3. EXISTING ENVIRONMENT

3.1 SITE DESCRIPTION, AESTHETICS, AND LAND USE

The proposed project would be located in an industrial setting in the city of Jacksonville along the north shore of the St. Johns River, approximately 10 miles west of the Atlantic Ocean. The local terrain is flat, and there is a mix of industrial, commercial, residential, and agricultural land use in the vicinity. The site property contains a number of wetlands, especially in the perimeter areas. The most striking environmental feature associated with the area is the nearby presence of estuarine salt marsh backwaters of the St. Johns River. The Timucuan Ecological and Historic Preserve borders the site to the east.

Because the site is located at Northside Generating Station, adjacent to the St. Johns River Power Park, the viewing landscape is conspicuously marked with combustor and steam turbine buildings, flue gas stacks, cooling towers, and associated infrastructure. Northside Generating Station has two stacks that are 250 ft and 350 ft tall. A 300-ft stack at the station was dismantled and removed in early 1998. The Power Park has a 640-ft chimney and two 425-ft hyperbolic cooling towers. Emissions from the Northside and Power Park stacks are occasionally visible, and plumes of water droplets from the Power Park cooling towers are frequently visible. In addition to these highly visible structures, there are numerous smaller structures, roadways, and parking areas. Blount Island, located immediately to the southeast in the St. Johns River, is a major port with loading and unloading cranes that are easily visible from nearby viewing points.

The city of Jacksonville encompasses nearly the entire land area of Duval County. Table 3.1.1 shows the distribution of various land uses within the Jacksonville city limits as of 1985 (the most recent year with reliable data). At that time, 40.8% of the land was vacant and another 26.2% was in agricultural use. Nearly 90% of the agricultural land was in planted pine, most of it under corporate ownership. Large portions of the city also were devoted to residential use (15.5%) and to public buildings and facilities (11.5%), with much smaller areas used for commercial, industrial, and other purposes. Rough estimates of current land use, calculated with population-based formulae contained in the *Future Land Use Element* of Jacksonville's comprehensive plan (JPDD 1996a), indicate that residential area has increased substantially since 1985, while there has been a slight decrease in agricultural usage and a more substantial decline in the amount of vacant land.

3.2 ATMOSPHERIC RESOURCES

3.2.1 Climate

Jacksonville's proximity to the Atlantic Ocean leads to a mild climate. Average July temperature is 82°F, and average January temperature is 52°F; the annual average is 68°F. Precipitation is greatest during summer; about one-half of the annual amount typically occurs from June through

Table 3.1.1. Distribution of land use in Jacksonville, 1985[a]

Land use	Percent of total land area
Residential	15.5
Commercial	1.4
Industrial	2.1
Recreation/open space	1.1
Public buildings and facilities	11.5
Historic resources	< 0.1
Conservation	1.3
Agriculture	26.2
Vacant	40.8
Total	100.0

[a]The most recent year with reliable data.
Source: JPDD 1996a.

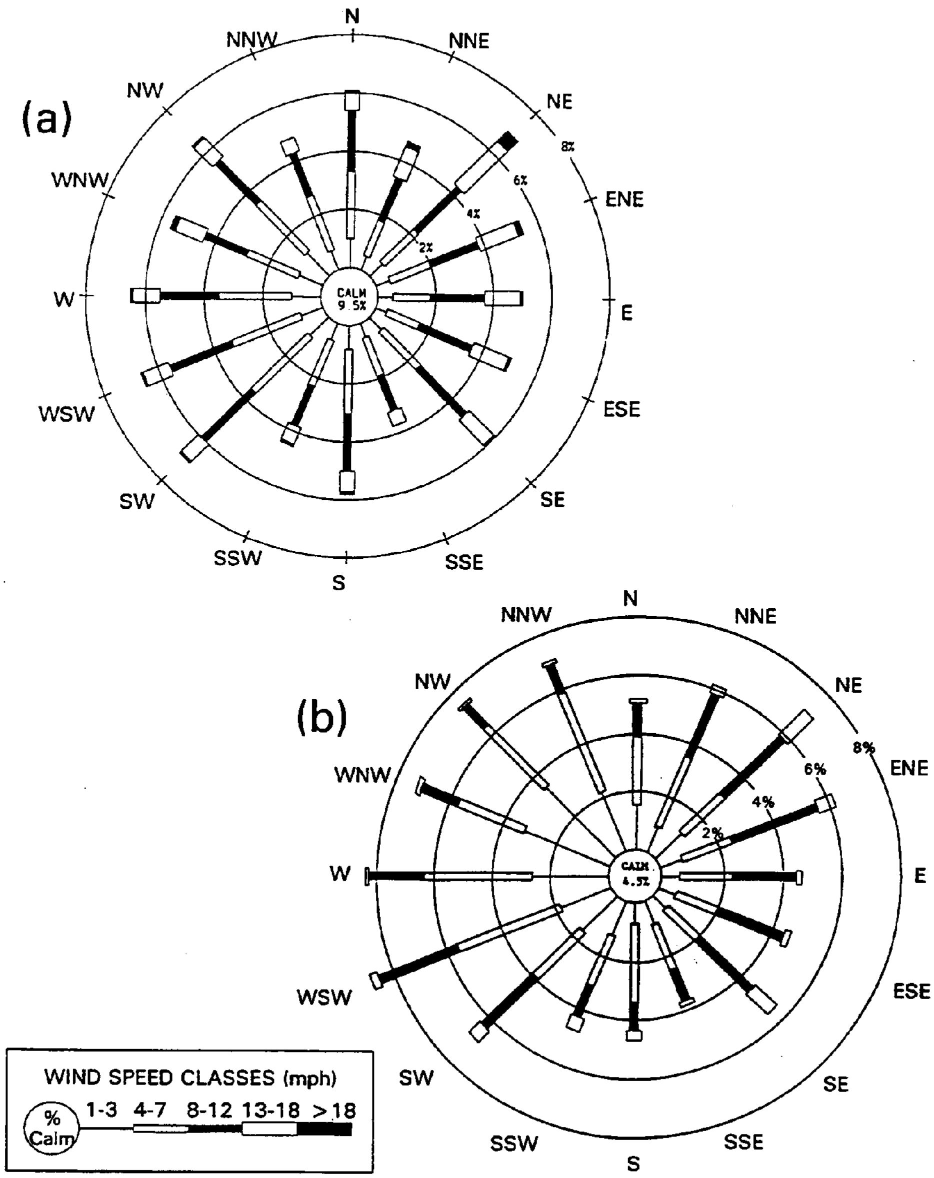
September. August is the wettest month, averaging 7.9 in., and November is the driest month, averaging 2.2 in. Average annual total precipitation is 51.3 in.

Hurricanes and lesser tropical cyclones can lead to appreciable precipitation for short periods. The estimated maximum 24-hour precipitation expected to be equaled or exceeded, on average, once in 100 years is 11 in.; this has not been achieved or exceeded in the 52-year period of record (1942–93). However, amounts greater than 10 in. during a 24-hour period occurred during September 1950 and July 1966.

Hurricane winds (having speeds of 74 mph or greater) have been recorded only once in Jacksonville, when the center of Hurricane Dora passed just to the south and west of the city on September 9, 1964, producing a maximum sustained wind of 82 mph. Hurricanes in the region have generally traveled parallel to the coastline, either remaining far out to sea or losing much of their force over land to the south of Jacksonville before reaching the city.

Winds in the area average about 8 mph. There is no clearly dominant wind direction: northwesterly winds are most prevalent during the winter and southwesterly winds prevail in summer. Sea breezes are generally from the east and land breezes are generally from the west. Winds are least frequent from the south-southeast. The wind rose for Jacksonville International Airport, about 9 miles west-northwest of Northside Generating Station, for the period 1948–95 is shown in part (a) of Figure 3.2.1. Wind data for 1 year (December 10, 1979–December 10, 1980) have also been gathered at a location about 2 miles north-northeast of Northside Generating Station; these data are summarized in the wind rose shown in part (b) of Figure 3.2.1. The two wind roses are quite similar. The terrain in the area is relatively flat and homogeneous, free of appreciable obstacles that

Figure 3.2.1. Wind roses for (a) Jacksonville International Airport (1948–95) and (b) a temporary monitoring site just north of the St. Johns River Power Park (December 10, 1979–December 10, 1980). The frequency of wind blowing from each direction is plotted as a bar that extends from the center of the diagram. Wind speeds are denoted by bar widths and shading; the frequency of wind speed within each wind direction is depicted according to the length of that section of the bar. Because the wind rose displays directions **from** which the wind blows, emissions would travel downwind in the opposite direction.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6%
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2%
CALM 4.5%
WIND SPEED CLASSES (mph)
% Calm
1-3
4-7
8-12
13-18
>18

could reduce wind speed or alter its direction; therefore, wind patterns would be expected to be similar from one location to another nearby location.

The height above ground to which appreciable vertical atmospheric mixing occurs (the mixing height) is an important factor influencing atmospheric dispersion of pollutants. If mixing height and wind speed are both very low, atmospheric dispersion of pollutants is limited and the meteorological potential for air quality deterioration is high. Such conditions are rare in Jacksonville; according to Holzworth (1972), only about 1 day per year has a high meteorological potential for air quality deterioration.

Relative humidity is higher at Jacksonville than in most parts of the United States, averaging from 75 to 80% during most months; however, it is closer to 70% during the spring. Fog occurs about 5 days per month in winter, and about 1 day per month in summer.

3.2.2 Air Quality

Criteria pollutants are defined as those for which National Ambient Air Quality Standards (NAAQS) exist. These pollutants are sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO), lead (Pb), and two sizes of particulate matter—particles less than 10 μm in diameter, designated PM-10, and particles less than 2.5 μm in diameter, designated PM-2.5. The NAAQS are expressed as concentrations of these pollutants in the ambient air; that is, in the outdoor air to which the general public has access [40 CFR Part 501(e)]. Primary NAAQS define levels of air quality that the U.S. Environmental Protection Agency (EPA) deems necessary, with an adequate margin of safety, to protect human health. Secondary NAAQS are similarly designated to protect human welfare by safeguarding environmental resources (such as soils, water, plants, and animals) and manufactured materials. Primary and secondary standards are currently the same for all pollutants and averaging periods, with the exception that 3-hour SO_2 averages have only a secondary standard. Florida standards are the same as the NAAQS except for annual and 24-hour standards for SO_2, for which the Florida standards are more stringent. The applicable (most stringent) standards are presented in Table 3.2.1.

