No Action

Under the No Action Alternative, any indirect or cumulative impacts to terrestrial animals would persist as a result of the continuous production of NO_x. Direct impacts to terrestrial species would be insignificant.

Alternatives A, B, and C

Proposed construction within COF would entail minimal amounts of clearing for road expansion. Because COF predominantly comprises heavily disturbed areas, the proposed project would not result in direct, indirect, or cumulative impacts to terrestrial animals in the vicinity. Due to improvements in air quality, completion of all three Action Alternatives may result in minor beneficial effects to terrestrial animals. Because Alternatives B and C offer the greatest decrease in NO_x emissions from COF, implementation of these alternatives may prove most beneficial to terrestrial animals at the local and regional levels.

Significant impacts to migratory birds that may use the area are not anticipated. The proposed SCR system installation and associated activities are not expected to affect unique animal habitat, nor are they expected to contribute to the spread of exotic or invasive terrestrial animals.

3.8. Threatened and Endangered Species

3.8.1. Affected Environment

Plants

Review of the TVA Regional Natural Heritage database revealed that three Alabama state-listed plant species are known from within 5 miles of COF (Table 7). In addition, two federal-listed plant species are known from outside of this review radius in the surrounding vicinity of Colbert County, Alabama.

Table 7. Federal- and State-Listed Plant Species Reported From Within 5 Miles of Colbert Fossil Plant and Additional Federal-Listed Plant Species Reported From Outside of This Review Radius in Colbert County, Alabama

Common name	Scientific name	Federal status[a]	State status[b]
Alabama glade-cress	*Leavenworthia alabamica*		NOST
Dutchman breeches	*Dicentra cucullaria*		NOST
False rue-anemone	*Enemion biternatum*		NOST
Lyre-leaf bladderpod	*Lesquerella lyrata*	LT	NOST
Prairie clover*	*Dalea foliosa*	LE	NOST

* This common name is routinely applied to more than one member of this genus.
[a] LE = federal-listed endangered; LT = federal-listed threatened.
[b] NOST = No status. Alabama Natural Heritage does not assign a state status to listed rare plant species.

No federal- or Alabama state-listed plant species, or suitable habitats for such species, were observed during field inspections of proposed project areas conducted in August 2002.

Terrestrial Animals

A review of the Natural Heritage Database indicated that four protected species have been reported from Colbert and Lauderdale Counties (Table 8). In addition, two heron colonies and 101 caves have been reported from these counties. Of these species, only the state-listed southern coal skink has been reported within a 3-mile radius of the fossil plant.

Table 8. State-Protected Terrestrial Animals Reported From Areas Within a 3-Mile Radius of Colbert Fossil Plant and Federal-Protected Species Reported From Colbert and Lauderdale Counties, Alabama

Common Name	Scientific Name	State Status	Federal Status
Bald Eagle	*Haliaeetus leucocephalus*	Protected	Threatened
Gray Bat	*Myotis grisescens*	Protected	Endangered
Red-cockaded Woodpecker	*Picoides borealis*	Protected	Endangered
Southern Coal Skink	*Eumeces anthracinus pluvialis*	Special Concern	—

Areas within COF do not meet the habitat requirements for the species listed above. Bald eagles nest in tall trees or on cliffs near reservoirs, rivers, and swamps. The small forested area within COF along Pickwick Reservoir is unlikely to provide suitable nesting habitat for this species. Gray bats typically roost in caves along rivers and reservoirs. Although the adjacent Pickwick Reservoir provides foraging habitat for this species, roosting habitat does not occur within COF. A historic record of red-cockaded woodpecker has been reported from Colbert County. This species generally inhabits open, mature pine woodlands. If this species presently occurs in the region, suitable nesting habitat for this species does not occur within COF. Southern coal skinks are found in humid wooded areas with abundant leaf litter and loose rocks. Suitable habitat for this species does not exist within COF. Caves and heron colonies do not occur within the boundaries of COF.

Aquatic Animals

Data from the TVA Regional Natural Heritage Project database and the Alabama Natural Heritage Program database indicated that several state- and federal-listed aquatic animal species are reported from the Tennessee River (Pickwick Reservoir) and its tributaries downstream of COF (Table 9).

Table 9. State- and Federal-Listed Aquatic Animal Species Reported From the Tennessee River (Pickwick Reservoir) and its tributaries downstream of Colbert Fossil Plant

Scientific Name	Common Name	State Status	Federal Status
Mussels			
Obovaria retusa	Ring pink	Endangered	Endangered
Ligumia recta	Black sandshell	Special Concern	-
Potamilus ohiensis	Pink papershell	Special Concern	-
Toxolasma lividus	Purple lilliput	Special Concern	-
Truncilla truncata	Deertoe	Protected	-
Fish			
Elassoma alabamae	Spring pygmy sunfish	Protected	-
Etheostoma tuscumbia	Tuscumbia darter	Protected	-

Mussels–A number of surveys of freshwater mussel resources have been conducted in the upstream part of Pickwick Reservoir during the last 25 years. These post-impoundment surveys and other studies in the area suggest that five federal-endangered mussel species and several species tracked in Alabama occur in the riverine part of the Tennessee River downstream from Wilson Dam. Farther downstream in the reservoir, however, mussel diversity declines and the endangered species appear to be either absent or much less abundant.

However, the five mussel species listed in Table 9, including the federal-endangered ring pink mussel, have all been recently collected near Koger Island, downstream of the project site along the north shore of the reservoir, and in the main channel of the Tennessee River (Pickwick Reservoir). None of these species were encountered during the recent surveys adjacent to the project site.

Fish–The two fish species known from the area, the spring pygmy sunfish and the Tuscumbia darter, are state-protected species that are known to occur in tributary streams in this portion of the Tennessee River system. The preferred habitat of both of these fish is springs with heavy growths of aquatic vegetation. This habitat does not occur on or adjacent to the project site, and these fish are not likely to occur in areas that could potentially be affected by this action.

Seven Mile Island Area

Six federal-endangered and several state-listed aquatic animal species have been observed around and upstream from the Seven Mile Island complex or from one of several tributary streams and cave systems located upstream of COF (Table 10). The two cavefishes and two crayfishes are cave obligate species and are not likely to occur in the main channel of the Tennessee River. Of the remaining species known to occur in the vicinity of the Seven Mile Island complex, none have been observed adjacent to COF.

Table 10. State- and Federal-Listed Aquatic Animal Species Reported From the Tennessee River (Wilson Reservoir Tailwater) and its Tributaries Upstream of Colbert Fossil Plant

Scientific Name	Common Name	State Status	Federal Status
	Mussels		
Hemistena lata	Cracking pearlymussel	Endangered	Endangered
Lampsilis abrupta	Pink mucket	Endangered	Endangered
Cyprogenia stegaria	Fanshell	Endangered	Endangered
Plethobasus cicatricosus	White wartyback	Endangered	Endangered
P. cooperianus	Orange-foot pimpleback	Endangered	Endangered
P. cyphyus	Sheepnose	Protected	-
Actinonaias pectorosa	Pheasantshell	Protected	-
Cumberlandia monodonta	Spectaclecase	Protected	-
Ellipsaria lineolata	Butterfly	Special Concern	-
Elliptio dilatata	Spike	Special Concern	-
Lampsilis ovata	Pocketbook	Special Concern	-
Ligumia recta	Black sandshell	Special Concern	-
Obovaria subrotunda	Round hickorynut	Special Concern	-
Pleurobema cordatum	Ohio pigtoe	Special Concern	-
P. rubrum	Pyramid pigtoe	Protected	-
Ptychobranchus fasciolaris	Kidneyshell	Special Concern	-
Quadrula c. cylindrica	Rabbitsfoot	Special Concern	-
Q. metanevra	Monkeyface	Special Concern	-
Toxolasma lividus	Purple lilliput	Special Concern	-
Truncilla truncata	Deertoe	Protected	-

Table 10. State- and Federal-Listed Aquatic Animal Species Reported From the Tennessee River (Wilson Reservoir Tailwater) and its Tributaries Upstream of Colbert Fossil Plant

Scientific Name	Common Name	State Status	Federal Status
Snails			
Lithasia armigera	Armored rocksnail	Special Concern	-
L. geniculata	Ornate rocksnail	Special Concern	-
L. lima	Warty rocksnail	Special Concern	-
L. salebrosa	Muddy rocksnail	Special Concern	-
L. verrucosa	Varicose rocksnail	Special Concern	-
Pleurocera alveare	Rugged hornsnail	Special Concern	-
P. corpulenta	Corpulent hornsnail	Special Concern	-
P. curta	Shortspire hornsnail	Special Concern	-
P. walkeri	Telescope hornsnail	Special Concern	-
Crayfish			
Cambarus jonesi	Troglobitic crayfish	Special Concern	-
Procambarus pecki	Troglobitic crayfish	Special Concern	-
Fish			
Speoplatyrhinus poulsoni	Alabama cavefish	Protected	Endangered
Typhlichthys subterraneus	Southern cavefish	Protected	-

Nonessential Experimental Populations

The USFWS has begun a project to establish nonessential experimental populations of 16 federal-listed endangered mussels and one endangered freshwater snail in the first 10 miles (16.09 km) of Pickwick Reservoir downstream from Wilson Dam (TRM 258 to TRM 248). None of these mollusk species are known to exist currently in this river reach, and these potential future populations are not expected to extend downstream into the river reach adjacent to COF (USFWS, 2001).

3.8.2. Environmental Consequences

Potential Impacts to Rare Plants

No Action Alternative

No impacts to rare plant species would occur under the No Action Alternative.

Action Alternatives A, B, and C

No occurrences of rare plant species are known or expected to occur in the areas associated with any of the proposed Action Alternatives. No impacts to such species are expected as a result of any of the actions proposed under Alternatives A, B, or C.

Terrestrial Animals

No Action Alternative

Under the No Action Alternative, any indirect or cumulative impacts to protected terrestrial animals would persist as a result of the continuous production of NO_x. Direct impacts to these species would be insignificant.

Action Alternatives A, B, and C

Rare terrestrial animals have not been reported in the vicinity and are not expected to find suitable habitat within COF. The project is therefore not expected to result in adverse impacts to protected terrestrial animals or their habitats. Due to improvements in air quality, completion of the project may result in minor beneficial effects to protected terrestrial species at the local and regional level. Because Alternatives B and C offer the greatest decrease in NO_x emissions from COF, implementation of these alternatives may prove most beneficial to protected terrestrial animals at the local and regional levels.

Aquatic Animals

No Action Alternative

Under the No Action Alternative, current operations would not change at COF, and no impacts to protected aquatic animal species would occur.

Action Alternatives A, B, and C

Potential impacts to sensitive aquatic resources in Pickwick Reservoir would be similar under any of the three Action Alternatives. The only potential impact to protected aquatic animal species would be from the accidental release of ammonia from the storage tank or as a byproduct of the SCR process.

Water Quality and Protected Aquatic Animals—The storage, handling, and use of anhydrous ammonia for the proposed SCR system would result in the potential for ammonia contamination of surface water and impacts to aquatic life. One pathway for impacts is a direct accidental release of ammonia to surface waters. The engineered features of the SCR system include a retention basin for spills and emergency water fogging to minimize this risk.

Another pathway for surface water impacts is ammonia contamination of combustion byproducts including bottom ash and fly ash. Water discharged from Ash Pond 4 and Ash Pond 5 may contain ammonia. Management of water treatment system flows and other appropriate mitigation measures as necessary (see Section 2.6) would maintain discharge ammonia concentrations at levels that would safeguard water quality and protect aquatic life. If necessary to meet NPDES permit limits, specific ammonia treatment facilities would be added to or integrated into the existing treatment systems.

With the precautions outlined above, protected aquatic animals are not likely to be adversely affected by installation and operation of systems to control NO_x emissions under any of the Action Alternatives. The USFWS concurred by letter of November 26, 2002 (Appendix B), that this project is not likely to adversely affect threatened and endangered plant or animal species.

3.9. Floodplains

3.9.1. Affected Environment

COF is located on the left bank of Pickwick Reservoir at about TRM 245.0 in Colbert County, Alabama. The 100-year floodplain for the Tennessee River at TRM 245.0 would be the area below elevation 423.0. The TVA Flood Risk Profile (FRP) elevation for the Tennessee River at TRM 245.0 would be elevation 424.1. The FRP is used to control flood damageable development for TVA projects and residential and commercial development on TVA land. At this location, the FRP elevation is equal to the 500-year flood elevation. The 500-year flood elevation is also used to establish the “critical action floodplain.” A “critical action” is defined in the Water Resource Council Floodplain Management Guidelines as any activity for which even a slight chance of flooding would be too great.

3.9.2. Environmental Consequences

<u>No Action Alternative</u>

Under the No Action Alternative, the floodplain areas would not be impacted, and there would be no change in existing conditions.

<u>Action Alternative A - SCR Installation on Unit 5 and No Action on Units 1 Through 4</u>

Under Alternative A, construction of the SCR system on Unit 5, along with the support facilities, such as the ammonia system, the proposed warehouse, and the office building, would not involve siting within the 100-year floodplain, which would comply with Executive Order (EO) 11988. The facilities for which even a slight chance of flooding would be too great (ammonia storage tanks, SCR system, etc.) would be located well above the 500-year flood elevation.

The existing barge terminal within the 100-year floodplain would be upgraded. For compliance with EO 11988, a barge terminal is considered to be a repetitive action in the floodplain that would not result in adverse floodplain impacts because a crane mat would be placed in the barge loading area and a crane would be used to offload equipment from the barges. The crane would be mobile and would be relocated during high-water events. No materials subject to flood damage would be stored within the 100-year floodplain. Widening the existing road to the barge terminal area would also involve work within the 100-year floodplain. For compliance with EO 11988, road fill is also considered to be a repetitive action in the floodplain that would not result in adverse floodplain impacts because only a minor amount of fill would be needed, there would be no increase in flood elevations, and the road would not be damaged if flooded. The proposed laydown areas, new bridge over the pipe band, overhead power lines, and underground water lines would not be located within the 100-year floodplain. No significant floodplain impacts would result from Action Alternative A.

<u>Action Alternative B - SCR Installation on Units 1 Through 5</u>

The potential floodplain impacts associated with Alternative B would be the same as those for Alternative A. Therefore, no significant floodplain impacts would result from Action Alternative B.

<u>Action Alternative C - SCR Installation on Unit 5 and NOxTech on Units 1 Through 4</u>

Under Alternative C, natural gas pipelines would be constructed from the natural gas metering station to the injection points on the boilers. This work would not be located within the 100-year floodplain. The other potential floodplain impacts associated with Alternative C would be the same as those for Alternatives A and B. Therefore, no significant floodplain impacts would result from Action Alternative C.

3.10. Land Use and Visual Aesthetics

3.10.1. Affected Environment

Current land use at the Colbert plant site is heavy industrial—coal-fired power production. The site is surrounded on three sides by low, wooded hills, gently sloping farmland, and sparse residential development. Pickwick Reservoir borders the plant along the north side. Groups of trees and other vegetation provide a visual buffer along most of the reservoir shoreline. Cane Creek meanders through woodland on the west side of the plant. U.S. Highway 72 and a narrow buffer of roadside vegetation border the site along the south side. The existing large-scale industrial facilities provide a significant visual contrast to the surrounding rural landscape. The most dominant plant structures are the powerhouse, precipitators, coal handling system, and six stacks of varying heights that can be seen for several miles. Other principal features include the switchyard, major transmission corridors, gas turbines, fuel oil tanks, coal pile, and ash disposal areas. Portions of the plant are visible above and intermittently through the trees to boaters on the reservoir, passing motorists on U.S. Highway 72, and some nearby residents.

The proposed SCR or NO_xTech facilities would be located along the north side of the powerhouse, with related features and construction facilities located in yard areas just west of it. These areas are seen primarily by employees, with occasional public views from the reservoir. The proposed natural gas pipeline route would run northwest from the main parking lot to the powerhouse across a yard area seen primarily by employees and plant visitors.

3.10.2. Environmental Consequences

All the proposed SCR or NO_xTech structures, piping, ammonia tanks, related facilities, and construction areas would be located fully within the plant site and near existing facilities, as shown in Figure 4. The heavy industrial land use would not change since these locations are used regularly for purposes associated with plant operations.

The visual discord of construction activities, material storage, and equipment for the proposed modifications would be temporary and relatively minor. They would be located among existing industrial facilities and in plant areas normally not seen by the public. Most visible activities, construction parking, and laydown areas for the three alternatives would be similar. Installation of either the four SCR units or the NO_xTech process would be visible from the reservoir near the intake channel, but shoreline vegetation would screen most other views. Intermittent activities, large equipment, and materials at the barge unloading area would also be seen from the reservoir. Improvements at the unloading area and access road could include some tree removal. The temporary crane proposed in this area would be visible above the remaining trees. Temporary buildings west of the powerhouse would be visually similar to warehouses nearby. Construction activities for the natural gas pipeline would add minor discord, temporarily reducing visual coherence and harmony at the plant entrance. Construction force traffic up to 500 vehicles per day and truck delivery of construction materials would result in moderate but temporary visual congestion and discord. It would be seen at shift changes by public motorists on U.S. Highway 72 near the plant entrance, as well as employees and visitors along the main access road.

The long-term visual impacts of any Action Alternative would be insignificant. The various additions would be relatively small-scale features and have an industrial appearance compatible with existing structures. They would be located within the plant site where public visibility would be minimal. Discernible differences at the plant would be relatively minor and would not alter the overall industrial character. Most of the visible changes would be similar for each alternative, including a freestanding SCR structure for Unit 5. The other four SCR units would be somewhat different but hardly noticeable among the existing precipitator structures and stacks. Piping and equipment for the NO_xTech process would also be relatively obscure. The buried power, water, and other systems in the proposed utility corridor would not be visible, nor would the underground natural gas pipeline. Impacts of aboveground features or signs related to operation of these systems would be negligible, as would the bridge over the sluice line corridor. More ammonia tanks and distribution features would be seen with Alternative C and the least with Alternative A. The tank and delivery facility at Location 2 could have slightly more visibility from the reservoir than Location 1 (see Figure 4). Truck delivery of ammonia up to 15 tankers per week would result in little if any visual impact. The proposed changes would normally be seen only by employees, technical visitors to the plant, and occasional views from the reservoir near the intake area. Visual impacts of the three Action Alternatives would be insignificant.

3.11. Archaeological and Historic Resources

3.11.1. Affected Environment

Human occupation of northern Alabama has occurred from the Paleo-Indian to the Historic period. In northern Alabama, prehistoric archaeological chronology is generally broken into five broad time periods: Paleo-Indian, Archaic, Gulf Formational, Woodland, and Mississippian (Walthall, 1980; McNutt and Weaver, 1985). Prehistoric land use and settlement patterns vary during each period, but short- and long-term habitation sites are generally located on floodplains and alluvial terraces along rivers and tributaries. Specialized campsites tend to be located on older alluvial terraces and in the uplands. European interactions associated with the fur trading industry with Native Americans in this area began in the seventeenth and eighteenth centuries. The first permanent occupation of northern Alabama by Europeans, European Americans, and African Americans occurred in the late eighteenth century. Various excursions and temporary settlements by the British, French, and Spanish occurred prior to this period. Colbert County was officially created in 1870. The agricultural production of the region involved some cotton in the antebellum period, but production focused more on grains and other crops. From the end of the Civil War to the early 1900s, the iron industry and other manufacturing interests moved into the area. When the iron industry began to decline in the late 1920s, the availability of low cost hydroelectric power from Wilson Dam helped to draw in new industrial interests. The project area is within the boundaries of COF, which was approved for construction by Congress in 1951 to provide power for the defense industry during the Korean Conflict (Wild, 2002).

Currently, there are 23 historic properties listed in the National Register of Historic Places in Colbert County. None of these properties is within the Area of Potential Effects (APE) for the proposed undertaking. The APE for this project was defined as any area where activities associated with the proposed undertaking would have the potential to affect archaeological resources. It was determined that the project did not have the potential to add any further visual effects to aboveground historic properties that had not already been introduced by plant construction.

An archaeological survey was conducted in October 2002. The survey identified approximately 6 acres of land within the 70-acre tract that had not been previously disturbed through plant construction or related activities and infrastructure. Two previously recorded archaeological sites, 1CT16 and 1CT77, were reinvestigated and determined to have been disturbed by plant activities. No new archaeological sites were identified by the survey (Wild, 2002).

3.11.2. Environmental Consequences

An archaeological survey of the proposed project's APE found that there were no archaeological sites that are potentially eligible, eligible, or listed in the National Register of Historic Places that would be affected by the proposed undertaking. TVA Cultural Resources staff submitted the determination that no historic properties would be affected to the Alabama SHPO on October 15, 2002. The Alabama SHPO concurred with TVA's findings on November 13, 2002, and reiterated concurrence on December 2, 2002, after reviewing the Draft EA (see Appendix B).

3.12. Solid and Hazardous Waste

3.12.1. Affected Environment

Municipal Solid Waste

Most nonhazardous materials not disposed on site at COF are currently taken to the Browning Ferris Industries (BFI) Morris Farm Sanitary Landfill in Lawrence County, near Hillsboro, Alabama. This landfill, a Subtitle D landfill with two clay liners and two synthetic liners, was opened in September 1997. The BFI Morris Farm Sanitary Landfill is permitted to receive 1,500 tons per day and has more than 20 years of capacity remaining.

Coal Combustion Byproduct Generation, Marketing, and Handling

COF is expected to burn between 3.52 and 4.07 million tons of coal annually through at least 2015. The coal ranges from 5.2 percent to 14.3 percent ash depending on the source. Total ash production will range from approximately 300,000 to 340,000 tons of ash per year. The ash is collected as either fly ash, which is fine enough and light enough to be carried with the flue gas stream exiting the boiler, or as bottom ash, which is coarser and heavier and falls to the bottom of the boiler. The fly ash/bottom ash split is about 90 percent fly ash and 10 percent bottom ash.

All bottom ash produced at COF is currently sluiced to the active bottom ash pond. Bottom ash is reclaimed for use in dike construction, roadways on the plant reservation, or for community projects like walking tracks. Between 30,000 to 34,000 tons of bottom ash are handled in this manner annually. Markets for bottom ash are currently being explored. Increasing marketability of bottom ash would require a pyrite separation system as part of the bottom ash handling equipment at the plant. Pyrites and mill rejects would be segregated from the bottom ash and handled separately if a pyrite separation system were installed.

Prior to 1990, all fly ash was sluiced to ash ponds on the plant site and dredged to dredge cells. Failure of one of the dredge cells due to sinkhole development necessitated the conversion to dry fly ash handling. In 1990, COF converted to dry fly ash collection, but because the fly ash contains high levels of unburned carbon, the material is not suitable for most market uses like ready-mix cement. Currently, small amounts of fly ash are being marketed at COF for use in landscaping mulches, but most of the fly ash is conditioned to about 18 percent moisture in pug mills and hauled to a fly ash stacking area for disposal. Rainfall runoff from the dry fly ash stacking area is routed to a small settling pond for treatment. This pond discharges to the river intermittently through serial discharge DSN 010.

TVA is exploring ways to beneficiate the fly ash in order reduce the carbon level, to market the material, and to avoid disposal. Several technologies are being evaluated for fly ash beneficiation. The most promising technology is carbon burn out in which the fly ash is reburned in a fluidized bed combustion process. The advantage of this process is that there are no unusable byproducts from the process, and if ammonia levels in the fly ash were to become too high as a result of the NO_x reduction technology, the carbon burn out process would also eliminate ammonia on the fly ash.

3.12.2. Environmental Consequences

Construction Impacts

Demolition of the old pilot scrubber lunchroom would produce scrap metal for recycling and would also fill an approximately 20 cubic yard dumpster with rock wool insulation. Demolition of the footings of the old concrete mixing plant would produce approximately 150 tons of concrete mixed with rebar. This demolition debris would most likely be shipped to the BFI Morris Farm Landfill or similarly permitted Class D landfill. Since the amount of material requiring disposal in a landfill is approximately one-tenth as much as is permitted per day at the BFI Morris Farm Landfill, and since there is more than 20 years capacity at the landfill, no significant impacts to local landfill capacity is anticipated as a result of construction associated with this project.

Potential Operational Impacts of Alternatives

For the No Action Alternative, COF could continue to handle fly ash by stacking in the dry fly ash stacking area or proceed with development of markets for the material. Bottom ash disposal and marketing would continue without being affected.

Use of either SCR systems or the NO_xTech system would result in “ammonia slip” or excess unreacted ammonia being deposited on the dry fly ash collected in the plant. As the fly ash is mixed with water to condition it for placement in the dry fly ash stacking area, the ammonia could volatilize to cause odor problems if the fly ash pH is high enough. The amount of ammonia volatilization would be dependent upon the concentration of ammonia on the fly ash, the pH of the fly ash, the rate at which fly ash is stacked on the dry fly ash stacking area, and rainfall events. This would not affect how the fly ash is handled unless ammonia concentrations in the settling pond exceeded discharge limits (see Section 3.14) or odor problems affected nearby residents. Small quantities of the fly ash could be marketed without additional processing for uses in construction materials, such as autoclaved cellular concrete, where the manufacturing process would not be affected by excess ammonia in the fly ash. However, the high levels of ammonia present in untreated fly ash would prohibit use of this fly ash in most markets, such as ready-mix cement, because of odor problems associated with the ammonia in the fly ash. The existing dry fly ash stacking area would still be utilized for disposal of this material at COF.

Bottom ash marketing is not expected to be impacted by the SCR or NO_xTech installation at COF since the bottom ash is collected in the boiler prior to ammonia injection. Since none of the Action Alternatives would result in a change in fly ash or bottom ash handling at COF, the effects on solid waste would be insignificant.

3.13. Aquatic Ecology

3.13.1. Affected Environment

Installation and operation of the SCR systems could potentially impact aquatic communities in Pickwick Reservoir adjacent to COF. This reach of Pickwick is more riverine than conditions found nearer Pickwick Dam. The dominant factor influencing aquatic conditions in the vicinity of COF is the discharge from Wilson Dam, about 14.4 river miles upstream. TVA began a program to monitor the ecological conditions of its reservoirs systematically in 1990. Reservoir (and stream) monitoring programs were combined with TVA's fish tissue and bacteriological studies to form an integrated Vital Signs Monitoring Program. Vital signs monitoring activities focus on (1) physical/chemical characteristics of waters; (2) physical/chemical characteristics of sediments; (3) benthic macroinvertebrate community sampling; and (4) fish assemblage sampling (Dycus and Baker, 2001).

Benthic (lake bottom) macroinvertebrate and fish samples were taken in three areas of Pickwick Reservoir from 1990 through 1994, and again in 1996, 1998, and 2000 as part of TVA's Reservoir Vital Signs Monitoring Program. Areas sampled included the forebay (area of the reservoir nearest the dam), a mid-reservoir transition station, and an upper-reservoir inflow station just below Wilson Dam. Any fish species (and most benthic species) known from elsewhere in the reservoir could occur in the vicinity of COF. Results of sampling at the transition and inflow stations are presented here because they would be more representative of fish and benthic communities in the vicinity of COF.