Currently, no portion of Duval County is designated as a nonattainment area for any NAAQS or Florida standard, but Duval County is a maintenance area for O_3 and the downtown area of Jacksonville is a maintenance area for particulate matter (R.S. Pace, Jacksonville Regulatory & Environmental Services Department, personal communication to R.L. Miller, ORNL, November 18, 1998). A maintenance area is an area that previously was a nonattainment area for a pollutant and which is striving to maintain attainment with the standard(s) for the pollutant and comply with the state implementation plan. Table 3.2.1 provides a recent 5-year (1993–97) summary of air quality data in Duval County at the monitoring stations nearest to Northside Generating Station for pollutants regulated by NAAQS or by state standards. For comparison with the standards, the table gives the highest measured concentrations for averaging periods of greater than 24 hours. The

Table 3.2.1. Summary of air quality data in Duval County for 1993–97

Pollutant	Averaging period	Year of occurrence	Location[a]	Air quality standard ($\mu g/m^3$)[b]	Concentration ($\mu g/m^3$)	Concentration as a percent of standard
Sulfur dioxide (SO_2)	3-hour	1993	Cedar Bay Road	1300	236[c]	18
	24-hour	1993	Cedar Bay Road	260	52[c]	20
	annual	1993	Cedar Bay Road	60	8[d]	13
Nitrogen dioxide (NO_2)	annual	1995	Bennett Street	100	30[d]	30
Carbon monoxide (CO)	1-hour	1994	Bay & Main	40,000	10,350[c]	26
	8-hour	1994	Bay & Main	10,000	4,830[c]	48
Lead (Pb)	Calendar quarter	1995	Bennett Street	1.5	< 0.1[d]	< 7
PM-10[e]	24-hour	1993	Buckman Street	150	66[f]	44
	annual	1993	Buckman Street	50	28[d]	56
PM-2.5[e]	24-hour	*g*		65[g]	*g*	*g*
	annual	*g*		15[g]	10[h]	67
Ozone (O_3)	1-hour	1993	Lanier Road	235[i]	210[i]	89
	8-hour	*g*		157[g]	*g*	*g*

[a]Distance and direction of each monitoring station from Northside Generating Station: Cedar Bay Road, 4 miles west; Bennett Street, 7 miles southwest; Bay & Main, 9 miles southwest; Buckman Street, 7 miles southwest; and Lanier Road, 5 miles north-northwest.

[b]National Ambient Air Quality Standards apply except for annual and 24-hour SO_2 averages, for which the more stringent state standards are used.

[c]The highest value for each year has been excluded and the highest of the remaining concentrations is shown for comparison with the standard.

[d]Maximum annual (or, for lead, quarterly) concentration.

[e]PM-10 and PM-2.5 = particulate matter less than 10 or 2.5 μm in diameter, respectively.

[f]The highest 24-hour average of PM-10 in the 5-year period.

[g]Standards for PM-2.5 and an 8-hour standard for O_3 have recently been promulgated (62 *FR* 38652). These standards will apply to 3-year averages; data for comparison with these standards will not be available until at least year 2000.

[h]Sufficient monitoring data are not available; 10 $\mu g/m^3$ is a 3-year average for Okefenokee Wilderness Area [Sisler (1996)].

[i]The 1-hour standard for O_3 has recently been replaced by an 8-hour standard. Because sufficient data are not yet available to compare with the 8-hour standard, the highest 1-hour concentration at Lanier Road is compared with the 1-hour standard.

long-term pollutant concentrations were well within the applicable standards (less than 70% of the standards for all pollutants, and 30% or less for all pollutants except particulate matter).

The standards for averaging periods of 24 hours or less include some allowance for occasional anomalous values. For comparison with the standards, the highest SO_2 and CO measurement for each year was excluded and the table gives the highest of the remaining concentrations (the highest second-highest value) for 1993–97. All short-term SO_2 and CO concentrations were well within the applicable standards (i.e., less than 50% of the standards).

Standards for PM-10 and PM-2.5 apply to statistical values derived from 3 years of data. However, because PM-10 measurements have traditionally been taken only every sixth day, the highest actual 24-hour concentrations might not be included in the data. Therefore, the table gives the highest measured 24-hour PM-10 concentration, which was less than 50% of the standards, rather than the highest second-highest value. Because 3 years of monitoring data are required for comparison with the PM-2.5 standards, which were promulgated in 1997 (62 *FR* 38652), sufficient PM-2.5 data are not yet available for evaluating compliance with the new standards. As a rough indicator of annual average PM-2.5 concentrations in Duval County, a 3-year (March 1992–February 1995) average PM-2.5 concentration of 9.8 $\mu g/m^3$ that was reported at Okefenokee Wilderness Area (Sisler 1996) can be used. That value (rounded up to 10) is given in Table 3.2.1; however, concentrations may be higher in the urban areas of Duval County.

Duval County was declared by EPA on March 6, 1995, to be in attainment of the 1-hour O_3 standard (i.e., Duval County is a maintenance area for O_3). However, the 1-hour standard is currently being replaced with an 8-hour standard, which was promulgated in 1997 (62 *FR* 38652). In general, the 8-hour standard has replaced the 1-hour standard in areas that were designated in attainment of the 1-hour standard; these areas include Florida and adjacent areas in southern Georgia (63 *FR* 31014). The new standard applies to a 3-year moving average of the annual 4th-highest 8-hour O_3 concentrations.

Because 3 years of data are not yet available for evaluating compliance with the new standard, some comparisons of air quality with the previous standard are given. The previous 1-hour standard allowed three exceedances over a 3-year period. Two exceedances occurred during 1995–97 at the monitoring site at the Naval Air Station, about 15 miles southwest of Northside Generating Station. No exceedances of the 1-hour standard occurred at the monitoring site on Lanier Road, about 5 miles north-northwest of Northside Generating Station. The highest 1-hour concentration recorded at that monitor during 1993–97 was 210 $\mu g/m^3$, which was less than 90% of the 1-hour standard.

Contaminants other than the criteria pollutants are present in the atmosphere in varying amounts that depend on the magnitude and characteristics of the sources, the distance from each source, and the residence time of each pollutant in the atmosphere. In the ambient air, many of these pollutants are present only in extremely small concentrations, requiring expensive state-of-the-art equipment to measure them. Measurements of existing ambient air concentrations for many hazardous pollutants are, at best, sporadic. Regulation of these pollutants is attempted at the sources; emissions from specific source categories are regulated by the National Emissions Standards for Hazardous Air Pollutants (40 CFR Part 61; 40 CFR Part 63). However, electric utilities are not included among the specific source categories to which these regulations apply.

In addition to ambient air quality standards, which represent an upper bound on allowable pollutant concentrations, there are national air quality standards for the Prevention of Significant Deterioration (PSD) (40 CFR Part 51.166). The PSD standards differ from the NAAQS in that the NAAQS specify maximum allowable concentrations of pollutants, while PSD requirements provide maximum allowable increases in concentrations of pollutants for areas already in compliance with the NAAQS. PSD standards are therefore expressed as allowable increments in the atmospheric concentrations of specific pollutants. Allowable PSD increments currently exist for three pollutants (NO_2, SO_2, and PM-10). PSD increments are particularly relevant when a major proposed action (involving a new source or a major modification to an existing source) could degrade air quality without exceeding the NAAQS, as would be the case, for example, in an area where the ambient air is very clean. One set of allowable increments exists for Class II areas, which cover most of the United States, and a much more stringent set of allowable increments exists for Class I areas, which include many national parks and monuments, wilderness areas, and other areas as specified in 40 CFR Part 51.166(e). Allowable PSD increments for Class I and Class II areas are given in Table 3.2.2.

Table 3.2.2. Allowable increments for Prevention of Significant Deterioration of air quality

Pollutant	Averaging period	Allowable increment ($\mu g/m^3$) Class I[a]	Class II[a]
Sulfur dioxide (SO_2)	3-hour	25	512
	24-hour	5	91
	annual	2	20
Nitrogen dioxide (NO_2)	annual	2.5	25
Particulate matter less than 10 μm in diameter	24-hour	8	30
	annual	4	17

[a]Class I areas are specifically designated areas (e.g., national parks greater than 6,000 acres in area) in which the degradation of air quality is to be severely restricted. Class II areas (which include most of the United States) have a less stringent set of allowable increments.

The PSD Class I area nearest to Northside Generating Station is the Okefenokee Wilderness Area, 38 miles to the west. The next nearest Class I area is Wolf Island Wilderness Area, 63 miles north of Northside Generating Station, on the Georgia coast.

3.3 SURFACE WATER RESOURCES

3.3.1 Hydrology

Northside Generating Station lies within the drainage basin of the lower St. Johns River, 10 miles upstream from the river's mouth (Figure 3.3.1). The station is located 0.5 mile north of the back channel of the St. Johns River (previously known as the Blount Island Channel) and across from Blount Island (Figure 3.3.2) (USGS 1992b). The back channel of the St. Johns River conveys 30 to 50% of the river's total flow (JEA 1976; EVSC 1983). The site drains into the San Carlos Creek watershed which in turn empties into the back channel of the St. Johns River, which was the original channel of the river. The Dames Point-Fulton Cutoff along the southern side of Blount Island was constructed in 1947 and is now the main course of the river. Blount Island is a major port with facilities for docking, loading, and unloading large ocean-going vessels.

The St. Johns River is the longest river entirely within the state of Florida, having a length of 300 miles (Patrick 1994a). This coastal plain river drains one-fifth of Florida's land area, approximately 9,000 $mile^2$ (DeMort 1991). The river's headwaters form in the St. Johns marsh around Hellen Blazes and Sawgrass lakes in Brevard County, 15 miles west of Melbourne, and to the southeast of Orlando (Grolier, Inc. 1993). The northward flow of the river is rare among larger U.S. rivers. The river gradually turns eastward at Jacksonville, flowing for 15 miles before emptying into the Atlantic Ocean at Mayport (USGS 1992a). The St. Johns River Water Management District (SJRWMD) has jurisdiction over the entire St. Johns River basin (Campbell et al. 1984).

Rodman Dam, about 80 miles upstream from Northside Generating Station, forms Lake Oklawaha (also known as Rodman Reservoir) (DMC 1989). The Lake Oklawaha standard project flood elevation is 23.2 ft above mean sea level (amsl), while the maximum recorded lake water surface elevation of 20.7 ft amsl occurred on February 4, 1970 (USGS 1997). In the lower part of the St. Johns River basin between Palatka (86 miles from the river's mouth) and Jacksonville, the main channel widens from 0.9 to 3 miles, with depths averaging less than 10 ft (DeMort 1991). At Jacksonville, the channel narrows and deepens to 30 ft. Some areas east of the Acosta bridge in Jacksonville are tidally scoured or dredged, and have depths exceeding 60 ft. The St. Johns River is navigable by large ocean-going ships for 15 miles, or as far as the downtown area of Jacksonville (Grolier, Inc. 1993).