Benthic macroinvertebrates are included in aquatic monitoring programs because of their importance to the aquatic food chain and because they have limited capability of movement, thereby preventing them from avoiding undesirable conditions. Sampling and data analysis were based on seven parameters that indicate species diversity, abundance of selected species that are indicative of good (and poor) water quality, total abundance of all species except those indicative of poor water quality, and proportion of samples with no organisms present. Compared to the transition stations of other TVA run-of-the-river reservoirs, the transition station benthic community at Pickwick has rated excellent in 1994, 1996, and 1998, but fair in 2000. The benthic community at the inflow rated fair in 1996 and 1998 and good in 1994 and 2000 compared to the inflow stations of other TVA run-of-the-river reservoirs (Dycus and Baker, 2001). Sampling sites have been established at TRM 244.0 and 246.0 for COF 316(a) thermal variance studies; benthic communities there rated good and fair, respectively, in 2000 (TVA unpublished report).

Freshwater mussels (bivalve mollusks) are the largest and most notable members of the invertebrate community of the Tennessee River. TVA has conducted two recent mussel surveys in the vicinity of COF. A 1992 dive survey of the reach between the mouths of Cane Creek and Mulberry Creek yielded 34 live mussels representing nine native mussel species (none were federal- or state-listed as endangered species). Results indicated that very few mussels exist in this area of the reservoir, and those present are widespread throughout much of the Tennessee River system (TVA, 1992). In 1998, TVA staff conducted a dive survey at the barge terminal (TRM 246.9) along the left (descending) bank just upstream of COF that identified 12 native mussel species (none were federal- or state-listed as endangered species); all are widespread and abundant elsewhere in Pickwick Reservoir (Jenkinson, 1998).

The Reservoir Vital Signs Monitoring Program also has included annual fish sampling at Pickwick from 1990 through 1994, and in 1996, 1998, and 2000. Fish are included in aquatic monitoring programs because they are important to the aquatic food chain and because they have a long life cycle that allows them to reflect conditions over time. Fish are also important to the public for aesthetic, recreational, and commercial reasons. Ratings are based primarily on fish community structure and function. Also considered in the rating is the percentage of the sample represented by omnivores and insectivores, overall number of fish collected, and the occurrence of fish with anomalies, such as diseases, lesions, parasites, deformities, etc. Compared to similar stations at other run-of-the-river reservoirs, the fish assemblage at the Pickwick mid-reservoir station rated good in 1990, 1991, 1993, 1994, and 2000, fair in 1992 and 1998, and excellent in 1996. At the inflow, the fish assemblage has rated good in all sampling years. A total of 34 fish species (excluding *Morone* hybrid) was collected at the transition and inflow stations in TVA's fish collections in the fall of 2000 (Table 11) (Dycus and Baker, 2001). Beginning in 2000, special sampling stations were established at TRMs 242.0 and 247.0 to begin fish sampling for COF 316(a) thermal variance studies. The fish assemblage rated good at TRM 242.0, where 32 species were collected, and excellent at TRM 247.0, where 34 species were collected (TVA unpublished report).

Pickwick Reservoir provides many opportunities for sport anglers. A Sport Fishing Index (SFI) has been developed to measure sport fishing quality for various species in Tennessee and Cumberland Valley reservoirs (Hickman, 1999). The SFI is based on the results of fish population sampling by TVA and state resource agencies and, when available, results of angler success as measured by state resource agencies (i.e., bass tournament results and creel surveys). In 2000, Pickwick rated above average for smallmouth bass, bluegill, walleye/sauger, and white bass, but below average for largemouth bass, spotted bass, channel catfish, crappie, and striped bass. Fossil plant condenser cooling water discharge channels or structures have historically provided enhanced sport fishing opportunities for species, such as catfish, white bass, and striped bass, that are seasonally attracted to warmer waters found there.

Table 11. Fish Species Collected by TVA in 2000 Fall Electrofishing and Gill Netting Samples at the Pickwick Mid-Reservoir Transition (TRM 230.0) and Upper-Reservoir Inflow (TRM 259.9) Stations

Common Name	Scientific Name	Transition	Inflow
Spotted gar	*Lepisosteus oculatus*	x	x
Longnose gar	*L. osseus*	x	-
Skipjack herring	*Alosa chrysochloris*	x	-
Gizzard shad	*Dorosoma cepedianum*	x	x
Threadfin shad	*D. petenense*	x	-
Spotfin shiner	*Cyprinella spiloptera*	x	x
Common carp	*Cyprinus carpio*	x	x
Emerald shiner	*Notropis atherinoides*	x	-
River carpsucker	*Carpiodes carpio*	x	x
Northern hogsucker	*Hypentelium nigricans*	x	x
Smallmouth buffalo	*Ictiobus bubalus*	x	x
Spotted sucker	*Minytrema melanops*	x	x
Silver redhorse	*Moxostoma anisurum*	x	x
River redhorse	*M. carinatum*	-	x
Golden redhorse	*M. erythrurum*	x	x
Shorthead redhorse	*M. macrolepidotum*	x	-
Blue catfish	*Ictalurus furcatus*	x	x
Channel catfish	*I. punctatus*	x	x
Flathead catfish	*Pylodictis olivaris*	x	x
White bass	*Morone chrysops*	x	x
Yellow bass	*M. mississippiensis*	x	x
Striped bass	*M. saxatilis*	-	x
Hybrid striped x white bass	*M. hybrid*	x	-
Rock bass	*Ambloplites rupestris*	-	x
Green sunfish	*Lepomis cyanellus*	-	x
Bluegill	*L. macrochirus*	x	x
Longear sunfish	*L. megalotis*	x	x
Redear sunfish	*L. microlophus*	x	x
Smallmouth bass	*Micropterus dolomieu*	x	x
Spotted bass	*M. punctulatus*	x	x
Largemouth bass	*M. salmoides*	x	x
Yellow perch	*Perca flavescens*	x	-
Logperch	*Percina caprodes*	x	x
Sauger	*Stizostedion canadense*	x	x
Freshwater drum	*Aplodinotus grunniens*	x	x

3.13.2. Environmental Consequences

<u>No Action Alternative</u>

Under the No Action Alternative, SCR/NO_xTech equipment would not be installed or operated, so no impacts to aquatic life would result.

Action Alternatives A, B, and C

Construction Impacts—Under any of the Action Alternatives, potential construction impacts to Pickwick Reservoir would include temporary erosion and siltation resulting from grading and graveling of the temporary barge unloading area and the associated access road and the equipment laydown area. Soil disturbance would also occur as a result of construction of a new bridge over piping to allow access to the main plant area, demolition of buildings and construction of new temporary or permanent office buildings, and any earthmoving related to construction of retention basins. These areas have previously been disturbed by plant construction and modification activities. These impacts would be minimized by implementation of BMPs to control erosion during construction and stabilize disturbed areas after construction is complete and by routing surface runoff to existing treatment facilities that meet regulatory requirements. These measures would substantially reduce the potential impacts in Pickwick Reservoir to the point of causing only minor and temporary effects on fish and other aquatic life.

Operational Impacts—The storage, handling, and use of anhydrous ammonia for the proposed SCR system would result in the potential for ammonia contamination of surface water and impacts to aquatic life. One pathway for impacts is a direct accidental release of ammonia to surface water. The engineered features of the SCR system include a retention basin for spills and emergency water fogging to minimize this risk. Another pathway for surface water impacts is ammonia contamination of combustion byproducts including bottom ash and fly ash. Water discharged from Ash Pond 4 and Ash Pond 5 may contain ammonia. Management of water treatment system flows and other appropriate mitigation measures as necessary (see Section 2.6) will maintain discharge ammonia concentrations at levels that would safeguard water quality and protect aquatic life. Appropriate mitigation of ammonia concentrations in effluent water would result in insignificant impacts to aquatic life that uses adjacent areas of Pickwick Reservoir for spawning or feeding.

3.14. Wastewater

3.14.1. Affected Environment

Existing Coal Combustion Byproducts Wastewater Treatment Facilities

As described below, the coal combustion byproducts handling system utilizes a number of areas that receive and treat wastewater effluents including the fly ash runoff pond (Ash Pond 5) and the bottom ash pond (Ash Pond 4).

Ash Pond 5 (Runoff Pond)

COF burns approximately 3.52 million tons of coal annually. The coal averages 9.4 percent ash; therefore, total ash production will average approximately 300,000 tons of ash per year. The ash is collected as either fly ash, which is fine enough and light enough to be carried with the flue gas stream exiting the boiler, or as bottom ash, which is coarser and heavier and falls to the bottom of the boiler. The fly ash/bottom ash split is approximately 90 percent fly ash and 10 percent bottom ash. Bottom ash is wet sluiced to Ash Pond 4 as described in the next subsection.

Fly ash production is 270,000 tons per year. The fly ash handling system at COF is a dry fly ash handling system. ESPs capture fly ash from the flue gases into hoppers. From the hoppers, fly ash is pneumatically transported to silos.

The dry fly ash is then conditioned with water and loaded into dump trucks for transport to the fly ash disposal or utilization areas. The maximum active area of exposed dry fly ash at the dry fly ash stacking area would be 10 acres or less (D. W. Robinson, TVA, personal communication, 2002). As stacking areas become inactive, they would be stabilized with an interim cover, such as grass or bottom ash, for fugitive emission control. Fugitive emission control would need to be in place on the unexposed or stabilized areas. The dry fly ash stack is graded to a 1 percent to 2 percent slope at the end of each day helping to limit ponding and encourage sheet flow runoff. Runoff from the dry fly ash stacking area drains to a sedimentation pond, Ash Pond 5, where it evaporates or overflows through Outfall DSN 010 into the Tennessee River.

Based on modeling 20 years of actual rainfall data with USEPA's HELP2 model, on average, an estimated 0.065 million gallons per day (mgd) are discharged from Ash Pond 5 through NPDES Outfall 010, which then discharges to the Tennessee River at TRM 245.8. In the plant NPDES permit, TVA is required to monitor pH, oil and grease, total suspended solids, and total recoverable arsenic in Ash Pond 5 water discharges and must meet a limit for oil and grease. These requirements currently do not include monitoring or limitations for ammonia or toxicity. This ash pond currently receives water only from runoff induced by precipitation as shown in Table 12.

Table 12. Outflow Sources from Ash Pond 5

Source	Annual Average Outflow From Ash Pond 5 (mgd)
Precipitation Dry Fly Ash Stacking Area	0.367
Evaporation from Dry Fly Ash Stacking Area	-0.272
Evaporation from Ash Pond 5	-0.030
Total Net Flow:	0.065

Ash Pond 4 (Bottom Ash Pond)

Bottom ash collects in the bottom of the boiler and is washed from the boiler bottoms with jets of water and sluiced to a bottom ash dewatering area within the ash pond complex. Dewatered bottom ash is removed from these cells with pan scrapers and then carried to storage areas within the ash pond complex. Bottom ash production is expected to be approximately 30,000 tons per year. Sources of flow into Ash Pond 4 are listed in Table 13. Further examination of the APH follows. In the plant NPDES permit, TVA is required to meet effluent limitations on Ash Pond 4 as shown in Table 14. These requirements currently do not include limitations for ammonia but do include limits for acute toxicity.

Table 13. Inflow Sources to Ash Pond 4	
Source	**Annual Average Inflow to Ash Pond 4 (mgd)**
Bottom ash sluice water	5.4070
Powerhouse sumps	2.0910
Coal pile runoff pond	0.6171
Dry fly ash silo wash down	0.2880
Nonchemical metal cleaning wastes (except air heater)	0.0600
Nonthermal sump	0.0320
Metal cleaning treatment pond through DSN 001b	0.0233
Septic tank through DSN 001a	0.0080
Direct precipitation onto ash pond	0.1505
Seepage from ash pond dike	-0.1560
Evaporation from ash pond	-0.1201
Total	8.401

Source: 1999 NPDES Permit Number AL0003867

Table 14. DSN 001 and DSN 001b Discharge Requirements				
	Effluent Limitations		**Monitoring Requirements**	
Effluent Characteristics	**Monthly Average mg/L or ppd**	**Daily Maximum mg/L, ppd, or s.u.**	**Measurement Frequency**	**Sample Type**
DSN 001				
Flow (mgd)	Monitor	Monitor	1/week	Instantaneous
pH	-	within range 6.0-9.0	1/week	Grab
Oil and Grease	7.0	9.0	1/week	Grab
Total Suspended Solids	19.0	55.0	1/ week	Grab
Total Copper	-	Monitor	1/month	Grab
Total Iron	-	Monitor	1/month	Grab
48-Hour Acute Bio-monitoring	-	50 percent	1/year	Grab
Total Phosphorus as P	Monitor	Monitor	1/quarter	Grab
Total Nitrates	Monitor	Monitor	1/quarter	Grab
Hydrazine	Monitor	Monitor	1/month	Grab
Ammonia as Nitrogen	Monitor	Monitor	1/quarter	Grab
Total Arsenic	Monitor	Monitor	1/ 2 weeks	Grab
DSN 001b				
Flow	Monitor	Monitor	Daily	Total Volume Estimate
pH (must be 6.0 or greater)	-	Monitor	1/discharge	Grab
Total Copper	1	1	1/discharge	Grab
Total Iron	1	1	1/discharge	Grab

Source: 1999 NPDES Permit Number AL0003867

mg/L = milligrams per liter
ppd = pounds per day
s.u. = standard unit
mgd = million gallons per day

Chemical Treatment Pond

The chemical treatment pond receives the intermittent (once every 24 months) wash water from unit APH and boiler wash. The chemical treatment pond is monitored at DSN 001b before discharging to the bottom ash pond. The chemical treatment pond is managed to meet limits listed in Table 14 above.