The St. Johns River is an estuarine river that is influenced by tidal motion and saline ocean water (Patrick 1994a). Normally the river is tidal for at least 80 miles from its mouth, and the influence of tides can extend as far as 283 miles inland during the spring. The great penetration of seawater is made possible by the low hydraulic gradient (i.e., low slope) of the river. The streambed of the St. Johns River drops only 26 ft in elevation from source to mouth (DeMort 1991).

The St. Johns estuary is a river-dominated, moderately stratified system (DeMort 1991). In the Mayport area, there is a horizontal as well as a vertical salinity wedge. The river is regularly brackish during high tide as far south as Orange Park, with high tide salinities ranging from 2,000 to 5,000 mg/L. During low flow years when the average annual rainfall is decreased, the saltwater

ORNL 97-129928A/rra

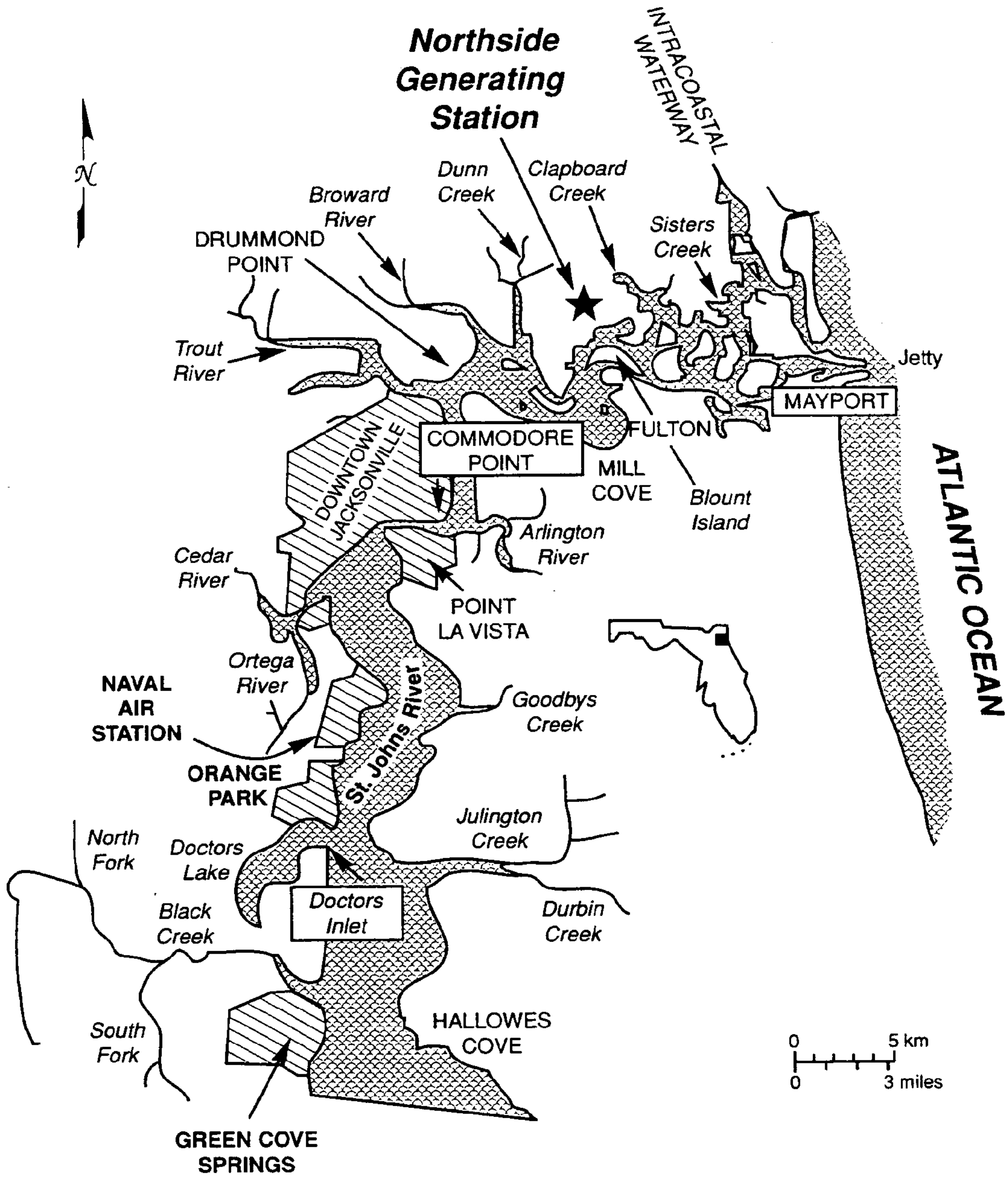


Figure 3.3.1. Map of the lower St. Johns River showing major tributaries and cities.
Source: DeMort 1991.

ORNL 97-129927/rfg

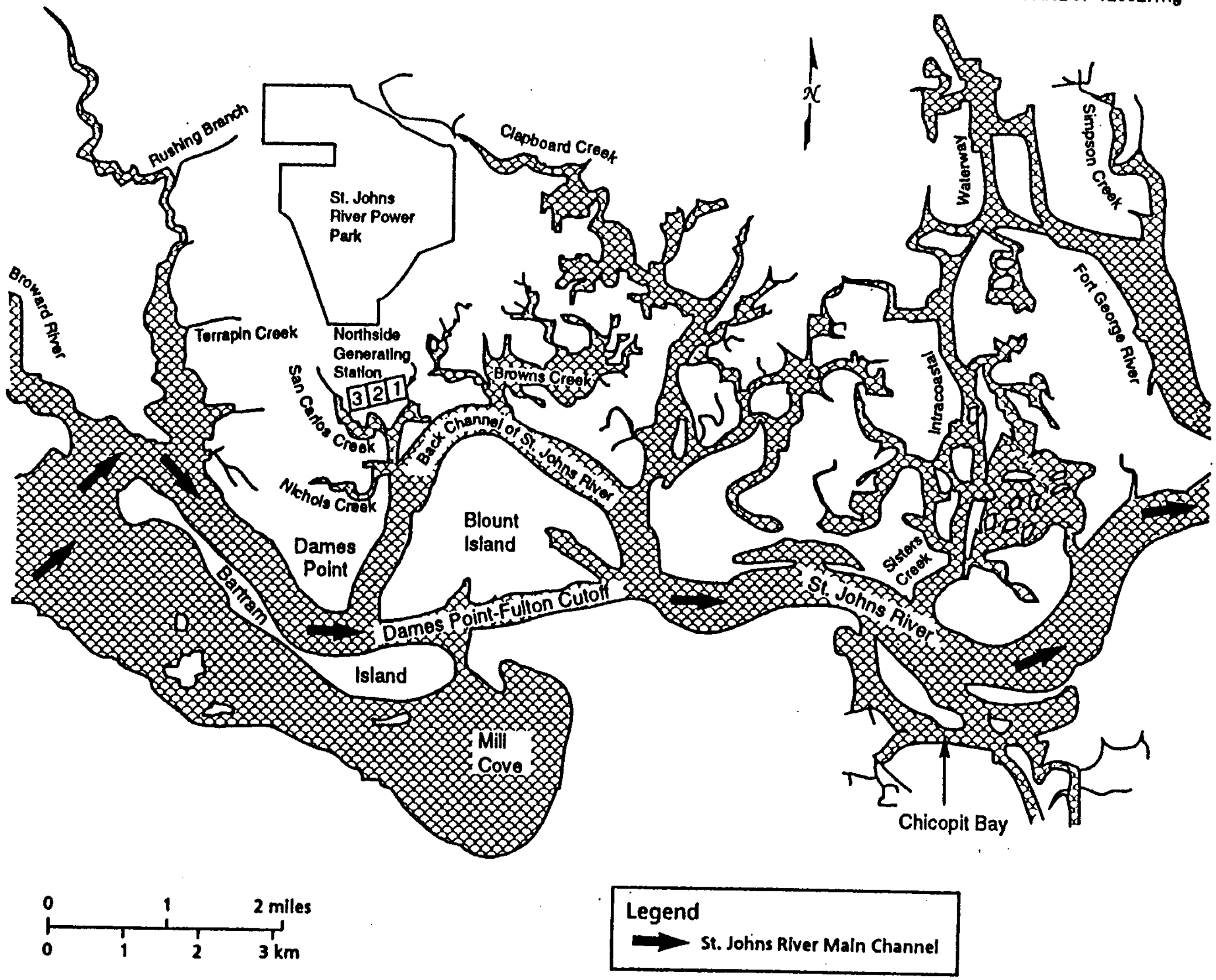


Figure 3.3.2. Local surface water hydrology in the vicinity of Northside Generating Station. *Source:* modified from EVSC 1981a.

mixing zone may extend south as far as Walaka. Low tide salinities in the Mandarin area north of Orange Park typically are less than 1,000 mg/L.

The hydrology of the St. Johns River is influenced by the presence of numerous wetlands in the drainage basin and limestone sinks, fissures, springs, and subsurface rivers, some of which are saline (Patrick 1994a). There are 51 first-magnitude (having a discharge exceeding 100 ft^3/s) springs and approximately 1,000 flowing artesian wells within the SJRWMD (Campbell et al. 1984). Freely flowing wells can seriously degrade groundwater quality by causing the upward leakage of salt water. The SJRWMD maintains a program to find and properly close abandoned wells and wells requiring remediation.

The net flow of the St. Johns River is negative over part of a 24-hour period (Patrick 1994a). During the tidal cycle, the river actually flows upstream more than it flows downstream. The U.S. Geological Survey operates a gaging station (station number 02246500) at the Main Street Bridge in Jacksonville, 22.7 miles upstream from the mouth of the river (USGS 1997). The average discharge for 23 years of record (water years 1955–74, 1981, 1988, and 1991) was 6,105 ft^3/s. The maximum daily discharge flowing into the ocean of 64,000 ft^3/s was recorded on June 20, 1972, while the maximum inland reverse flow of −62,700 ft^3/s was recorded on October 20, 1972 (the negative sign on the numerical value indicates a reverse flow, in which water moves upstream from the ocean).

The following average daily tidal stages were measured in the back channel of the St. Johns River adjacent to Northside Generating Station between November 1979 and October 1980 (EVSC 1983): (1) a high water level elevation of 2.24 ft amsl, (2) a low water level elevation of −1.28 ft below mean sea level, and (3) a mean water level elevation of approximately 0 ft (i.e., at mean sea level). Similar average daily tidal stages recorded between November 1980 and October 1981 were as follows: (1) a high water level elevation of 1.80 ft amsl, (2) a low water level elevation of −0.92 ft below mean sea level, and (3) a mean water level elevation of approximately 0.18 ft amsl.