3.14.2. Environmental Consequences

Construction Impacts

<u>Surface Runoff</u>

All construction activities would be within the existing plant site. Construction-related runoff may require a construction permit. Using appropriate BMPs, all construction activities would be conducted to ensure that waste materials are contained and that no polluting materials are introduced into receiving waters.

<u>Construction Workforce Domestic Sewage Disposal</u>

Portable toilets would be provided for the construction workforce. These toilets would be regularly pumped out and the sewage transported by tanker truck to a publicly owned treatment works accepting pump out.

Operational Impacts

<u>Wastewater Management of Ammonia Slip</u>

Ammonia slip, the emission of unreacted ammonia (NH_3), is caused by the incomplete reaction of injected ammonia with NO_x present in the flue gas. In high-dust SCR and NO_xTech configurations, the ammonia slip could adhere to or commingle with the fly ash and be discharged to dry handling systems through the precipitators. For the high-dust SCR arrangement, it is estimated that the worst-case slip rate at 2 parts per million volume (ppmv) is approximately 2.5 lbs NH_3/hour/unit to Units 1-4 and 4.66 lbs NH_3/hour to Unit 5 for a total of 14.66 lbs NH_3/hour to all five units. For the combination NO_xTech on Units 1-4 (5 ppmv) and high-dust SCR on Unit 5 (2 ppmv), the resultant slip rate would be 5 lbs NH_3/hour/unit and 4.66 lbs NH_3/hour, respectively, for a total slip rate of 24.66 lbs NH_3/hour. Both loadings above represent combined slip to the fly ash and to the APH.

The unreacted residual NH_3 might react with available gaseous sulfuric acid to form ammonium bisulfate (NH_4HSO_4). The resulting ammonium bisulfate can potentially mix in with the fly ash or build up on the APH elements.

$$NH_3 + H_2O + SO_3 \Leftrightarrow NH_4HSO_4$$

European experience on SCRs using low sulfur coals led to a recent study conducted by ABB Environmental in which, about 20 percent of the NH_3 slip adhered to the heating surfaces in the APH, and about 80 percent adhered to fly ash (ABB Environmental, 1999). No known ammonia partitioning study for NO_xTech has been performed. This assessment assumes that the partitioning will remain the same as for the ABB SCR study. Until there is further experience with U.S. coal types or one of TVA's current operating units' catalyst beds degrades to the point of resulting in ammonia slip, the partition of ammonia slip between fly ash and heating surfaces in the APH will remain theoretical.

Excess ammonia (or ammonia slip) that does not react with the NO_x in the flue gases will pass through the SCR or NO_xTech systems. The amount of ammonia slip will depend on unit operation, and for SCR, the time the catalyst has been in service. Typically, TVA will replace the catalyst or install another layer of catalyst when degraded catalyst allows ammonia slip to reach 2.0 ppmv flue gas concentrations. The option of operating SCR units at a continuous 2-ppmv slip is desired to achieve maximum NO_x reduction. A continuous 2.0 ppmv slip would be a worst-case condition and would result in a total ammonia load of 14.66 pounds per hour if SCRs were installed on Units 1-5. The expected slip rate for Units 1-4 is 2.5 lbs/hour and 4.66 lbs/hour for Unit 5. The catalyst aging is nonlinear and occurs gradually.

For NO_xTech, the units would operate at or below 5 ppmv. Since there is no catalyst, the slip is at a constant rate. The expected slip rate for NO_xTech is 5 lbs/hour/unit for a total loading rate of 20 lbs/hour for Units 1-4. As described above, excess ammonia (as NH_3) will react with the SO_3 in the flue gas to form ammonium bisulfate. Sufficient SO_3 will be available to react with all of the NH_3. Portions of the resulting ammonium bisulfate would have the following fates: (1) adhere to the fly ash that is dry stacked or (2) adhere to the APH elements and be removed by periodic cleaning.

According to the study conducted by ABB Environmental, about 20 percent of the NH_3 slip is precipitated onto the heating surfaces in the APH, and about 80 percent of the ammonia adheres to the fly ash (ABB Environmental, 1999). The worst-case studies conducted for this EA assume that the SCRs have been operating at 2 ppmv slip and NO_xTech at 5 ppmv, and that 100 percent of the APH slip and 100 percent of the available open 10-acre area of the dry stack will have the potential to enter the wastewater stream. Similar to the ABB study, the worst-case analysis for this EA assumes that 80 percent of the ammonia is removed with the dry fly ash and 20 percent adheres to the APH elements.

<u>Effects on Ash Pond 5, Dry Stack Runoff Pond</u>

Analyses in this section assumed that all ammonia adhering to fly ash in contact with storm water would instantaneously dissolve and stay with the water phase until assimilated by the pond or discharged. No volatilization losses to the atmosphere were assumed. Infiltration and seepage by rainfall from the dry stacking area was analyzed independently in the Groundwater Section (Section 3.16) of this assessment.

Two scenarios were evaluated to estimate the potential of ammonia compounds in the dry fly ash to enter the wastewater stream during rainfall events as runoff from the dry fly ash stacking area flows into Ash Pond 5. The first scenario assumed that the varying rain events shown in Table 15 generated runoff from the fly ash stacking area. The second, more in-depth scenario used 20 years worth of actual daily rainfall data in the USEPA HELP2 model to predict expected daily rainwater runoff from the dry fly ash stacking area, resulting concentrations of ammonia in Ash Pond 5, and estimated ammonia nitrogen concentrations in effluent discharged at DSN 010. Other assumptions for the ammonia leaching from the dry fly ash stacking area scenarios are summarized below:

- The concentration of ammonia in the fly ash varies from 60 to 320 milligrams (mg) of ammonia per kilogram (kg) of fly ash as shown in Table 15.

- All of the ammonia stored in the top 1 inch of the active area of the stack dissolves into rainwater and flows into Ash Pond 5.

- The units have been operating at a constant 2 ppmv (SCR units) or 5 ppmv (NO_xTech Units 1-4) slip.
- At a 2-ppmv ammonia slip for Unit 5 and 5-ppmv slip for Units 1-4, Alternative C yields the worst-case ammonia load with an estimated distribution as follows: approximately 4.93 lbs per hour to the APHs and approximately 19.73 lbs per hour to the fly ash.
- A rainfall event generated runoff from the dry fly ash stack, which has just reached maximum 10-acre capacity before being covered.

Table 15 gives the expected effluent ammonia nitrogen concentrations that would result from the runoff from the 20-year simulation and a series of standard storm events. These calculated runoff concentrations assume there are no losses of ammonia to the atmosphere through volatilization.

The runoff from the dry stack area flows to Ash Pond 5, which overflows through DSN 010 into the Tennessee River. If estimates of ammonia concentrations in the fly ash were excessively high, and if the assumption that all ammonia will leach from the top inch of exposed fly ash is erroneous, the actual ammonia concentrations in the storm water runoff would be much lower than estimated. As discussed below, ammonia nitrogen concentrations of 3.2 mg/L or more in effluent water of pH 8.5 or above would exceed the water quality criterion for acute toxicity to aquatic life. As can be seen in Table 15, estimated ammonia concentrations in DSN 010 effluent are below the water quality criterion for acute toxicity to aquatic life at pH 8.5 or below. The predicted effluent concentrations are highly similar because the volume of rainfall is small compared to the volume of the pond, and it was assumed that each rain event leached the same total mass of ammonia compounds.

To analyze the potential for ammonia to accumulate in Ash Pond 5 as a result of successive rainfall events, 20 years of daily rainfall data from the nearby Muscle Shoals Airport were used in USEPA's HELP2 model to predict evaporation and expected volumes of runoff from the dry fly ash stack. Seasonal evaporation data were used to predict evaporation from the surface of Ash Pond 5. On days for which the USEPA HELP2 model predicted runoff from the 10-acre active fly ash handling area, all ammonia compounds in the top inch of the 10-acre active fly ash handling area were assumed to dissolve and be present in the runoff flow into Ash Pond 5. Ammonia loadings on the fly ash, which would result from the three alternatives, were used to calculate ammonia nitrogen concentrations in the runoff, in the pond, and in the effluent. Based on the 20-year simulation, the average residence time for Ash Pond 5 is 389 days. Average flow from the pond was estimated as 23.6 million gallons per year or 0.065 mgd. The 20-year simulation predicts that flow from Ash Pond 5 occurs less than 20 percent of the time. Average flow on days on which flow occurs was estimated as 0.331 mgd. Assuming the dry stack runoff mixed with 80 percent of the pond volume and ammonia removals of 50 percent were achieved in the pond, the maximum estimated effluent ammonia nitrogen concentration for the 20-year simulation was 2.74 mg NH_3-N/L for Alternative C, the SCR and NO_xTech System combination, which is less than the water quality criterion maximum concentration of 3.2 mg NH_3-N/L for pH 8.5.

Table 15. Potential Ammonia Nitrogen Concentrations (mg NH_3-N/L) in DSN 010 Resulting From Varying Rain Events on Dry Fly Ash Stack

		Rain Event						
		Simulation with 20 Years of Actual Rainfall Data		Standard Rainfall Events				
	Calculated NH_3 Concentration on the Fly Ash (mg NH_3/kg)	Averages	Event Producing Maximum Concentrations in Effluent	1 year/ 1 hour	10 years/ 1 hour	10 years/ 6 hours	10 years/ 12 hours	10 years/ 24 hours
Rain Amount (inches)		54.7 inches/yr	3.74 inches/ 4 days[1]	1.4	2.3	3.75	4.75	5.5
Runoff Volume (10^6) (gallons)		23.6	6.6	2.8	4.6	7.5	9.5	11
		Average Effluent NH_3-N Concentrations (mg NH_3-N/L)	Potential Maximum Effluent Ammonia Nitrogen Concentrations (mg NH_3-N/L) Assuming Mixing With 80 Percent Pond Volume					
SCR Unit 5 Only[2]	60	0.06	0.52	0.50	0.46	0.41	0.38	0.36
SCR Units 1-5[2]	190	0.17	1.62	1.56	1.44	1.29	1.20	1.15
SCR/NO_xTech[2,3]	320	0.29	2.74	2.62	2.43	2.17	2.03	1.93

Notes
1. Based on daily rainfalls of 2.23, 1.41, 0.04, and 0.06 inches, respectively; similar to actual rainfall on days 342-345 of 1986.
2. Concentration in milligrams ammonia nitrogen per liter (mg NH_3-N/L) unless otherwise noted.
3. Assumes NO_xTech on Units 1-4 and SCR on Unit 5.

Since compliance with water quality standards may depend on achieving adequate mixing in the pond and adequate removals of ammonia by the pond, studies to determine the most effective means of enhancing the ammonia assimilative capacity of Ash Pond 5 were begun in conjunction with the preparation of this EA. Since flow from DSN 010 has only been monitored on a semiannual basis in the past, a recording rain gauge and a flow meter have been installed at DSN 010 to obtain data that will be used to determine the flow response accurately from DSN 010 in response to different rainfall events. This data will be used in conjunction with historical rainfall data to validate and improve the 20-year simulation that was done for this EA. The pond will also be evaluated to predict its existing assimilative capacity for ammonia. This evaluation will include an algal growth test (including initial and final ammonia concentrations) and toxicity tests using fathead minnows and daphnids. Previous tests of ammonia degradation by ponds at TVA's Paradise Fossil Plant and Allen Fossil Plant have demonstrated ammonia removals of 68 to 95 percent with residence times varying from less than 1 day to 7 days. More encouragingly, ammonia concentrations leaving the test ponds have been 1.0 mg/L or less in all five test cases.

TVA will continue to monitor literature and current industry progress on ammoniated ash runoff. Specifically, TVA will monitor impacts on ash and ash leachate from ammonia additions involving other TVA projects. The flow dynamics of Ash Pond 5 will be studied to determine optimum means of ensuring that adequate mixing occurs. The pond will be modified as necessary, most probably by baffling, to ensure that adequate mixing and assimilation of ammonia compounds occurs. The pH of Ash Pond 5 will be adjusted as necessary to meet NPDES discharge permit requirements.

Baffling Ash Pond 5

Installation of baffles in the pond would ensure full mixing of the entire pond volume. Experience at other TVA plants suggests that the water traveling through Ash Pond 5 may not completely mix with the full free water volume, but instead "short circuits" toward the outfall. Baffling Ash Pond 5 would increase the retention time closer to the theoretical maximum for the pond volume. Increasing retention time would increase mixing, improve pond dynamics, and allow maximum opportunity for biological ammonia removal to occur.

Adjusting pH in Ash Pond 5

As compounds containing ammonia dissolve, and as natural microbial and algal processes for assimilating ammonia proceed, pH changes may occur. If necessary, TVA will install a pH control system to maintain the pH at DSN 010–the effluent from Ash Pond 5–within ranges required by the NPDES permit.

Other Potential Mitigation Measures for Ash Pond 5

If studies indicate that the ammonia assimilative capacity of the dry fly ash stack runoff pond will need to be enhanced, other potential mitigation measures include, but are not limited to, passive treatment systems, such as constructed wetlands, Ringlace media or other media for enhancing growth of nitrifying microorganisms, solar-powered pumps for recirculating water within the pond, or aeration rapids or weirs along the runoff channel. More active potential measures include aeration nozzles within the pond. Aeration devices would increase dissolved oxygen concentrations and enhance aerobic microbial degradation of ammonia. Additional potential mitigation measures may include supplemental nutrient addition system for enhancing algal and microbial degradation of ammonia, reciprocating wetlands, redirecting the pond discharge away from the DSN 010 outfall, dredging to increase the volume of the pond, installation of pumps and a flow control system to manage flows and optimize storage capacity in the pond, air stripping, electrolytic processes for ammonia degradation, installation of recirculating sand filters, installation of trickle filters, installation of conventional biological treatment system, or any other measure consistent with sound engineering practice and sanctioned by ADEM.

TVA's commitment to evaluate the ammonia assimilative capacity of Ash Pond 5 and, if necessary, either enhance the assimilative capacity of Ash Pond 5 or install some other appropriate mitigative measure would ensure that any potential ammonia released through DSN 010 from the dry stack runoff would have no significant impact. TVA's final design would ensure that discharge from DSN 010 met NPDES discharge limitations.

Effects on Ash Pond 4 (Bottom Ash Pond)

Normal operation of the SCR or NO_xTech systems would not be anticipated to affect the operation of the bottom ash pond or bottom ash storage areas since the bottom ash is collected in the boiler prior to the point where ammonia would be injected. However, occasional discharges from the chemical treatment pond into Ash Pond 4 with anticipated ammoniated water is possible from washing APHs through DSN 001b.

Air Preheaters

Data on the effects of SCRs or NO_xTech on APH operation and resulting ammonia concentrations in APH wash water will be unavailable until similar systems operate for a sufficient length of time at other facilities. Theoretically, ammonia build up on the APHs occurs constantly when the unit is in operation and ammonia is being injected. There is potential for a concentrated slug of ammonia to enter the wastewater stream when the APHs are washed. The longer the interval between washings, the more ammonium bisulfate would adhere to the APH elements, in effect, increasing the ammonia load released during a wash.

Unit 5 APHs at COF are ordinarily washed every 2 years off line, while Units 1-4 are washed every 3 years. The need for preheater washing is determined by changes in differential pressure, which indicate basket pluggage. The worst-case estimate is Unit 5 being washed in combination with any other single unit. The highest shock loads of ammonia to the wastewater stream would occur if all four Unit 5 APHs and two of any of the other unit APHs are washed during an outage. The worst-case APH wash scenario analyzed for this EA conservatively assumes the four APHs on Unit 5 are washed at the same time as one of the other units with two preheaters, each with an average 24-month build up of ammonium bisulfate. No losses of ammonia through volatilization or chemical reaction were assumed. Steady release of the ammonium bisulfate material throughout the washing process was assumed although it is likely that a more concentrated release of the material may occur over a shorter time span during the beginning of the washing process.

Under the worst-case scenario, an estimated 50,500 pounds of ammonia are expected to be washed out of the APHs and eventually loaded through Ash Pond 4 as a result of washing the previously mentioned APHs after a 24-month interval between APH washings.

The worst-case APH washing scenario, analyzed for this EA, is summarized below:

- At a 2-ppmv SCR slip on Unit 5 and 5-ppmv NO_xTech slip on Units 1-4, the ammonia load is estimated to be distributed as follows: approximately 4.93 pounds per hour to the APHs and approximately 19.73 pounds per hour to the fly ash.

- The respective units have been operating at a constant 2-ppmv (Unit 5) or 5-ppmv (Units 1-4) slip.

- The units are off line during a planned outage and all Unit 5 and one of the other unit's APHs are being washed for a total of six APHs.

Table 16 gives the expected effluent concentrations of Ash Pond 4, using the worst-case scenario.

Table 16. Potential Ammonia Nitrogen Concentrations at DSN 001

Condition	Worst-Case NH_3 Load (lbs)	Estimated Concentration at DSN 001 (mg NH_3-N/L)
APH Wash[1]	1,278	1.37

1. APH wash water limited to discharging chemical treatment pond ammoniated water over 45 days. Calculation based on complete mixing in the bottom ash pond = 85.8 million gallons. SCR on Unit 5 @ 2 ppmv and NO_xTech on Units 1-4 @ 5 ppmv.

The estimated ammonia concentration in DSN 001 effluent in Table 16 is below the criterion maximum concentration (CMC) for ammonia in effluent water of pH 8.5 (See Table 17), and does not account for possible algal or microbial ammonia degradation of ammonia, so treatment beyond staged release may not be necessary. Additional treatment of APH wash water would be performed if necessary to meet NPDES permit requirements. Conventional ammonia treatment measures, such as pH adjustment, air stripping, biological degradation, and re-circulating sand filters, could be employed at the chemical treatment pond to reduce ammonia from the pond prior to discharge into Ash Pond 4.

Table 17. Maximum Allowable Ammonia Concentrations to Protect Aquatic Life From Acute Effects at Typical pH Levels (assumes salmonids absent)

Acute Criterion (mg N/L)						
pH 6.0	**pH 6.5**	**pH 7.0**	**pH 7.5**	**pH 8.0**	**pH 8.5**	**pH 9.0**
54.99	48.83	36.09	19.89	8.41	3.20	1.32

The APH wash with treatment scenario shown in Table 16 was through an operational treatment measure—staged discharge of the APH wash water. Staged discharge of the APH wash water can be attained by slowly releasing the wash water from the chemical treatment pond to the ash pond over a number of days.

It will be important to ensure that there is enough available volume in the chemical treatment pond to hold and slowly release the APH wash water as prescribed above. The chemical treatment pond may need to be pumped before an APH washing to hold the wash water. A typical APH wash uses approximately 1 million gallons of wash water per preheater (M. A. Gean, TVA, personal communication, September 2002).

There is currently a quarterly monitoring requirement for ammonia at DSN 001; however, there is no ammonia discharge limit. There is also a requirement to monitor acute toxicity once per year, with a WET limit of 100 percent effluent (LC_{50} = 100 percent). Currently there are no ammonia monitoring requirements, ammonia limits, or toxicity limits associated with DSN 010. Any possible future toxicity limit for DSN 010 would be expected to be an acute limit based on the volume of the discharge from DSN 010 relative to the receiving stream (Tennessee River) as well as the intermittent nature of the discharge. The ammonia discharge limits necessary to meet acute toxicity requirements would be a function of pH. For example, the ammonia concentration to protect from acute (lethal) effects to aquatic life in undiluted DSN 001 effluent is 40.61 mg nitrogen per liter (N/L) at pH 6.85 (low end of DSN 001 pH range, January 2000 to January 2002) and 1.43 mg N/L at pH 8.95 (high end of DSN 001 pH range in January 2000 to January 2002). The corresponding range for DSN 010 is 40.32 mg N/L at pH 6.86 and 2.33 mg N/L at pH 8.67 (based on April 2001 to January 2002 data).

Table 17 shows that the ammonia concentrations projected for Outfall 001 (Ash Pond 4) with treatment of the APH washes are below the estimated maximum allowable concentrations for protection of aquatic life under typical operating and pH conditions. These estimates are based on the USEPA CMC. Comparison of possible concentrations that could occur in Outfall DSN 010 during certain rainfall events (Table 15) with water quality criteria in Table 17 shows concentrations which should not exceed criteria and which would not be expected to produce acute toxicity. TVA has conducted acute toxicity tests with fathead minnows and daphnids using ammonia-spiked pond water at varying pH levels to determine the actual toxicity to test organisms in ammoniated site water. The 48-hour LC_{50} values for fathead minnows and daphnids ranged from 38.8 mg NH_3-N and 56.6 mg NH_3-N, respectively, at pH 7.5 to 7.2 mg NH_3-N and 12.2 mg NH_3-N, respectively, at pH 8.5. These results indicate that USEPA's CMC for ammonia would be protective of aquatic life. Algal tests are also scheduled to help estimate removal of ammonia within the pond through biological processes before discharge so appropriate mitigation options can be determined.

There could be some increase in the pH at either outfall due to increased phytoplankton productivity in the ash ponds if nitrogen is currently a limiting nutrient. Any reduction in ammonia or pH necessary to meet WET or other limits would be met by necessary operational and treatment measures in the ash ponds.

Whole Effluent Toxicity

Discharge from Outfall DSN 001 is regulated under NPDES Permit No. AL0003867. Since no effluent toxicity occurred during the last 5-year-permit cycle, TVA was able to demonstrate that under current operating conditions there is no reasonable potential for Outfall DSN 001 to cause toxicity to aquatic life using biomonitoring data. As a result, the frequency of toxicity monitoring was reduced from quarterly to annually under the renewed permit (effective November 18, 1999). The permit currently contains a WET limit of 50 percent mortality in undiluted effluent (48-hour $LC_{50} \geq 100$ percent effluent). There is no WET monitoring requirement or limit for DSN 010.

Acute toxicity of ammonia to aquatic life is pH-dependent, such that at higher pH levels toxicity increases. In addition, the presence or absence of salmonids is a factor in determining the acute criterion. The formula for calculating the acute criterion, or CMC, for ammonia is provided in the recently revised criteria document (USEPA, 1999a). The acute CMC is the 1-hour average concentration of total ammonia nitrogen (in mg N/L) that should not be exceeded more than once every 3 years on the average.

To protect aquatic life from ammonia toxicity at the discharge point for Outfalls DSN 001 and DSN 010, effluent ammonia concentrations that should not be exceeded at various pHs are provided in Table 17. As described in the previous section, operational treatment measures would be utilized to meet permitted toxicity limits for the Ash Pond 4 discharge. It appears ammonia-related toxicity would not be expected for Outfall DSN 001 or DSN 010 based on projected concentrations if adequate mixing with the dry fly ash stilling pond (Ash Pond 5) volume and appropriate assimilation of ammonia by the pond are achieved at or below pH 8.5. Studies discussed in the previous paragraphs will be used to evaluate the toxicity of ammonia in site water and to determine appropriate pH and/or ammonia control measures. In any event, TVA will meet NPDES limits for DSN 001 and DSN 010.

3.15. Surface Water Quality

3.15.1. Affected Environment

The COF site is located on the Tennessee River on Pickwick Reservoir at TRM 245 in north Alabama in a rural area near the community of Barton. The nearest major cities are Florence, Sheffield, Muscle Shoals, and Tuscumbia, Alabama, about 10 miles east of the site. The site is drained by Cane Creek, which has an average flow of 99 cubic feet per second (cfs) (Fehring, et al., 1987). The stream is classified for the uses of swimming and fish and wildlife. The Tennessee River is classified for the uses of public water supply, fish and wildlife, swimming, and other whole body water contact sports (Alabama Water Quality Criteria Standards, 1991). Three municipal drinking water intakes are within 10 miles of COF: the city of Sheffield's Municipal Water Intake, Colbert County Municipal Water Intake, and the city of Cherokee's Municipal Water Intake. The intakes are shown in Figure 5. The Colbert County Municipal Water Intake is also shown in Figure 4.

The Colbert County Municipal Water Intake is located approximately 150 feet upstream of DSN 010, the discharge for Ash Pond 5. The intake is a 30-inch pipe that projects about 350 feet from the bank into the river. This municipal drinking water plant is expected to become operational in May 2003. The design capacity of this plant is 5 mgd. The plant is expected to withdraw 500,000 to 600,000 gallons per day upon initial start-up and gradually increase the amount of water used as additional customers are found. This plant is equipped with standard equipment for potable water treatment including equipment for chlorinating water.

The Tennessee River in the vicinity of the site has experienced historical pollution problems due to poor treatment from municipal and industrial treatment facilities and nonpoint sources (Watson, et al., 1985; Mulkey, 1986; Fehring, et al., 1986 and 1987). Mercury contamination in Pickwick was a significant concern in the 1970s, but concentrations in fish have decreased to levels below Food and Drug Administration limits, and the issue is no longer considered to be significant.