3.3.2 Water Quality and Use

3.3.2.1 Water Quality

Surface water quality in the lower St. Johns River is influenced by a variety of natural and man-made sources. Tidal flushing, which involves an average of four tidal exchanges each day, provides an important mechanism for removal and dilution of contaminants and other pollutants that enter the river upstream of the site. Because the St. Johns River at the Northside Generating Station site is downstream from the urban core of Jacksonville, the water quality at this site would be affected by upstream inputs of industrial and domestic pollutants (approximately 25% of the land use in Duval County is urban-industrial). The major contributors to impaired water quality in the lower St. Johns River are sewage effluents, urban runoff, pulp mill effluents, and a variety of other industrial discharges (DeMort 1991). There currently are 33 industrial sources, 13 municipal sources, and 63 other permitted sources (including JEA sources) in the lower St. Johns River (M. Cadenhead, Florida Department of Environmental Protection, personal communication to R. L. Miller, ORNL, December 11, 1998). Another factor that influences surface water quality in the lower St. Johns River is a vertical salinity density gradient, which is typical of tidally influenced reaches of the St. Johns River in the vicinity of the site.

The waters in the vicinity of Northside Generating Station are classified by the state of Florida as Class III waters, which are designated for recreation and the propagation of well-balanced fish and wildlife populations. For discharges into these waters, the state water quality criteria apply beyond a designated mixing zone. In addition, at the point of discharge, the concentration of any toxic pollutant must be less than the 96-hour LC_{50} for any important ecological species. Based on water quality data collected in the St. Johns River during the St. Johns River Power Park pre-application monitoring program (EPA 1981), the following nine pollutants exceeded the state water quality standards for Class III marine waters: aluminum, total residual chlorine, copper, total coliform, cyanide, iron, mercury, oil and grease, and silver. However, the Florida Department of Environmental Protection (FDEP) determined in 1996 that all the above pollutants except mercury and copper meet the Class III criteria and no longer require a variance. Because ambient levels of mercury and copper are currently within the state water quality standards, a request by Power Park staff to remove these parameters from the list requiring a variance was submitted to the FDEP in March 1997; however, there has been no final action taken to date on this request.

Surface water quality resulting from the operation of Northside Generating Station is regulated primarily by a National Pollutant Discharge Elimination System (NPDES) permit (FL0001031) that requires JEA to monitor a number of physicochemical parameters in the St. Johns River and San Carlos Creek. Specifically, NPDES limitations or reporting requirements have been established for the following liquid process streams: (1) once-through cooling water discharged via pipeline into the St. Johns River—volumetric flow, discharge temperature, temperature rise, total residual oxidants, intake water temperature, and acute whole effluent toxicity; (2) sewage treatment plant discharge via the pipeline into the St. Johns River— volumetric flow, carbonaceous 5-day biochemical oxygen demand, total suspended solids, pH, and fecal coliform bacteria; (3) potable water storage tank overflow into San Carlos Creek—volumetric flow; and (4) non-chemical and chemical metal cleaning wastes, boiler blowdown, and other low-volume wastes at the emergency overflow into San Carlos Creek—volumetric flow, total suspended solids, oil and grease, arsenic, cadmium, chromium, copper, total iron, lead, total manganese, mercury, nickel, selenium, zinc, pH, and total hardness as calcium carbonate. No discharge of floating solids or visible foam in other than trace amounts is permitted in these effluents.

As a required component of the St. Johns River Power Park NPDES permit, a bioassay test program was developed for the combined Northside Generating Station/St. Johns River Power Park effluent discharge to determine if plant operation affects the water quality of the St. Johns River. This program consisted of three components, (1) measurement of the water quality at the intake and discharge points, (2) bioaccumulation studies on oysters to determine potential uptake of methylmercury and copper, and (3) aquatic toxicity tests to determine the effect of discharge water on the survival of two species of estuarine animals (mysid shrimp and silverside fish). These studies were conducted during a 2-year period (1986–88) and consisted of two phases—a pre-operational component to determine baseline conditions and a post-operational component to assess potential changes in baseline water quality as a result of facility operation.

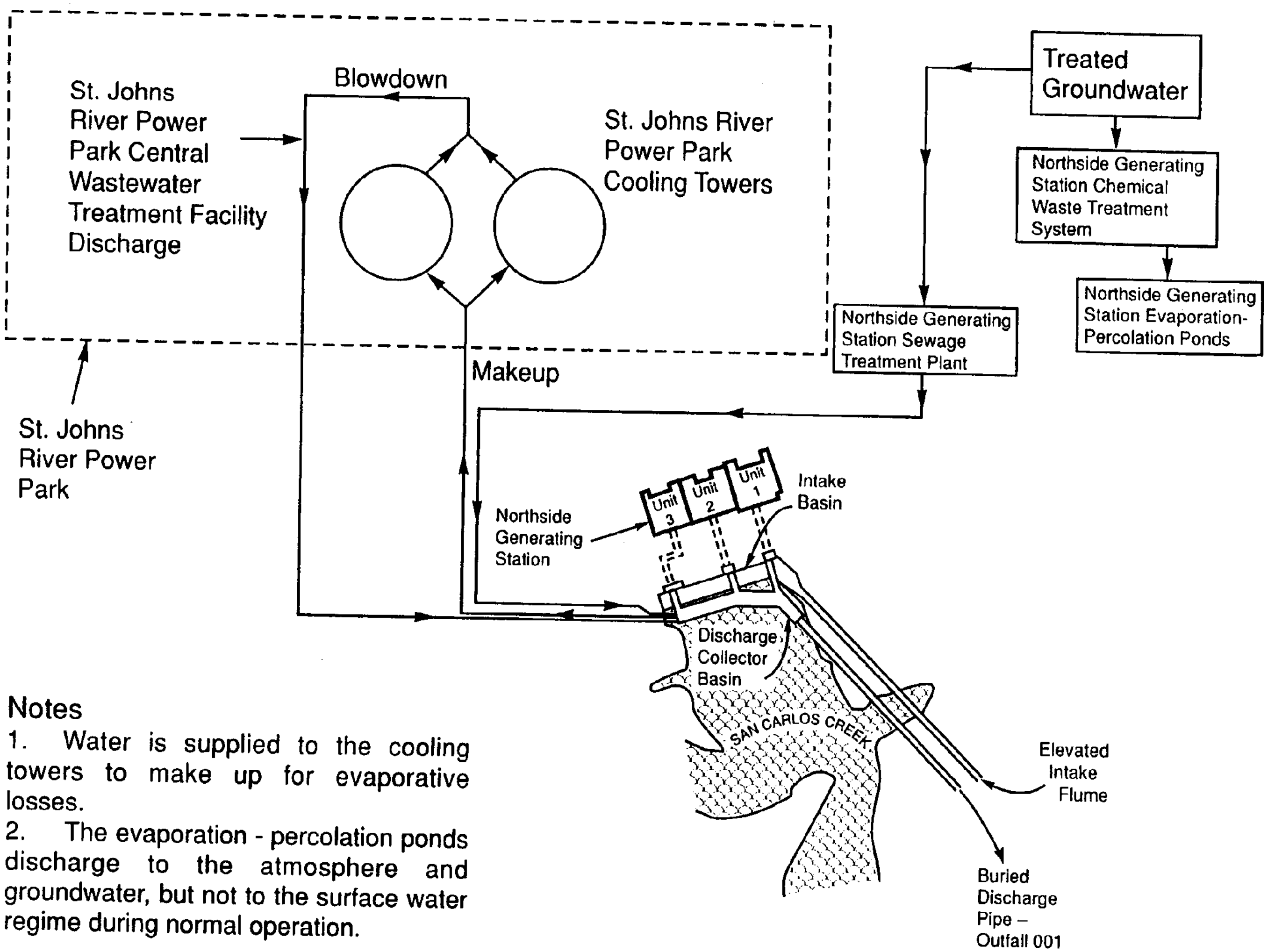
Bioassays with caged oysters and toxicity testing on mysid shrimp and silverside fish have been conducted to determine the effects of water quality (primarily mercury and copper) on representative biota in the site vicinity (JEA 1989). Bioconcentration studies on native and caged oysters exposed for 3, 6, and 12 months were performed in 1986 throughout the first year of operation of the St. Johns River Power Park. Placement of oyster cages was such that the combined discharge of the St. Johns River Power Park and Northside Generating Station was monitored. All methylmercury concentrations in oyster tissue were found to be below analytical detection levels in the reference and experimental oysters following exposure to the discharge effluents. Even though copper was detected in all oysters, including the reference individuals, there were no statistically significant differences in levels of heavy metals between the reference and effluent-exposed oysters after 3–9 months of exposure. The quarterly toxicity bioassays also demonstrated that the combined St. Johns River Power Park/Northside Generating Station discharge effluent was not acutely toxic to the mysid shrimp or the Atlantic silverside. The results of the bioaccumulation and toxicity tests demonstrated, therefore, that operation of the St. Johns River Power Park/Northside Generating Station facilities had no detectable effect on the water quality of the St. Johns River as reflected by toxicity to representative biota.

3.3.2.2 Water Use

Water is obtained from the back channel of the St. Johns River to cool the Northside Generating Station condensers and it is returned to the back channel (Figure 3.3.3). An elevated intake flume delivers the water from the back channel to the station condensers. This cooling water does not mix with other liquid process streams while in contact with the condensers. Because Unit 2 has been out of service since 1983, the actual demand for cooling water by Northside Generating Station at full load since that time has been approximately 620 Mgd (430,700 gpm) to operate Units 1 and 3 (Figure 2.1.9). Operation of the entire 3-unit plant occurred only from about 1978 until 1980. During that time, the demand for cooling water was approximately 827 Mgd (574,000 gpm) (JEA 1976, 1997b; EVSC 1983): (1) 24.5% for Unit 1, (2) 24.5% for Unit 2, and (3) 51% for Unit 3. This amount of surface water supplied to the station was approximately 10% of the average flow passing through the back channel of the St. Johns River (JEA 1976).

Before passing through the condensers, noncontact cooling water at Northside Generating Station is treated intermittently with a biocide to prevent biological growth on the heat exchanger tubes.

Sodium hypochlorite (NaOCl) and occasionally sodium bromide (NaBr) are used (JEA 1997b). Treatment occurs no more than 2 hours per day per operating unit.



Notes

1. Water is supplied to the cooling towers to make up for evaporative losses.
2. The evaporation - percolation ponds discharge to the atmosphere and groundwater, but not to the surface water regime during normal operation.

Figure 3.3.3. Water use diagram for Northside Generating Station and the St. Johns River Power Park.