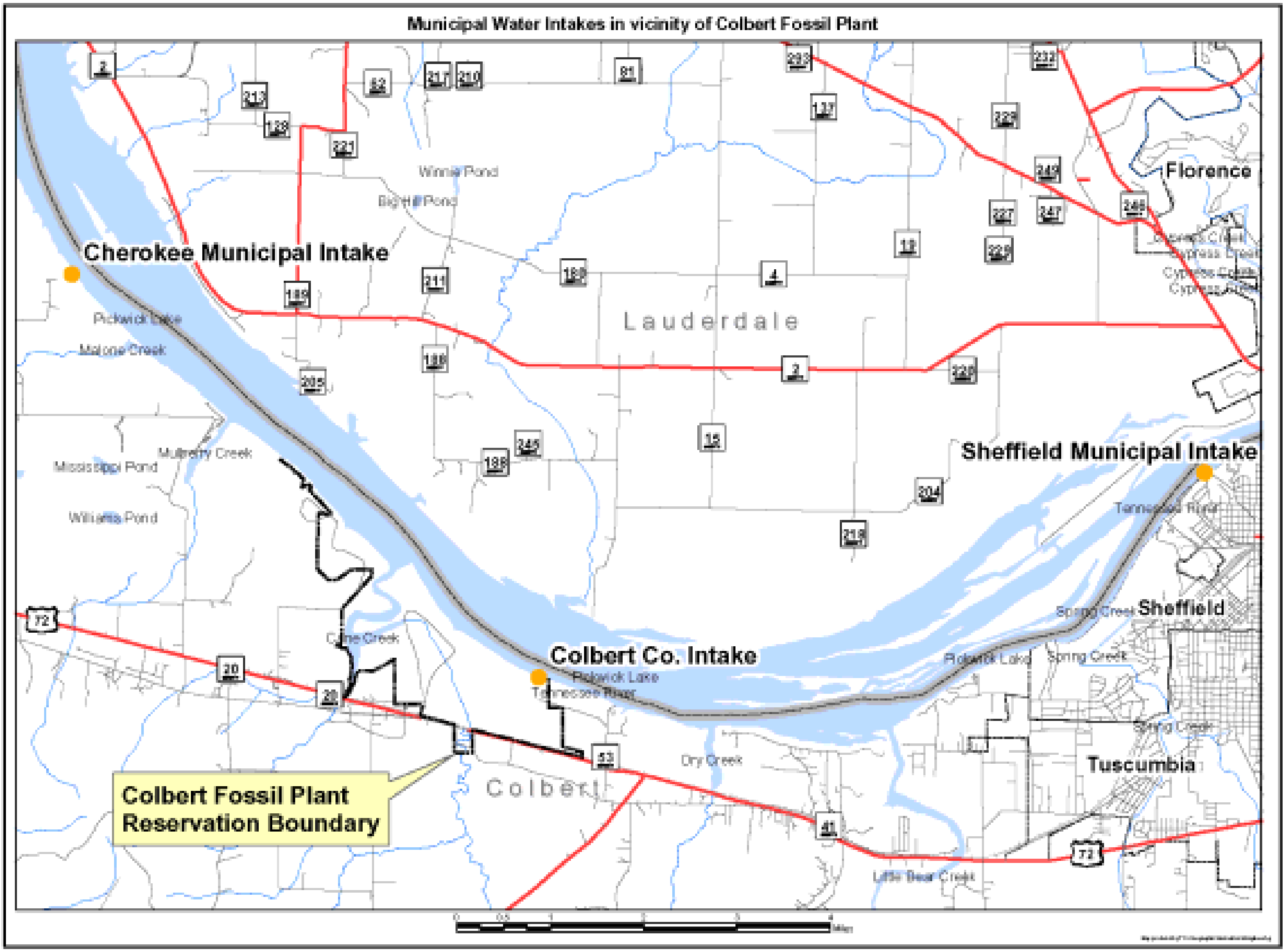

Figure 5. Municipal Water Intakes in the Vicinity of Colbert Fossil Plant

From USEPA's STORET database, historical ammonia nitrogen concentrations in the vicinity of COF range from 0.04 to 0.3 mg NH_3-N/L. Historical nitrate plus nitrite concentrations in the vicinity range from 0.45 to 0.59 mg N/L. Since nitrite is oxidized to nitrate by the standard potable water treatment of chlorination, the water in the vicinity is a source of drinking water, which is well below the drinking water standard of 10 mg N/L for nitrate.

Recent concerns have included occasional low dissolved oxygen from Wilson Dam and occasionally questionable bacteriological quality. The city of Sheffield also has had concerns with trihalomethanes in its water supply (Fehring, et al., 1987). The quality is currently considered to be relatively good, typically meeting ADEM's water quality standards for the designated uses of public water supply and fish and wildlife from the Sheffield water intake at TRM 254.3 to Wilson Dam at TRM 259.4 (Alabama Water Quality Criteria Standards, 1991). Reservoir Water Quality Index values have been high, averaging over 91 for 1990, indicating very good reservoir water quality (Meinert, 1991). Unlike most other TVA reservoirs, Pickwick Reservoir does not thermally stratify, although stratification of dissolved oxygen and to a lesser extent pH does occur (Fehring, et al., 1987). Pickwick is ranked as the least nutrient laden of the nine main stem reservoirs of the Tennessee River system (Placke, 1983). The most significant issue concerning Pickwick water quality at present would be preventing any further degradation during extreme conditions, such as low-flow drought periods, periods of zero flow, and periods of reverse flow.

Another concern is the effect of warm water discharges in the summer. The existing water discharge permits issued by ADEM are designed to protect aquatic species from ill effects of hot water. TVA monitors water temperatures in the vicinity and inputs these data into computer models to predict when the combination of flow and weather conditions could potentially lead to water discharges in excess of limits specified by ADEM. To avoid discharging water at temperatures above ADEM-specified limits, COF curtails coal-fired generating activities as necessary to maintain compliance. These reductions in generation usually occur in the summertime when intake temperatures reach predetermined temperature limits.

3.15.2. Environmental Consequences

Construction Impacts

No impacts to surface water would be expected from construction and installation of the SCRs or NO_xTech, associated ammonia storage, and related systems. COF is already an industrial facility with existing BMPs in place. Any additional BMPs to prevent erosion and runoff to surface waters would be implemented as needed.

Operational Impacts

No direct negative (toxic) impacts on water quality of Cane Creek or the Tennessee River would be anticipated since discharges from the ash ponds and chemical treatment pond would be required to meet NPDES limits designed to prevent degradation of the receiving streams.

The average discharge flow from Ash Pond 5 through DSN 010 of 0.065 mgd is very small compared to the average flow in the Tennessee River at COF of 54,116 cfs or 34,976 mgd. However, during circumstances of zero flow or reverse flow in the river, water discharged from DSN 010 may become part of the water withdrawn by the nearby Colbert County

Municipal Water Intake. For all three Action Alternatives, the average expected concentration of ammonia nitrogen in the discharge from Ash Pond 5 at DSN 010 ranges from 0.06 to 0.29 mg NH_3-N/L. The range of historic background concentrations in the Tennessee River in the vicinity is 0.04 to 0.3 mg NH_3-N/L. Since the average ammonia nitrogen discharge concentrations, which would be anticipated as a result of this project, are comparable to existing background concentrations, the treatment facilities at the Colbert County Municipal Water Plant should be adequate to treat any water discharges from DSN 010. Even in the event of the occurrence of the maximum anticipated discharge concentration of 2.7 mg NH_3-N/L, which would result from Alternative C, the chlorination facilities in the Colbert County Municipal Water Plant would convert the ammonia to nitrate and the resulting nitrate concentrations would still meet the federal drinking water standard of 10 mg N/L or less for nitrate. No significant impact on the Colbert County Municipal Water Intake or other water intakes in the vicinity would be anticipated. In addition to no impacts from NPDES discharges, the estimated low amounts of added nitrogen and ammonia to the Tennessee River due to leached seepage from the dry fly ash stack (Table 18) should not impose any additional stress to biota.

Table 18. Predicted Increases of Ammonia and Nitrate in the Tennessee River Due to Groundwater Leaching from Dry Fly Ash Stack

Parameter	Alternative A	Alternative B	Alternative C
Average ammonia content of ash (mg-NH_3/kg-ash)	162	238	399
Total ammonia loading (kg-NH_3/day)	37.9	55.4	93.2
Ammonia concentration increase (mg/L as N)	0.001	0.002	0.003
Nitrate concentration increase (mg/L as N)	0.001	0.002	0.003

3.16. Groundwater Quality

3.16.1. Affected Environment

The Tuscumbia Limestone (Mississippian age) constitutes bedrock over the majority of the plant site and consists of up to 200 feet of medium-bedded to massive, fossiliferous limestone with abundant chert. The limestone locally contains up to 8 percent bitumen (i.e., a viscous hydrocarbon mixture) which occurs within the rock matrix and occasionally in small vugs or cavities (Benziger, 1951). The Tuscumbia is underlain by up to 200 feet of cherty limestone of the Fort Payne formation (Mississippian), followed by 30 feet of the Chattanooga Shale (Devonian). These sedimentary units are essentially flat lying with regional dips of less than 1 degree. Past core drilling and outcrop observations have shown little evidence of bedrock faulting. Only one fault was identified, and its displacement was less than 1 foot (Benziger, 1951). Surface lineament analysis and subsurface investigations indicate two major, near-vertical bedrock joint sets present in the bedrock (Lindquist, et al., 1994). One joint set is oriented approximately N45°W and the other about N45°E. Groundwater circulation through these joints is believed to be the primary mechanism responsible for development of the numerous dissolution cavities observed in the bedrock. Evidence of karst terrain is abundant with numerous sinkholes across the site and several caves along the river bluff.

The upper bedrock surface at the site is extremely irregular due to differential weathering of the limestone. Consequently, thickness of the residual and alluvial soils, which mantle bedrock, is highly variable, ranging from about 1 to 80 feet. Residual soils are present across most of the reservation and generally consist of clay with variable amounts of chert gravel and cobbles. Quaternary age alluvial deposits are limited to areas along Cane Creek and adjacent to the river beneath the inactive ash pond. The alluvium is typically composed of lenticular deposits of clay, silt, sand, and chert gravel averaging about 10 feet in thickness (Benziger, 1951).

The first occurrence of groundwater beneath the site is generally near the base of the soil overburden or in the upper portion of bedrock. Exceptions occur in the immediate vicinity of plant surface impoundments, e.g., Ash Pond 4, the metal cleaning pond, and the stilling pond associated with inactive Ash Pond 5. In these areas, impoundment seepage artificially maintains saturation or near saturation of the soil profile below the impoundment. Natural recharge of the overburden is derived from infiltration of precipitation. The Tuscumbia Limestone represents the principal aquifer in the site locality. Groundwater occurs in bedrock fractures, joints, and bedding planes, many of which have been enlarged by dissolution of carbonate minerals present in the rock matrix. Borehole flowmeter tests in ten site wells indicate that hydraulically active fractures are typically limited to the upper 45 feet of bedrock, with the most transmissive zones occurring between elevations 377 and 413 feet mean sea level (Lindquist, et al., 1994). Local recharge to the bedrock aquifer occurs from several sources including downward seepage from the soil overburden, direct infiltration of surface runoff through sinkholes and streams, and lateral inflow along the southern boundary of the plant reservation. Groundwater in the Tuscumbia generally flows northward and ultimately discharges into the Tennessee River (Figure 6).

Private water-supply wells in the plant vicinity are listed in Table 19 and locations are shown on Figure 6. With the exceptions of Wells P2 and P8, all wells are used as backup water supplies and for nonpotable uses, such as lawn-garden irrigation and car washing. Well depths range from 136 to 265 feet suggesting that all are completed in the Tuscumbia aquifer. TVA has monitored the water quality of Wells P2 and P8 at least semiannually since September 1989. Monitoring was also performed at Well P3 until May 1998 and at P15 until November 1994. Evaluation of water quality data for these wells indicates that none have been affected by plant operations (Lindquist, et al., 1994; Milligan, 2001).

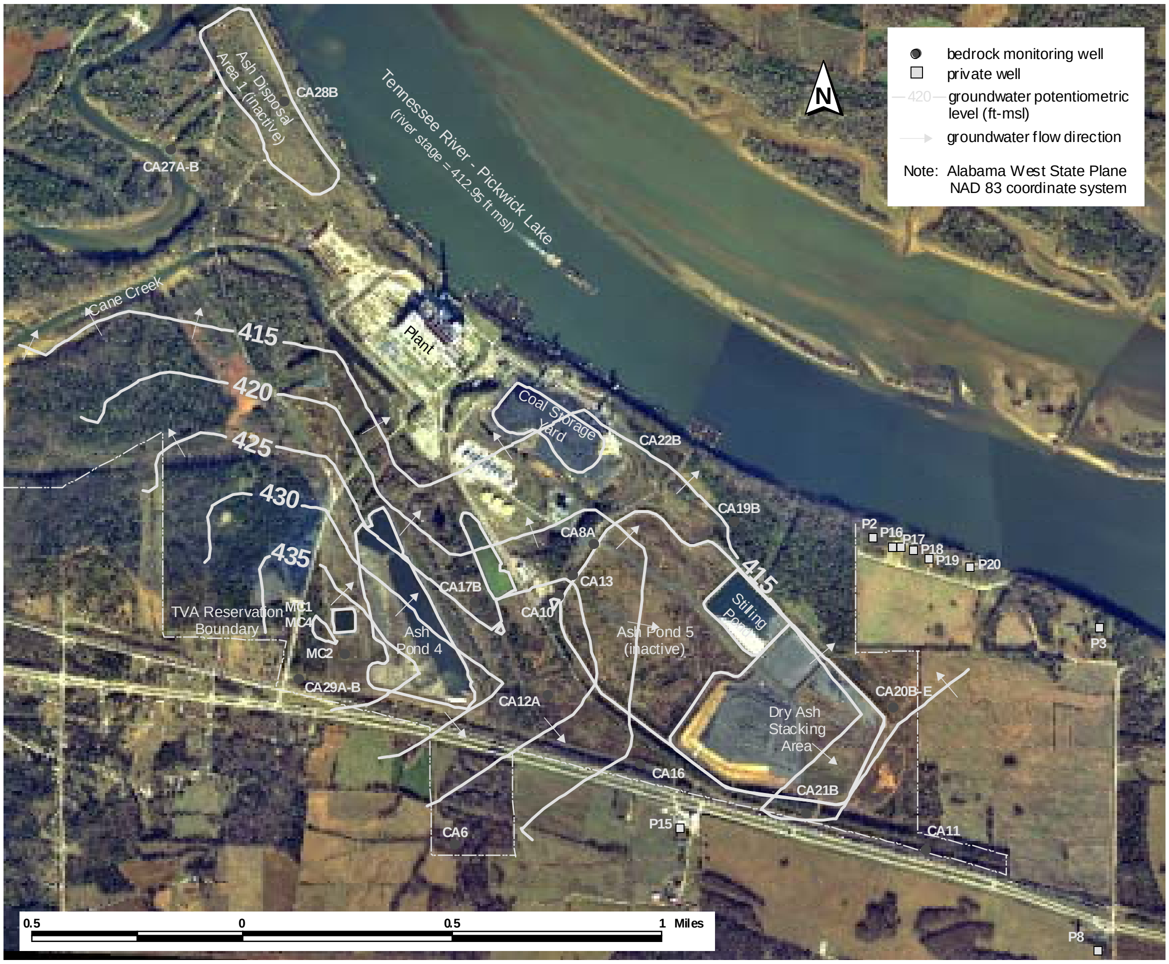

Figure 6. Groundwater Levels and Movement in Tuscumbia Aquifer (October 2001)

Table 19. Well Inventory in Plant Facility

Well No.	Owner	Well Use	Depth (feet)	Comment
P2	E. Buckley	residential	190	
P3	J. Newsome	backup	265	residence on public water
P8	G. Donald	residential	200	
P15	G. Foster	backup	136	residence on public water
P16	D. Sides	backup	220	residence on public water
P17	P. Sides	backup	220	residence on public water
P18	F. Seward	backup	unknown	residence on public water
P19	S. Dickinson	backup	250	residence on public water
P20	D. McAnalley	backup	180	residence on public water

3.16.2. Environmental Impacts

Construction Impacts

No Action Alternative

There would be no groundwater resource impacts associated with this alternative.