The St. Johns River Power Park taps into the discharge side of the Northside Generating Station condensers to obtain cooling tower makeup (Figure 3.3.3). The average surface water flow supplied to the Power Park heat rejection system is 50 Mgd (34,400 gpm) (Figure 2.1.9). Approximately 25% of this surface water evaporates into the atmosphere from the cooling towers. Cooling tower blowdown is routed back into Northside Generating Station's discharge collector basin. The daily average temperature of the cooling tower blowdown is limited to 96°F (FDER 1981).

Recreation and commercial navigation constitute the primary uses of surface water in the vicinity of the station (EVSC 1981a). Recreational activities include boating, water skiing, swimming, fishing, and shellfish harvesting. The navigable channel serves both domestic and foreign cargo lines at the Port of Jacksonville, including Blount Island immediately south of the station.

The salinity of the estuarine water precludes using the lower St. Johns River as either a drinking water supply or a source of water for the irrigation of crops without prior treatment. Water is used by industries such as the pulp and paper industry for cooling and process use. The industrial consumption of surface water from the lower St. Johns River was approximately 25 Mgd in 1980 and is expected to increase by about 50% to 38 Mgd by 2020 (EVSC 1981a). Surface water use (including once-through cooling) required for the generation of electricity is currently about 923 Mgd (M. Cadenhead, FDEP, personal communication to R. L. Miller, ORNL, December 11, 1998).

3.3.3 Effluent Discharges

All discharges from Northside Generating Station are regulated under limits specified in an NPDES permit (FL0001031) (JEA 1997b). The NPDES permit renewal application currently under review by the FDEP addresses effluent discharges associated with the existing units and proposed outfalls and discharges that would occur after Units 1 and 2 are repowered.

The primary discharge from the station occurs at outfall 001, located just offshore in the back channel of the St. Johns River (Figure 3.3.4). A pipeline buried beneath San Carlos Creek conveys the effluent from the elevated discharge collector basin located on the bank of San Carlos Creek to a submerged pair of diffuser pipes having a Y-configuration.

The discharge collector basin is an integrated system that receives and mixes discharges from both Northside Generating Station and the St. Johns River Power Park (Figure 3.3.3). During the operation of all 3 units at Northside (i.e., from approximately 1978 until 1980), effluents entering the discharge collector basin from Northside included 827 Mgd (574,000 gpm) of heated noncontact cooling water exiting the condensers (JEA 1976, 1997b; EVSC 1983) and 0.005 Mgd (4 gpm) from the sewage treatment plant (outfall 007) (JEA 1997b). Because Unit 2 has not been used since 1983, the current amount of heated Northside cooling water entering the collector basin is about 620 Mgd (430,700 gpm) (Figure 2.1.9). Approximately 50 Mgd (34,400 gpm) of the heated Northside cooling water is drawn from the collector basin and used at the Power Park as make-up water to replace cooling tower blowdown and water that evaporates into the atmosphere from the cooling towers. The Power Park returns about 37 Mgd (25,900 gpm) of cooling tower blowdown and effluent from its

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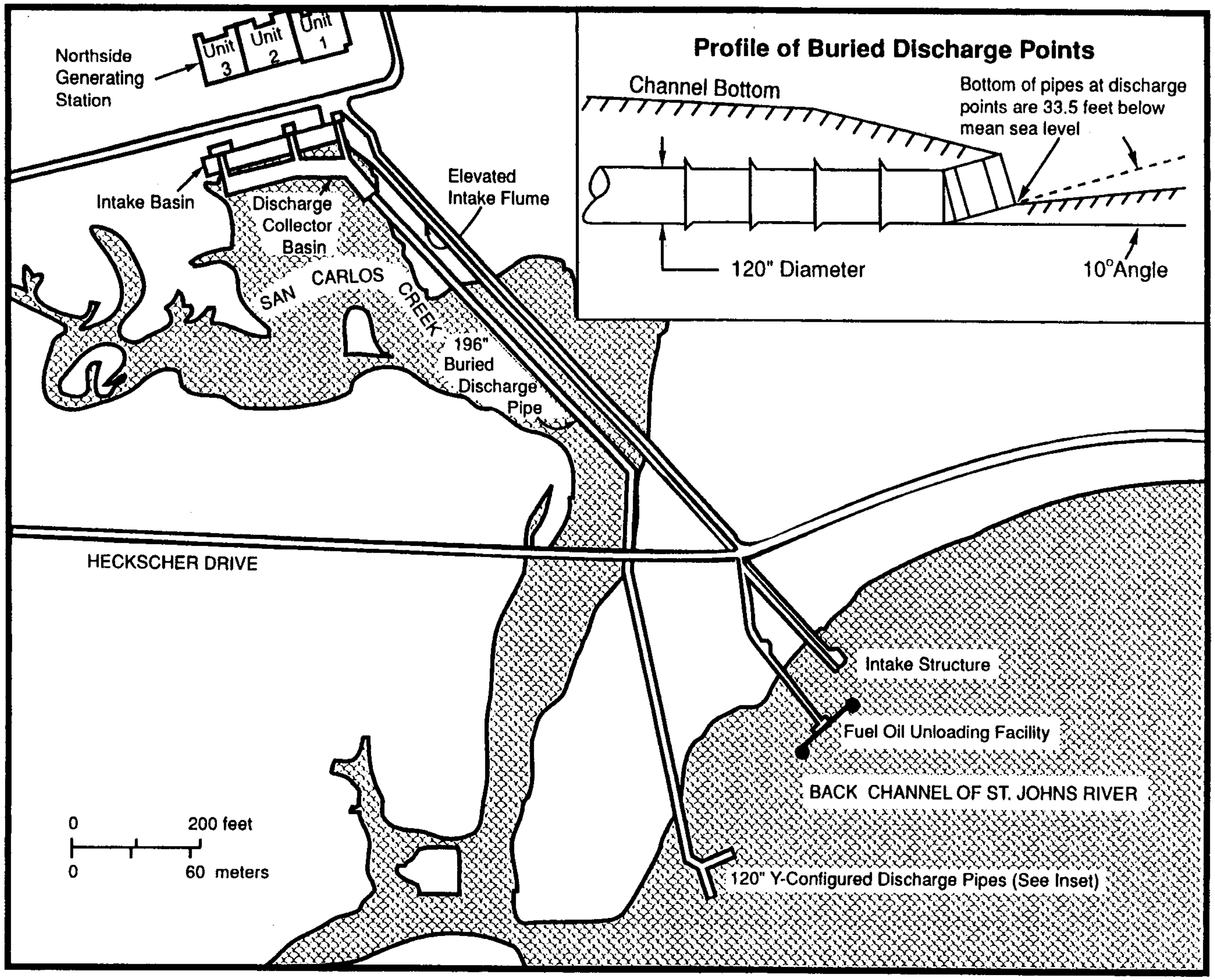

Figure 3.3.4. Primary discharge points for Northside Generating Station.

sewage treatment plant and central wastewater treatment system. The total permitted flow discharged into the back channel of the St. Johns River at outfall 001 is 815 Mgd (566,000 gpm), based on the operation of all 3 units at Northside (i.e., from approximately 1978 until 1980) and both units at the Power Park. The current discharge is approximately 608 Mgd (422,300 gpm), which approximately equals 620 Mgd (430,700 gpm) entering the collector basin minus 50 Mgd (34,400 gpm) sent to the Power Park plus 37 Mgd (25,900 gpm) returned from the Power Park (Figure 2.1.9).

Three Northside Generating Station outfalls that drain into San Carlos Creek are regulated under requirements specified in the NPDES permit (JEA 1997b). Outfalls 009, 010, and 011 are located at the elevated tank used to store treated groundwater, the emergency overflow for the chemical waste treatment system percolation pond, and the emergency overflow for the south lime settling basin, respectively. Discharges from these outfalls seldom occur. These emergency outfalls are associated with flow control devices that prevent the tank, pond, and basin from overfilling. Stormwater discharges at Northside Generating Station are regulated in accordance with a general permit (FLR00B341) issued by EPA (JEA 1997b).

3.3.4 Thermal Discharge

Because Unit 2 has been out of service since 1983, the actual heat rejected by Northside Generating Station at full load since that time has been approximately 4×10^9 Btu/hour from the condensers of Units 1 and 3. Operation of the entire 3-unit plant occurred only from about 1978 until 1980. During that time, the heat rejected by the condensers was approximately 5.3×10^9 Btu/hour at full load (EVSC 1983): (1) 24.5% for Unit 1, (2) 24.5% for Unit 2, and (3) 51% for Unit 3. The temperature rise of 19°F (at the design flows quoted in Section 3.3.2) was the same for each condenser (JEA 1976; EVSC 1983).

The heat rejected by the condensers is dissipated by the tidal waters of the back channel of the St. Johns River. A thermal plume extends both upstream and downstream from the Y-configured pair of submerged discharge pipes (outfall 001) in response to flow reversals created by the flood and ebb (i.e., high and low) tides, respectively. If, because of reduced load, less electricity is generated and correspondingly the heat rejected by the condensers decreases, the flow of cooling water may also decrease because one of the four circulating water pumps may be taken out of service. The mixing that occurs in the St. Johns River is a function of both the heat rejected by the condensers and the exit velocity of the cooling water at the outlet of the submerged discharge pipes.

The temperature and total area of the thermal plume are regulated by limits specified in the NPDES permit (FL0001031), which includes three units (even though Unit 2 has been out of service) (JEA 1997b):

1. The daily (i.e., 24-hour) average effluent temperature at the point of discharge into the back channel of the St. Johns River cannot exceed 104°F.

2. The daily average effluent temperature at the point of discharge cannot exceed the daily average ambient water temperature of the back channel of the St. Johns River by more than 19°F. (During 1997 and 1998, the average temperature rise at Northside Generating Station was 9°F and the maximum measured temperature rise was 16.6°F.)
3. The thermal discharge cannot cause the water temperature of the back channel of the St. Johns River, as measured 3.3 ft below the water surface, to exceed 2°F above the natural water temperature outside of a 275-yd wide mixing zone extending no more than 1,800 yd from the point of discharge. The permitted surface area enclosed by this 2°F rectangular thermal discharge zone is 102 acres.
4. The thermal discharge cannot cause the water temperature of the back channel of the St. Johns River, as measured 3.3 ft below the water surface, to exceed 4°F above the natural water temperature outside of a 133-yd wide mixing zone extending no more than 1,300 yd from the point of discharge. The permitted surface area enclosed by this 4°F rectangular thermal discharge zone is 36 acres.

The thermal discharge limitations specified in the NPDES permit were formulated using results from thermal plume mathematical modeling studies that assessed and substantiated the preoperational design of the station’s heat rejection system (JEA 1976).

Northside Generating Station operates under a variance from thermal effluent limitations promulgated in Florida Administrative Code (FAC) 62-302.520 as provided for in the Clean Water Act Section 316 (a), otherwise referred to as a “316 (a) variance.” The 316 (a) variance is a part of the NPDES permit renewal that includes the proposed project and would require EPA approval for continuance. A *316 Demonstration* for the existing station has verified compliance with cooling water criteria promulgated under Chapter 17-3 of the FAC (JEA 1976). The extent of the thermal plume was measured during temperature mapping surveys that were performed on September 3–4, 1980; February 27, 1981; and May 20, 1981 (EVSC 1983). Results obtained during the monitoring program demonstrated that the extent of the thermal plume as defined by the area of the 2°F thermal discharge zone was approximately one order of magnitude smaller than (i.e., one-tenth the size of) the 102-acre plume permitted by NPDES limits. The largest plume, which occurred during the slack of ebb tide (no flow), measured 7 acres. Continuous water temperature measurements recorded near the mouth of San Carlos Creek under all tidal conditions also verified that the thermal plume did not penetrate into the creek.

When all three units were in service, Northside Generating Station operated in one of five different modes in response to demand for electricity (EVSC 1983). For instance, only Unit 3 might operate if peaking power were not needed. Modeling simulations of the thermal plume were performed with mathematical models to determine which operating mode produced the largest thermal plume (EVSC 1983). The largest thermal plume occurred when the flow through the condensers was approximately

400 Mgd (280,000 gpm) (e.g., if Unit 3 were operating alone at full load with the flow reduced to 400 Mgd). At higher flow rates, the increased velocity at the submerged discharge promoted rapid mixing and heat dissipation; at lower flow rates, the corresponding decrease in heat load was large enough to reduce the size of the thermal plume. Thus, the thermal plume was smaller when all three units were operating at full capacity from approximately 1978 until 1980 because the increased velocity of the discharge promoted more rapid mixing.

The mathematical modeling predicted a maximum extent for the 2°F thermal discharge zone of 1,000 yd and an areal extent of 17 acres; the modeling confirmed compliance with NPDES permit limitations of length, width, and area under all operating conditions for the station. The maximum width predicted by the thermal plume modeling was about 82 yd. The maximum width of the 2°F thermal discharge zone allowed by the NPDES permit is 275 yd. The width of the back channel of the St. Johns River is approximately 530 yd near outfall 001 (JEA 1976). Therefore, a large zone of passage for aquatic organisms exists in the back channel around the plume during all operating conditions. Because the zone of passage remains at the ambient river temperature, it provides a pathway for aquatic species to move past the thermal discharge without being stressed.

3.4 GEOLOGICAL RESOURCES

3.4.1 Geology

This section discusses geological characteristics and properties in the area of the proposed project.

3.4.1.1 Physiography

The topography of eastern Duval County is controlled by a series of Pliocene and Pleistocene marine terraces. These terraces were formed during intervals when the sea level was higher than it is today. When the sea level fell, sedimentary deposits formerly on the sea floor emerged as a gently sloping terrace. A subtle wave-cut bench (scarp) developed on the seaward side of the terrace. Northside Generating Station is located on one such terrace.

Surface elevations at Northside Generating Station vary from 4 ft amsl near the confluence of the east and west branches of San Carlos Creek to 13 ft amsl about 330 ft north of the 40-acre dredge spoil site. The water table is at or near the surface at the lower end of the terrace, and wetlands are prevalent on the lower end. The subsurface consists of medium to fine sand with lesser amounts of silt and even less clay to depths of at least 20 ft.

The main geologic structure in northern Florida is the Peninsular Arch (Phelps and Spechler 1997) which trends south-southeast from southeastern Georgia to central Florida. The crest of this arch is about midway between the east and west coasts in northern Florida and near the Atlantic coast in central Florida.

The Ocala Group (Eocene) is exposed at the surface along the crest of the arch in central and western Florida. Eocene strata dip generally to the east and are buried beneath 400–600 ft of successively younger strata in Duval County in extreme northeastern Florida (Phelps and Spechler 1997). Figure 3.4.1 shows schematic subsurface stratigraphic sections from west to east.

Leve (1978) used geological and geophysical logs of water wells to map the top of the buried Ocala Group in Duval County and discovered large vertical variations (50–200 ft) in the elevations of the top of the Ocala Group. The somewhat linear trend of these variations led Leve to postulate the presence of two buried north-south striking faults. One of these faults lies near Northside Generating Station and the other lies a few miles to the west.

There is no evidence that the postulated faults near Northside Generating Station reach the surface. A subsurface drilling program (Leve 1978) failed to find similar variations in vertical relief at the top of the Hawthorn Formation (Miocene), which directly overlies the Ocala Group. The range of Hawthorn elevations was less than 20 ft. The absence of offsets in the Hawthorn Formation suggests that most of the activity on these faults ended by the close of Oligocene time (about 25 million years ago). An alternative interpretation for the observed topographic relief at the top of the buried Ocala Group is that the relief may have been caused by paleokarst development (ancient sinkholes) (Phelps and Spechler 1997) rather than by faults as proposed by Leve.

3.4.1.2 Stratigraphy

In this section, stratigraphic units are discussed in order, beginning with the deepest strata (Eocene) penetrated by water wells in Duval County and moving through successively younger and shallower units.

Eocene strata are more than 820 ft thick in Duval County. All these strata were originally deposited as shallow marine carbonate (now limestone and dolomite) sediments. The deepest Eocene units have not been penetrated by water wells in Duval County. The deepest penetrated strata in Duval County are in the Oldsmar Formation (the upper zone of the lower Floridan aquifer). The next shallower strata are in the Avon Park Formation and the Ocala Group which comprise the upper Floridan aquifer (Phelps and Spechler 1997). A confining bed in the lower part of the Avon Park Formation separates the lower Floridan aquifer from the upper Floridan aquifer as shown in Figure 3.4.1.

The Ocala Group comprises the thickest part of the upper Floridan aquifer (more than 200 ft thick in Duval County) . The Ocala consists of interbedded hard crystalline limestone, dolomitic limestone, and soft, chalky, limestone. The upper surface of the Ocala Group is highly irregular (Section 3.4.1.1). Solution cavities, pipes, and sinks are common in some parts of the Ocala Group.

Strata above the Ocala Group (from the base of the Hawthorn to the surface) have lithologic characteristics, depositional environments, and stratigraphic characteristics that contrast sharply with the Eocene strata that underlie them. Whereas Eocene strata are carbonate rocks of marine (off-shore) origin, the overlying Miocene to Holocene strata are unconsolidated sands, silts, mudstones

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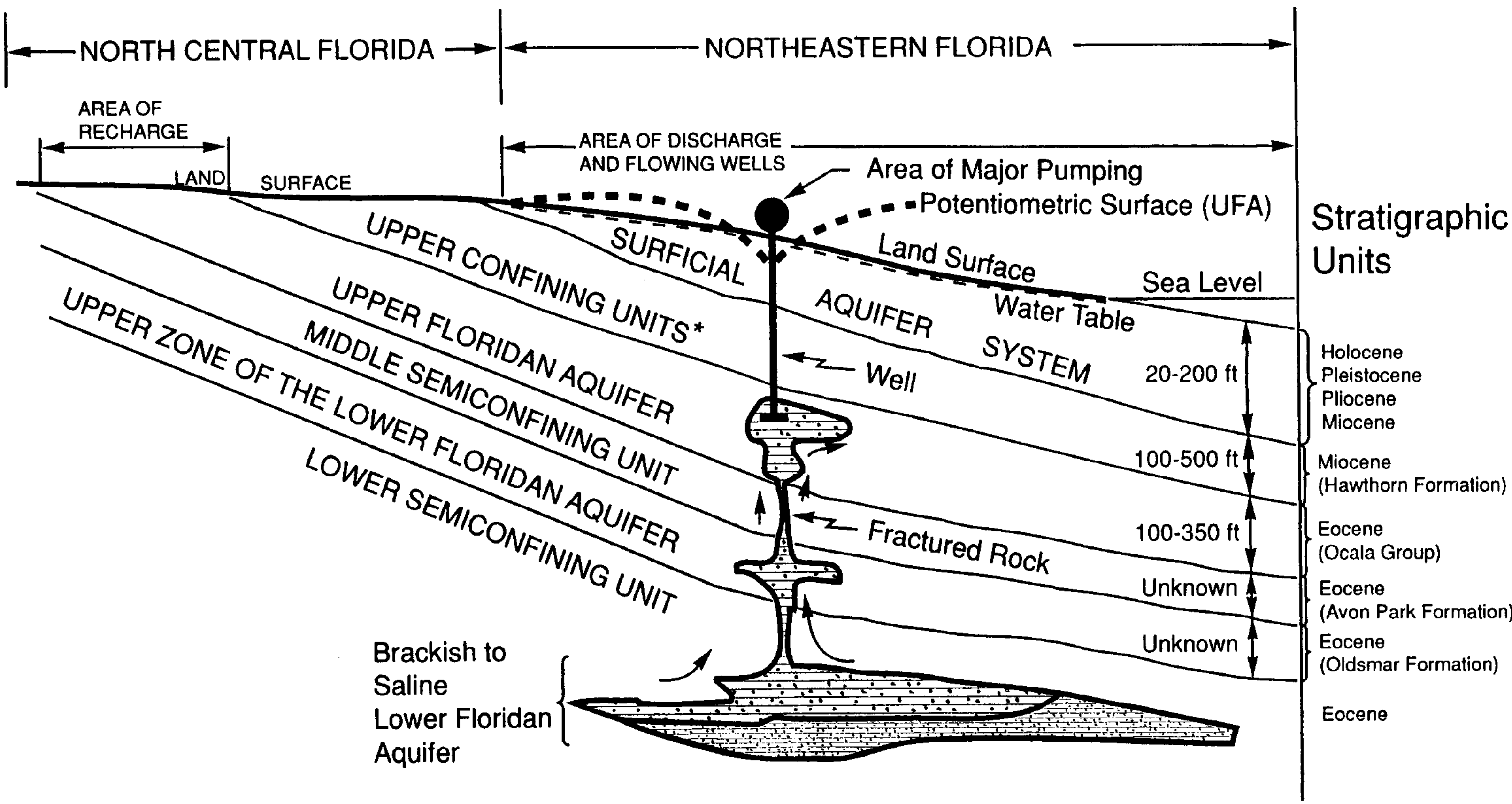

LEGEND

UFA	Upper Floridan Aquifer

*includes interbedded units of the intermediate aquifer system

Figure 3.4.1. Schematic cross-sectional view of the east flank of the Peninsular Arch The crest and west flank are not shown. *Source*: modified from Phelps and Spechler 1997.

and isolated lens-shaped beds of carbonate rocks. Miocene to Holocene strata were deposited in mostly terrigenous (at or above the shoreline) environments. Deposition of these sediments occurred in a wide variety of environments such as floodplains, river deltas and channels, lakes (formed in sinkholes in the Ocala), tidal lagoons, and beaches.