Alternative A - SCR Installation on Unit 5 and No Action on Units 1 Through 4

Plant construction activities potentially affecting groundwater resources would be limited to excavations associated with (1) the SCR reactor, (2) the ammonia retention basin at either Location 1 or 2, and (3) ammonia transfer lines between the ammonia storage tanks and the SCR unit. Excavations associated with structures and subsurface lines are not expected to exceed about 5 feet in depth, and are not expected to encounter significant groundwater. The overall impact of Unit 5 SCR construction on groundwater resources would be negligible and insignificant.

Alternative B - SCR Installation on Units 1 Through 5

The construction impacts of this alternative on groundwater resources would be similar to those of Alternative A.

Alternative C - SCR Installation on Unit 5 and NOxTech Installation on Units 1 Through 4

In addition to the construction activities listed for Alternative A, the NO_xTech installation would involve construction of an underground natural gas line between the existing metering station and the plant (Figure 4). The excavation associated with the gas line is not expected to exceed 5 feet in depth and is not expected to encounter significant groundwater. Groundwater control, if needed, would be limited to short-term dewatering of excavations. The construction impacts of this alternative on groundwater would be negligible and insignificant.

Operational Impacts

In general, the potential sources of groundwater contamination during plant operations include (1) infiltration of surface releases of ammonia within the storage tank retention basin following accidental spills or tank failure, and (2) infiltration of ammoniated-ash leachate from the dry ash stacking facility.

Accidental Release of Ammonia from Storage Facility

Preliminary design indicated that the spill retention basin would most probably have a depth of 2 feet. However, due to the preliminary nature of that design calculation, the worst-case depth for the ammonia solution in the retention basin was assumed to be 5 feet (1.52 meters). This is similar to the greatest solution depth (5.24 feet for Bull Run Fossil Plant) estimated or assumed so far for the other TVA plants that have been evaluated in this regard. Thus, this assumption should cover the range of possible design revisions of the spill retention basin at COF.

This basin would be located adjacent to the tank storage area such that it would collect any emergency ammonia solution releases from the tank area. At a minimum, TVA would line the basin with either clay liner or compacted in-situ soils. For the management of an ammonia spill, two scenarios were analyzed: (1) the retention basin is lined with compacted, low permeability clay or a synthetic liner and (2) the basin is comprised of a wall or berm surrounding the floor/bottom that is comprised by the existing in-situ soil materials. For either of the two scenarios, outdoor containment such as proposed would be drained of excess precipitation periodically as necessary to retain storage capacity. This is particularly important, as precipitation from the entire ammonia tank storage area would be directed to the retention basin. If this rainwater is thought to be contaminated, it would be tested prior to drainage/disposal and managed appropriately.

For the scenario with the clay-lined basin, the released solution would be totally contained within the basin, except for the likely off-gassing of ammonia. Well-compacted clay liners would typically exhibit permeabilities of from 0.5×10^{-7} to 1×10^{-7} centimeters per second (cm/s)—essentially impermeable, as would be a synthetic liner. The liquid accumulated in the basin would be pumped out and hauled off for commercial disposal or transferred to a storage pond on site for further management.

In the absence of the specific volume of leaked ammonia and the quantity of dilution water (deluge and rainfall runoff water) a specific calculation of the pH of the resultant ammonia solution cannot be done. However, based on the previously examined systems, the ammonia solution in the retention basin at COF would be no more concentrated than about 10 molar in ammonia/ammonium and would have a pH of about 12. At this pH, the solution falls below the threshold (pH 12.5) that would qualify it as a hazardous waste. Nevertheless, the concentrated ammonia solution is very caustic. In addition, ammonia vapor would volatilize quite readily from such a high pH solution. Thus, careful neutralization of the ammonia solution accumulating in the retention basin from an accidental release to reduce the pH to less than 8 is recommended as an interim management measure. At pH 8, the volatilization of ammonia would be negligible.

For the alternative scenario lined with in-situ soils, the degree of containment of the worst-case ammonia solution is dependent primarily on the permeability of the soils comprising the floor of the retention basin. As mentioned previously, the assumed worst-case average depth of the ammonia solution is 5 feet (1.52 meters). The infiltration of this ammonia solution into the soil of the retention basin was estimated based on the Green-Ampt model (Green and Ampt, 1911) for infiltration through partially saturated soils (J. M. Boggs, TVA, personal communication, 2002). It assumes a sharp (step function) wetting front without diffusion or dispersion of the ammonia solution.

The proposed location for the ammonia tanks and the associated retention basin is either Location 1 or 2. There are no boring logs currently available for either of these locations. In the absence of soils data specific to the retention basin locations, data derived from other areas at the COF reservation and from the literature were used for the analysis. The closest borings are about 200 feet from either site.

Using available data, the thickness of clay residuum at the proposed retention basin at Location 1 is conservatively estimated to be 23 feet, while the depth to the water table is about 40 feet below existing grade. Residual soils at Location 2 are estimated to be on the order of 50 feet, and the water table lies at an estimated depth of 30 feet below existing grade. Laboratory testing of soil cores collected elsewhere on the COF reservation indicates that the residual clay is relatively impervious, having an average vertical hydraulic conductivity of approximately $2.2x10^{-7}$ cm/s. Volumetric moisture content of the residuum averages 0.46. The Tuscumbia Limestone underlies the soil overburden at both proposed basin sites. Soil overburden in the storage area is generally expected to consist of clay residuum, as found in most areas of the COF reservation outside of the Tennessee River floodplain.

Physical and hydraulic soil properties used in this analysis were largely obtained from soil investigations conducted at COF by Benziger (1951) and Lindquist, et al. (1994). These studies provided values for saturated hydraulic conductivity (*Ks*), porosity (*n*), and ambient moisture content (*Wo*). Moisture retention and relative hydraulic characteristics for the site soils were assumed using properties for a soil having a similar grain-size distribution (i.e., Yolo light clay) as reported by Mualem (1976).

The Green-Ampt infiltration model was used to estimate the rate of downward movement of the ammonia solution wetting front through the layer of soil fill material between the bottom of the retention basin and the likely water table. Values for key parameters used in the infiltration analysis included a vertical saturated hydraulic conductivity of $1.9x10^{-4}$ meters per day (m/d) ($2.2x10^{-7}$ cm/s), a total porosity of 0.50, an initial volumetric moisture content of 0.46, and pressure head at the wetting front of -0.17 meters. Results are given in terms of estimated time for ammonia front to reach selected depths below the basin floor (J. M. Boggs, TVA, personal communication, 2002).

Excerpts of these results are presented in Table 20 below. By this reckoning, at Location 1, it would take the front almost 2 years to go through the entire existing layer of clay residuum (18 feet below the basin floor) and still not encounter the groundwater at a depth of 35 feet below the basin. Similarly, for Location 2, it would take almost 3.5 years for the wetting front to reach the groundwater there, which is approximately 25 feet below the basin floor and in the layer of clay residuum. No retardation factor was incorporated in the calculations of the movement of the ammonium because the high ammonium concentrations involved would readily saturate any available soil cation exchange capacity.

Table 20. Infiltration of the Worst-Case Ammonia Solution into the Ammonia Tank Retention Basin Soil Based in Part on Estimates for a Similar Reference Soil[a] (Yolo Light Clay)

Depth of Wetting Front		Yolo Light Clay Time Elapsed	
(meters)	(feet)	(days)	(hours)
0	0	0	0
0.15	0.5	1.25	30
0.30	1.0	5	115
0.61	2.0	17	417
0.91	3.0	36	--
1.52	5.0	86	---
6.1	20 [b]	707 (1.94 years)	--
9.15	30 [c]	1227 (3.4 years)	--

[a] Cumulative infiltration of less than 1 percent of initial ammonia solution depth in basin would occur within 5 days for the Yolo light clay.
[b] Depth to estimated high groundwater level for Location 1.
[c] Depth to estimated high groundwater level for Location 2.

The infiltration data also indicate the changes in the depths for cleanup above and below the basin bottom with increasing time. Thus, it would take 30 hours and almost 5 days for the front to penetrate to 6 inches and 1 foot, respectively, below the basin floor (Table 20). Yet, even with penetration of the front 1 foot below the basin floor, over 99 percent of the depth of ammonia solution retained initially in the basin would be uninfiltrated and available for removal and alternate management. Of course, removal of the infiltration head by removal of the pool of free liquid would have the added benefit of reducing the rate of infiltration of the solution into the bottom of the basin.

The nature of anhydrous (liquid) ammonia and the regulatory background have a direct bearing on the use of the infiltration data. The reportable quantity for anhydrous ammonia is given in 40 CFR 117 (USEPA, 1999b) and 40 CFR 302 (USEPA, 1999c) as 100 pounds for releases to the environment. If the environment is an unlined basin constructed on the existing ground, any spills would have to be cleaned up expeditiously.

The infiltration/transport analysis indicates that the great depth to the groundwater table and the low permeability of the native soil in the area put groundwater at little risk for contamination in the event of a catastrophic tank failure under worst-case conditions. On the basis of this analysis, it would appear that the native in-situ soil at either site (Location 1 or 2) would be more than adequate to protect the groundwater in the event of a catastrophic loss of a tank of liquid ammonia under worst-case circumstances.

Notably, because of the similarities in hydraulic conductivities between the artificial clay liner (0.5×10^{-7} to 1×10^{-7} cm/s) and the native in-situ soil (2.2×10^{-7} cm/s) scenarios, the performance of these two alternatives under the emergency ammonia release conditions would be similar.

However, despite the apparent adequacy of native soils to contain an ammonia release, the state of Alabama may require that the retention basin be lined with an impermeable membrane (synthetic liner). The presence of a karstic aquifer beneath the COF site and the history of karst-related pond failures suggest the possibility that over time runoff accumulation and seepage in an unlined retention basin might produce sinkhole collapse beneath the pond.

Impacts of Ammoniated Ash Disposal

No Action Alternative

There would be no groundwater resource impacts associated with this alternative.

Action Alternatives A, B, and C

Dry ammoniated ash produced by any of the proposed SCR or hybrid NO_xTech-SCR systems would be stacked directly on top of existing ash at the 80-acre dry ash stacking facility shown on Figure 6. No more than 10 acres of dry ash would be exposed at any time during the stacking period. The ash stack would ultimately be capped with 1 foot of clay having hydraulic conductivity of 10^{-7} cm/s or less, followed by 1 foot of vegetated topsoil.

The quantity of ash leachate produced by infiltrating precipitation during stack development was estimated by Lindquist and Young (1989) to be approximately 23,000 gallons (87,000 liters) per day or about 8 percent of average annual precipitation. Their stack water budget analysis assumed an average stacking rate of 10 feet/year, an initial volumetric moisture content of 24 percent for the ash, and average annual precipitation of 51 inches/year. Ash leachate seepage through the base of the dry stack would migrate downward through the partially saturated residuum and into the underlying Tuscumbia aquifer. Ammonia present in leachate emerging from the base of the stack is expected to undergo microbial oxidation to nitrate during transport through the largely aerobic soil column. Consequently, most if not all of the ammonia would likely be transformed to nitrate before reaching the Tuscumbia aquifer. Groundwater flow patterns shown on Figure 6 indicate that leachate entering the shallow bedrock aquifer would then flow northeastward and ultimately discharge into the Tennessee River.

Worst-case estimates of ammonia and nitrate concentration increases in the Tennessee River are provided for each Action Alternative in Table 18. Given the uncertainty regarding the extent of transformation of ammonia to nitrate during groundwater transport, estimates were made for two extreme cases: (1) assuming no attenuation or transformation of ammonia during transport and (2) assuming complete transformation to nitrate. The average ammonia content of the ash and total ammonia loading (i.e., total quantity of ammonia leaving the dry stack as leachate) are provided for each alternative for reference. Ammonia and nitrate concentration increases in the Tennessee River were estimated assuming complete mixing of the total ammonia (or nitrate) loading with the 7Q10 (minimum 7-day low flow that occurs once in 10 years) low river flow of 12,000 cfs (E. A. Thornton, TVA, personal communication, 2002). The resulting nitrate concentration increases in the river range from approximately 0.001 to 0.003 mg/L as nitrogen for the three alternatives. Historical nitrate levels in the Tennessee River at the COF intake range from 0.12 to 1.00 mg/L as nitrogen. Therefore, none of the Action Alternatives would result in nitrate concentrations exceeding the USEPA drinking water standard of 10 mg/L as nitrogen. Potential nitrogenous compound concentration increases from ash leachate seepage are less than the usual detection limits for the compounds in question. Due to the extremely low concentrations, the effects of ammonia leaching to the river from the dry ash stacking area should be insignificant.

Based on groundwater flow patterns in the plant vicinity, off-site Wells P2 and P16 through P20 appear to be situated downgradient of the dry ash stacking facility (Figure 6). Well P2 has been monitored at least semiannually since September 1989, and water quality data show no evidence of ash leachate contamination (Milligan, 2001). This may be due to the fact that Well P2 is relatively deep (190 feet) and may not encounter shallow groundwater in the upper portion of the Tuscumbia aquifer where leachate would be expected. On this basis, groundwater quality impacts of ammoniated ash disposal at the dry stacking facility are not anticipated at Well P2 or at neighboring Wells P16 through P20.