Whereas Eocene marine carbonates are thick and widespread, Miocene to Holocene lithologic units come in a wide variety of shapes and sizes. Most individual lithologic units are thin and discontinuous. Collectively, however, Miocene to Holocene strata cover a large area of northeastern Florida from the Atlantic shoreline to central Florida. The collective thickness ranges from 0 at the exposed Ocala-Hawthorn contact in central Florida to 400–600 ft in Duval County. Sediments that overlie the Ocala Group are about 500 ft thick at Northside Generating Station.

3.4.1.3 Chemical Properties

Chemical properties of Miocene to Holocene strata contrast sharply with those of Eocene strata in northeastern Florida. Eocene strata are relatively soluble in rainwater and tend to form solution cavities near the water table. Generally, Miocene and Holocene strata are insoluble. Solution cavities do not form in these strata except in isolated carbonate lenses.

3.4.1.4 Physical Properties

Physical properties also contrast sharply between Eocene and younger strata in northeastern Florida. Whereas most Eocene strata are difficult to penetrate with a percussion drill, younger strata offer variable resistances to such drilling activity (depending on depth of burial and sand/silt versus clay content). Sediments rich in loose sand are prevalent on the terrace where Northside Generating Station is located. Sands are cohesionless and yield readily to penetration. Loose sand and silt located below the water table may settle during strong and sustained vibratory motion of heavy machinery or during an earthquake. This phenomenon is referred to as liquefaction.

3.4.2 Regional Hydrogeology

There are three aquifer systems in northeastern Florida. The Floridan aquifer system is 400–600 ft deep and provides all municipal and most industrial potable water supplies in Duval County. The Floridan aquifer system is inaccessible to most private users because of the high cost of well completions. The surficial and intermediate aquifers provide potable water for rural residences that are not connected to municipal water supplies. The surficial aquifer is also a major source of nonpotable water for irrigation and livestock use. The intermediate aquifer is a less important source of groundwater in northeastern Duval County where the proposed project is located.

3.4.2.1 Floridan Aquifer System

The recharge area of the Floridan aquifer system is in the central part of the northern end of the Florida peninsula. This system is at the surface and is unconfined in its recharge area (Figure 3.4.1). Wells in the outcrop area of north central Florida are nonflowing because the potentiometric surface coincides with the shallow water table.

The Floridan aquifer system is confined in northeastern Florida. Confining clays and silts are in the overlying Hawthorn Formation (Phelps and Spechler 1997). The confining strata prevent upward flow and cause the hydrostatic pressure to increase within the Floridan aquifer system. The potentiometric surface of the Floridan aquifer system rises above the confining strata and above the ground surface in many places. At isolated locations, hydraulic connection may be established with the surface and cause water to flow up the connection and into overlying strata or even to the surface (depending on the height of the potentiometric surface in relation to the land surface).

The Floridan aquifer system is divided into upper and lower parts. The upper Floridan aquifer is separated from the lower Floridan aquifer by confining strata. Locally, hydraulic connection exists along solution channels and by wells that are screened in both units.

The potentiometric surface of the upper Floridan aquifer was much higher prior to development (over 100 years ago). According to Phelps and Spechler (1997), the potentiometric surface has been declining at rates between 0.33 and 0.75 ft per year in northeastern Florida. Vergara (1998) estimates that the potentiometric surface in Duval County will decline an additional 3 to 15 ft between 1995 and 2020 (based on projected increased groundwater use). The largest declines would be experienced south and east of the St. Johns River.

Discharge from the upper Floridan aquifer occurs to wells and springs in eastern Florida and offshore on the continental shelf beneath the Atlantic Ocean. The most prominent springs in eastern Florida are south of Duval County (German 1997). Many of these springs occur along the St. Johns River from St. Johns County to Seminole County. Limited discharge occurs to the overlying intermediate and surficial aquifers at locations where some degree of hydraulic connection exists (Phelps and Spechler 1997). Most of the industrial and municipal wells penetrate only the upper Floridan aquifer in Duval County. The lower Floridan aquifer is under-utilized because of its greater depth and relatively low water quality in Duval County.

Water quality in the upper Floridan aquifer meets EPA and Florida secondary water standards (less than 250 mg/L for chloride and sulfate and less than 500 mg/L for total dissolved solids) in most of Duval County (Huff and McKenzie-Arenberg 1990). Water quality in northern Duval County is well below these maximum concentration limits.

A few municipal wells in Jacksonville exceed maximum recommended secondary drinking water standards for total dissolved solids. Furthermore, the chloride concentration has been rising in a number of wells for several decades. Phelps and Spechler (1997) believe the rising chloride concentration is in response to the decline in the potentiometric surface of the upper Floridan aquifer and subsequent upward leakage of saline or brackish water from the upper zone of the lower Floridan aquifer.

In contrast, water quality in the upper Floridan aquifer south of Duval County generally exceeds EPA drinking water standards. Total dissolved solids concentrations exceed 500 mg/L throughout the southern two-thirds of St. Johns County, nearly all of Flagler County, and the eastern third of Putnam County.

3.4.2.2 Intermediate Aquifer System

According to Toth (1993), the intermediate aquifer system is not extensive in area, but occurs in portions of Duval, St. Johns, Clay, Putnam, and Flagler counties. It ranges from less than 10 to about 300 ft below mean sea level and varies in thickness from less than 1 to about 15 ft. The intermediate aquifer system consists of strata of the Hawthorn Group and undifferentiated post-Hawthorn Group sediments. The Hawthorn Group consists of early to middle Miocene clay and limestone that act as confining units between the underlying Floridan aquifer system and the overlying surficial aquifer system. Layers of interbedded sand and shell fragments (groundwater resources) lie within the Hawthorn Group. Generally, the intermediate aquifer system is slightly artesian and is recharged from below by the more artesian Floridan aquifer system through upward leakage via intervening confining strata. In a few locations, the intermediate aquifer system is nonartesian and may be recharged by the surficial aquifer also. The largest groundwater production from the intermediate aquifer system is in Clay County, which borders Duval County on the southwest side (Huff and McKenzie-Arenberg 1990).

3.4.2.3 Surficial Aquifer System

The surficial aquifer system is not a single continuous aquifer. Rather, it is a series of discontinuous and thin aquifers progressing in age from oldest (Miocene) in east central Florida to youngest (Pleistocene and Holocene) in eastern Duval County where Northside Generating Station is located.

In parts of Duval County a limestone unit is the principal water-bearing unit in the surficial aquifer system (Toth 1993). A series of high-standing Pliocene and Pleistocene beach deposits extends inland from the present-day coastline. The surficial aquifer consists of medium- to fine- grained sand in these areas. In swampy lowland areas (e.g., at Northside Generating Station) the water table is at or near the land surface throughout most of the year.

According to Toth (1993), the surficial aquifer system is recharged by local rainfall, ditches, tributaries, septic tank effluent, and percolation pond effluent (a groundwater mound is sustained beneath percolation ponds by nearly continuous recharge by liquid wastes). Also, in areas where the elevation of the potentiometric surface of the Floridan aquifer system is above the water table (as it is at Northside Generating Station), upward leakage from the upper Floridan aquifer to the surficial aquifer system may occur. Reverse flow (discharge) occurs when the water table is higher than the above features. The St. Johns River may alternately recharge and discharge the aquifer during high tides and low tides, respectively, depending on the water table elevation.

The quality of water taken from the surficial aquifer at depths ranging up to 125 ft is generally suitable for domestic, commercial, and industrial uses in most areas of Duval County (Phelps 1994). However, some wells are affected by water with high concentrations of chloride from the St. Johns River, other estuaries, and tidal marshes. Water in clean (low in clays and decaying vegetation) sandy zones is generally soft (total hardness less than 60 mg/L) and slightly acidic. Water in shellbeds of limestone is generally hard (total hardness greater than 120 mg/L) and slightly alkaline. Iron concentration generally exceeds EPA’s secondary drinking water standards (which are guidelines rather than regulatory restrictions). The mean concentration of iron in the surficial aquifer is 1.5 mg/L compared to EPA’s standard of 0.3 mg/L.

3.4.3 Hydrogeology in the Vicinity of Northside Generating Station

This section discusses production wells in the upper Floridan aquifer, groundwater monitoring wells in the surficial aquifer, and groundwater characteristics at Northside Generating Station.

3.4.3.1 Production Wells

There are four active deep production wells (D-1149, D-1150, D-1151, and D-1152) at Northside Generating Station and a fifth deep production well (D-228) that is on standby (Figure 3.4.2). Based on the following casing records, there is no interaction between the upper Floridan and surficial aquifer waters at the four active production wells. Each of these 16-in.-diameter wells was drilled to a depth of 1,104 ft and cased to a depth of 520 ft (USGS 1997). The casing exteriors were cemented to the surface. Cemented casings are periodically pressure-tested for leaks. When a leak is identified, a well is either repaired or the casing interior is plugged with cement and abandoned. Presumably the casings were placed at least 10 ft into the upper Floridan aquifer and certainly below the confining strata in the lower Hawthorn Formation. There is no published casing record for well D-228 that was drilled to 850 ft. Well D-228 appears to have casing that effectively seals off the surficial aquifer. The potentiometric surface had an average water level elevation of 25.1 ft for well D-228 during the 1996 water year (USGS 1997). Well D-1152 (with a published casing record) had a lower average water level elevation (20.8 ft) during the same time interval. If all other influencing factors are equal, these data suggest that well D-228 may be as effective as well D-1152 in preventing leakage through the casing.