To ensure that local residential wells are not adversely affected by dry stacking of ammoniated ash, future groundwater samples collected semiannually from private Wells P2 and P8 would be analyzed for an expanded list of water quality parameters including ammonia, total nitrate-nitrite, and total Kjeldahl nitrogen. TVA would continue to monitor Wells P2 and P8 semiannually as indicators of off-site groundwater quality. In TVA's judgment, should the water quality of any private well be impaired by ammoniated ash leachate such that water is no longer suitable for its intended use, the owner would be provided either a water treatment system, a connection to the local public water system, or a new well.

3.17. Socioeconomics

3.17.1. Affected Environment

COF is located in Colbert County, Alabama, west of Tuscumbia. Colbert County, along with Lauderdale County to the north, constitutes the Florence Metropolitan Area. The central cities of the metropolitan area are Florence (in Lauderdale County) and Muscle Shoals, Sheffield, and Tuscumbia (in Colbert County). According to the 2000 Census of Population, the total population of the metropolitan area is 142,950, of which 54,984 are in Colbert County. Colbert County has a somewhat greater share of its employment (about 20 percent) in government than the state as a whole (16 percent) and a smaller share (about 20 percent) in services (26 percent statewide). There is a smaller share of Colbert County's workers employed in managerial and professional jobs and other white-collar occupations and more in blue-collar occupations, compared to the state. The latter span the range of skill requirements.

The labor market area is defined to include the adjacent counties, including Tishomingo County, Mississippi, west of the site; also included are Madison and Morgan Counties, in which are located the cities of Huntsville and Decatur. The two latter counties, along with the Florence Metropolitan Area, are likely major sources of employment for any construction activity.

<u>Population</u>—As noted above, the population of Colbert County is 54,984, which is an increase of 6.4 percent compared to the 1990 Census count of 51,666. This was a slower rate of growth than the state of Alabama, which increased by 10.1 percent. The labor market area grew faster than the state, reaching a 2000 population of 681,579, an increase of 13.3 percent from the 1990 total of 601,427.

The population in Colbert County is 81.5 percent white and 16.6 percent black or African American. The minority population of the county, including the white Hispanic or Latino population, is 19.1 percent of the total.

Income and Employment—Per capita personal income in Colbert County in 2000 was $22,299, almost 95 percent of the state average of $23,521, and almost 76 percent of the national average of $29,469. The level was higher in the labor market area as a whole, $24,884 or 106 percent of the state and 84 percent of the nation. There was considerable variability, however, among the counties in the labor market area, ranging from $17,003 in Tishomingo County, Mississippi, to $28,995 in Madison County. The largest source of earnings in Colbert County in 2000 was government employment, which contributed 29.1 percent of earnings, followed by manufacturing, with 22.3 percent of the total, and services, with 14.1 percent.

With a civilian labor force of 25,245 in 2001, Colbert County had an unemployment rate of 8.4 percent, well above the rate in the labor market area (5.3), the state (5.3), and the nation (4.8). The distribution of jobs by industry in Colbert County is somewhat different from that of earnings. Government is also the largest source of jobs, providing 20.3 percent of the total. However, due to relatively higher wages and fewer part-time jobs, manufacturing provides a smaller share (16.1 percent) of jobs than of earnings (22.3 percent). On the other hand, services provides a larger share of jobs (19.7 percent) than of earnings (14.1 percent).

3.17.2. Environmental Consequences

Construction Impacts

No Action Alternative

Under the No Action Alternative, no construction activity would occur. Therefore, there would be no impacts.

Alternative A

Employment—Under this alternative, an SCR system would be installed on Unit 5, and no action would be taken on Units 1 through 4. The construction period for the unit is estimated to be about 11 months, with peak employment levels corresponding with outages in early 2003 and in 2004. Maximum employment at any one time would be close to 600 workers. Employment would peak during the 2004 outage, with a somewhat smaller peak during the early 2003 outage. Between these peaks, employment would generally be in the 100 to 200 range. The peaks themselves would be of short duration, spiking up and back down over a period of about 3 months or less. Related construction activities, such as road grading and widening or office building or demolition, might occur during unit construction. However, these activities would employ only a few additional workers and would be short lived. Therefore, they would not add significantly to the peak employment levels.

Based on experience and on the proximity of the site to Huntsville, as well as to the Florence Metropolitan Area, most of these workers are expected to live in the general area, close enough that they would commute rather than move. However, some would move to the general vicinity of the plant.

Income—Total cost of labor for the unit is expected to be a few million dollars, somewhere around 1 percent of the annual earnings of Colbert County. However, since many of the workers would commute from other counties, the actual impact on Colbert County would be much less. The expected total cost of labor would be a minor addition to earnings, less than one-tenth of 1 percent of earnings in the labor market area. Construction-related purchases in the area would be minor but, along with spending by workers who temporarily move to the area, would have a small but positive impact on income in the county and surrounding area.

Population—Since only a small share of the workers are expected to move into the area, the maximum impact on population at any one time would probably be less than 200 workers plus whatever family they brought with them. As noted above, the peaks would be of very short duration, spiking up and back down over a period of about 3 months. Because of this short duration, the number of family members who move with the workers would probably be low. It is likely that the maximum population impact at any one time would be around 300 persons, about one-half of 1 percent of the current population of Colbert County. The distribution of this population among counties and within counties would depend largely on the availability of housing or of sites for trailers. Locations near the site or near shopping and other amenities would generally be preferred.

Community Services—Impact on community services, such as police, fire, and medical, would be small because of the small size of the impact on population and because of the short duration of the maximum impact.

Alternative B

Employment—Under this alternative, SCR systems would be installed on all five units. The construction period for each unit is estimated to be about 11 months, with peak employment levels corresponding with outages in about the third and ninth months. The second peak would reach a maximum employment level of close to 600 workers. The first peak should be somewhat smaller. Construction on Unit 5 and Units 1 through 4 would not be expected to overlap, but the construction on Units 1 through 4 would most likely overlap. Peak employment for the entire project would be close to 600 workers. Between the peak levels, employment would generally be in the 100 to 200 range. The peaks would be of short duration, spiking up and back down over a period of about 3 months or less. Related construction activities, such as road grading and widening or office building or demolition, might occur during unit construction. However, these activities would employ only a few additional workers and would be short lived. Therefore, they would not add significantly to the peak employment levels.

Based on experience and on the proximity of the site to Huntsville, as well as to the Florence Metropolitan Area, most of these workers are expected to live in the general area, close enough that they would commute rather than move. However, some would move to the general vicinity of the plant.

Income—Total cost of labor for each unit is expected to be a few million dollars, somewhere around 1 percent of the annual earnings of Colbert County. Since many of the workers would commute from other counties, the actual impact on Colbert County would be much less. The total cost of labor for each unit would be less than one-tenth of 1 percent of earnings in the labor market area, a minor addition to earnings. Construction-related purchases in the area would be minor but, along with spending by workers who temporarily move to the area, would have a small but positive impact on income in the county and surrounding area.

Population—Since the peak employment levels would be about the same, the impacts on population would be similar to those of Alternative A. However, they would continue until all five units were complete.

Community Services—Impact on community services, such as police, fire, and medical, would be small because of the small size of the impact on population and because of the short duration of the maximum impact.

Alternative C

Employment—Under this alternative, an SCR system would be installed on Unit 5 and some combination of SCR and NO_xTech systems on Units 1 through 4. Employment impacts of the SCR system construction would be the same as those described for Alternative A. Construction employment for the NO_xTech system is expected to be less than for the SCR system since there would be no heavy equipment demolition or construction. Therefore, the total employment impacts for this alternative should be somewhat less than for Alternative B.

Income—Under this alternative, income impacts should be somewhat less than under Alternative B.

Population—Under this alternative, population impacts should be similar to those of Alternative B, but the magnitude of the impacts would be somewhat less.

Community Services—Impact on community services, such as police, fire, and medical, would be small because of the small size of the impact on population and because of the short duration of the maximum impact.

Operational Impacts

Once the construction is complete, any operational changes would be minor under any of the Action Alternatives and would have no noticeable socioeconomic impacts. Under the No Action Alternative, there would be no impacts on operations.

Environmental Justice

The proposed actions would physically be a minor addition to an expansive heavy industrial facility having a significant property buffer area. Therefore, there is low potential during construction for important impacts on any of the residents of the surrounding area, and there are unlikely to be any disproportionate impacts to minority or low-income populations. On the other hand, all the residents of the surrounding area, including minority and low-income residents, would benefit from the resulting reduction in NO_x.

In general, operational impacts would be minor and not noticeable to residents of the surrounding area. However, there is a small probability of ammonia releases, as discussed above. In the unlikely event of such releases, demographic data for areas around the site indicate that disproportionate impacts to minority or low-income populations would be unlikely. Data from the 2000 Census of Population show that the Block Group (a Census of Population subcounty geographic unit) in which the plant is located has 9.2 percent minority population and a poverty rate of 15.0 percent. This minority population share is lower than the county as a whole, as well as the state average; the poverty rate is slightly higher than the county, but lower than the state level. Areas immediately around the plant site, as shown in Table 21, have minority population levels well below the statewide average, with poverty rates slightly higher than the state average.

Table 21. Minority, Low Income, and Total Population Levels for Areas Surrounding Colbert Fossil Plant

Distance From Site to Endpoint	Total Population, 2000	Minority Population, 2000 (%)	Low-Income Population, 1999 (% below poverty level)
5.8 km (3.6 miles)	1,661	13.5	17.7
11.1 km (6.9 miles)	8,698	12.4	16.5
Colbert County	54,984	19.1	14.0
Lauderdale County	87,966	12.2	14.4
Alabama	4,447,100	29.7	16.1

Source: Based on data from the U. S. Bureau of the Census, 2000 Census of Population

3.18. Transportation

3.18.1. Affected Environment

COF is served by highway and railway modes of transportation. Portions of the existing transportation network in the vicinity of the plant are shown in Figure 1. The plant is located in Colbert County, Alabama, approximately 10 miles west of Tuscumbia and 3 miles east of Cherokee. Truck and automobile access to the plant is via U.S. Highway 72, which is a principal four-lane, divided highway with wide shoulders traversing a gently rolling rural area in an east-west direction through north Alabama. State Road 247 is a two-lane highway that serves as a connector and feeder route to U.S. Highway 72. Table 22 shows the 2000 average daily traffic counts.

Table 22. Average Daily Traffic Counts for 2000

U.S. Highway 72	20,450
State Road 247	2,300

Source: Alabama Department of Transportation, Second Division, District 1

Norfolk Southern Railroad operates a main east-west rail line just south of the plant; however, no deliveries to the plant are made by rail except for special circumstances, such as transformer movements.

3.18.2. Environmental Consequences

If no plans are undertaken to add NO_x reduction facilities at COF, none of the roads listed above would be affected. By adding NO_x reduction facilities, there would be additional road traffic generated during both the construction of the facility itself and for deliveries of ammonia to the plant. Although rail delivery could be utilized, this analysis is based on the impacts that truck delivery of ammonia would have on the area roads. Rail delivery is not being considered for this facility.

By building NO_x removal facilities at COF, there would be minor impacts to the federal, state, and county roads during both the construction and operational periods. Additional traffic generated would be for construction of the facility itself. The construction period for Unit 5 would be approximately 2 years, with the peak workforce about 600 employees for up to 30 days during unit outages. Assuming an average ridership of 1.6 persons per vehicle, and a trip in and out each day, about 500 vehicles would be added to the road network due to daily commuters during this period. There would also be additional traffic added to the road network throughout the day in the form of construction material deliveries to the site. These deliveries may be by highway or river. Some additional delay may be experienced at the intersection of Steam Plant Road and U.S. Highway 72 at shift changes. The people primarily experiencing the delay would be the construction commuters. Such a problem can be easily tolerated for the duration of the construction period. The employment levels would spike to peak levels in short durations, rising and falling quickly over a period of 1 to 2 months. A much smaller number of additional workers may be on site performing construction-related work during the few months before and after a unit outage.

The methodology in the Transportation Research Board, 1994, manual was used to identify possible traffic flow problem areas. The manual provides a qualitative method to measure the operational conditions within a traffic stream and their perception by motorists. This method takes into account lane widths, shoulder effects, average highway speed, alignment, etc. Six levels of service (LOS) are defined and given letter designations, from A to F, with LOS A representing the best conditions and LOS F the worst. At several representative points, the LOS provided to the existing traffic was compared to the LOS to the sum of the existing traffic and the projected additional traffic. Traffic impact is considered significant if the predicted LOS drops below D.

In the long term, operation of the NO_x removal equipment would not generate any noticeable additional traffic for the roads in the local area. The roads in this area are fully capable of absorbing this additional traffic with no drop in the existing LOS currently provided to the road users. There is no location where the LOS provided to the commuting public drops below LOS D due to this proposed development. The potential traffic impact for both the construction and operational phases of the NO_x removal equipment is insignificant.

Ammonia Unloading Facilities/Operation

The ammonia unloading facility would be sited on the western side of COF near the plant perimeter road. After construction is completed, operation of SCR on Unit 5 and NO_xTech on Units 1 through 4 (Action Alternative C) would require ammonia deliveries of approximately three tanker trucks per day per 5-day week. The truck deliveries would not affect the capacity or LOS currently provided by the existing road network. Since the impacts of the ammonia deliveries for Action Alternative C, which would require the greatest number of deliveries, are insignificant, the lesser impacts of fewer ammonia deliveries for Action Alternatives A and B are also insignificant.