The 18-year historical record (1978–96) of potentiometric surface heights is inconclusive in terms of whether these heights are declining or recovering at Northside Generating Station. The potentiometric surface heights of wells D-228 and D-1152 have declined from their historically highest levels in 1983 (29.4 ft and 26.5 ft, respectively). In contrast, the heights of the potentiometric surfaces for wells D-1149, D-1150, and D-1151 reached their historically highest levels during the

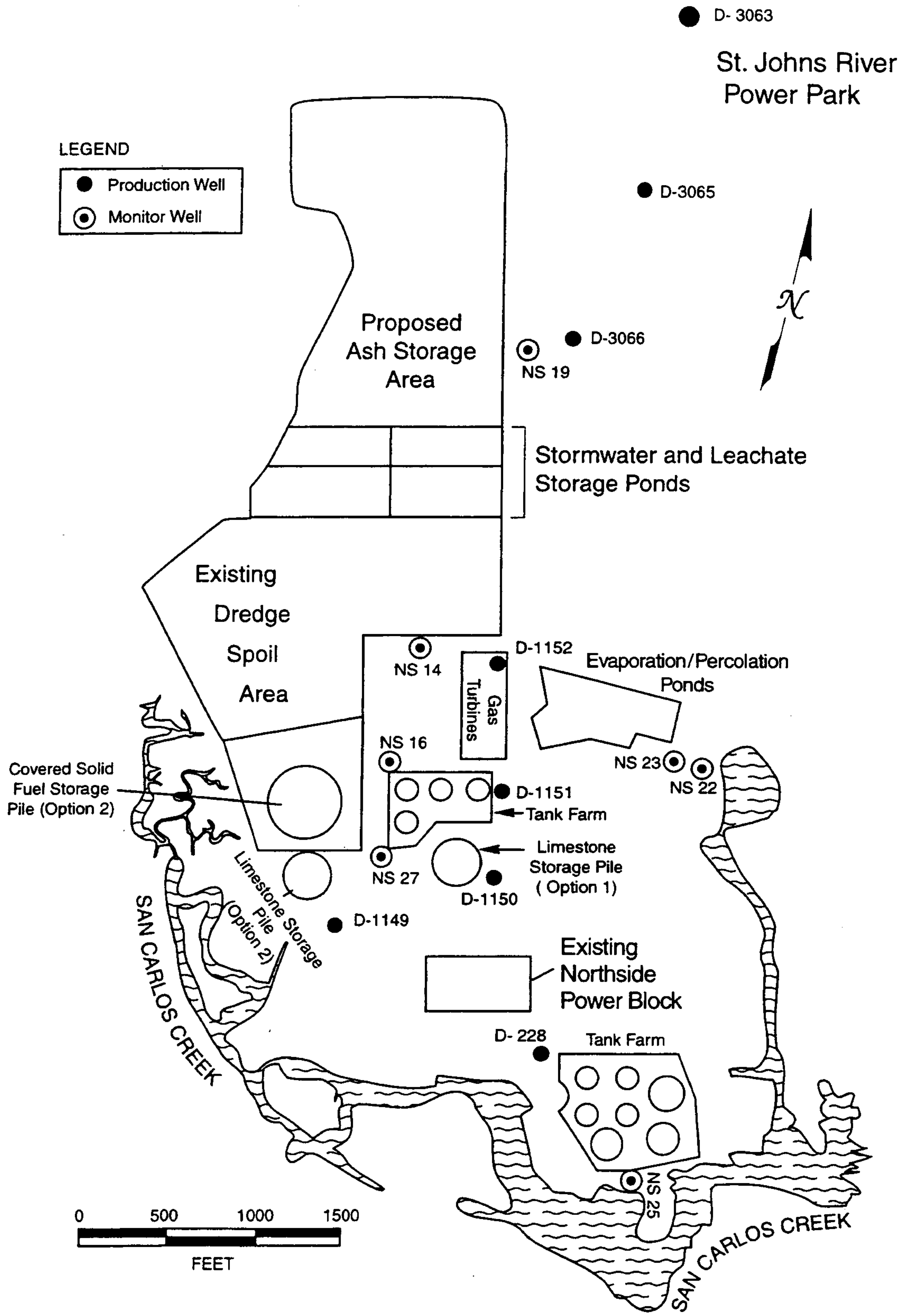
D- 3063
St. Johns River
Power Park
LEGEND
Production Well
Monitor Well
D-3065
N
Proposed
Ash Storage
Area
D-3066
NS 19
Stormwater and Leachate
Storage Ponds
Existing
Dredge
Spoil
Area
NS 14
D-1152
Evaporation/Percolation
Ponds
Gas
Turbines
NS 16
NS 23
NS 22
Covered Solid
Fuel Storage
Pile (Option 2)
D-1151
Tank Farm
Limestone
Storage Pile
(Option 1)
NS 27
D-1150
Limestone Storage
Pile
(Option 2)
D-1149
SAN CARLOS CREEK
Existing
Northside
Power Block
D- 228
Tank Farm
NS 25
0
500
1000
1500
FEET
SAN CARLOS CREEK

Figure 3.4.2. Location map for upper Floridan aquifer production wells, surficial aquifer monitoring wells, and proposed ash storage area and runoff ponds.

1995–96 water year (36.4 ft, 42.0 ft, and 24.8 ft, respectively) (USGS 1997). Data collected during more recent water years have not yet been published.

3.4.3.2 Surficial Aquifer Monitoring Wells

JEA (1997b) reports the results of quarterly groundwater quality sample analyses for seven surficial aquifer monitoring wells to the FDEP, Northeast District, Jacksonville, Florida. Other wells are plugged and abandoned or utilized only for measuring the depth to the water table. The seven surficial aquifer monitoring wells are at scattered locations around Northside Generating Station (Figure 3.4.2).

A background well (NS19) is located about 375 ft north (upgradient) from the dredge spoil pile. One well (NS14) is located on the inside edge of the L-shaped dredge spoil pile. Two more wells are located near the northwest and southwest corners of the northern tank farm (NS16 and NS27, respectively). The western boundary of this tank farm is about 500 ft from the west fork of San Carlos Creek, a tributary to St. Johns River. Another two wells (NS22 and NS23) are located near the southeast corner of the evaporation/percolation ponds. Another well (NS25) is located on the south side of the fuel oil tank farm and adjacent to the confluence of the east and west forks of San Carlos Creek.

Well depths range from 11 to 20 ft. Fine, loose sand is the predominant sediment encountered in all the wells. Surface elevations range from 4.3 to 12.9 ft amsl. Water table elevations range from 0.1 to 2.9 ft amsl. Seasonal variations in water table elevations range from 3 to 6 ft. Higher water table elevations and greater water table fluctuations are associated with wells at higher surface elevations.

Five of the seven wells were monitored mainly for inorganic constituents, as shown in Table 3.4.1. Fourth-quarter analytical results for 1993 and 1995 are presented. These data are provided by JEA to the FDEP under terms of their groundwater permit. Water samples from two wells (NS22 and NS23) close to the evaporation/percolation ponds have high concentrations of sulfate, chloride, and total dissolved solids. The other three wells all meet EPA secondary drinking water standards for these constituents. Analyses did not detect the presence of metals above their detection limits. Iron was not included in these analyses. All water samples were slightly acidic (pH between 5 and 6), including samples from the background well (NS19).

The water quality was better in all five wells when the water table was high in 1995. When the water table is high as a result of infiltrating rainwater, the surficial aquifer discharges to San Carlos Creek, nearby ponds, and ditches. Conversely, when the water table is low, the surficial aquifer may be recharged by the creek, nearby ponds, and ditches.

Two compliance wells (NS25 and NS27) are adjacent to fuel oil tank farms. These wells were monitored for the presence of many organic compounds that are commonly associated with fuel oil. Analyses did not detect the presence of any of these compounds above their detection limits.

Table 3.4.1. Water table elevations and concentrations of chemicals in 1993 and 1995 water samples from the surficial aquifer at Northside Generating Station

	Background well (NS19)		Dredge spoil area well (NS14)		Northern tank farm well (NS16)		Percolation pond well (NS22)		Percolation pond well (NS23)	
Parameter	1993	1995	1993	1995	1993	1995	1993	1995	1993	1995
Surface elevation, ft amsl	13	13	11	11	13	13	6	6	8	8
Water table elevation, ft amsl	6	10	5	10	4	9	2	3	4	7
pH	6	6	5	6	5	6	6	6	6	6
Sulfate, mg/L	7	5	18	11	12	8	680	500	1100	690
Chloride, mg/L	27	4	15	9	7	12	290	89	420	160
Total dissolved solids, mg/L	140	82	120	120	44	71	1800	820	2600	1300
Total organic carbon, mg/L	7	5	5	4	2	4	14	26	11	29
Total organic halogens, μg/L	19	35	25	33	14	21	62	44	50	49
Metals	BDL[a]	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

[a]BDL = below detection limits.

Three surficial aquifer studies were conducted for JEA from 1992 to 1995 in areas adjacent to one another. The first study (Law Engineering 1992) was initiated to support the development of a new groundwater monitoring plan for a proposed sludge disposal site on the dredge spoil berms. Law Engineering used existing surficial aquifer wells to characterize local groundwater conditions around the dredge spoil area. However, the proposed project was cancelled, and the new wells were never installed. Similar characterizations were completed in support of limited contamination assessments for the surficial aquifer immediately downgradient from the combustion turbines on the southeast side of the dredge spoil area (EMCON 1995), and the nearby tank farm (RBA 1995). Results of these three independent groundwater characterizations are presented in Table 3.4.2. Estimates of aquifer porosity, hydraulic conductivity, hydraulic gradient, and groundwater velocity varied by factors of 2, 21, 12, and 20, respectively. The wide variation in estimated groundwater velocities indicates contaminant travel times ranging from a few decades to over 100 years to reach San Carlos Creek.

Table 3.4.2. Hydraulic characteristics of the surficial aquifer in the vicinity of the dredge spoil, tank farm, and combustion turbine areas

	Dredge spoil[a]	Tank farm[b]	Combustion turbines[c]
Conductivity, ft/day	5.7	0.27	4.5
Gradient	0.002	0.0036	0.0003
Porosity	0.15	0.25	0.30
Groundwater velocity, ft/year	28	1.4	1.6

[a]Law Engineering 1992.
[b]RBA 1995.
[c]EMCON 1995.

3.4.3.3 Water Quality

In 1996, chloride concentrations ranged from 20 to 36 mg/L for individual quarterly samples from the four active production wells (D-1149, D-1150, D-1151, and D-1152) at Northside Generating Station (USGS 1997). Similar samples of specific conductance ranged between 488 and 613 μmhos/cm at these wells. Two wells (D-3841, located 10 miles to the east, and D-1095, located 10 miles to the west) had concentrations ranging from 13 to 20 mg/L for chloride, 86 to 100 mg/L for sulfate, 296 to 338 mg/L for total dissolved solids, and 480 to 530 μmhos/cm (Phelps and Spechler 1997). Table 3.4.3 presents a compilation of annual average concentrations for four quarterly water samples from the four active production wells and the two offsite wells. Although total dissolved solids were not reported at Northside Generating Station, specific conductance is a good estimator of total dissolved solids. Based on a comparison of the maximum specific conductance at Northside Generating Station with the specific conductance at the two offsite wells and assuming a similar

Table 3.4.3. Upper Floridan aquifer water quality in production wells at Northside Generating Station compared with wells located 10 miles east and west of the station[a]

Parameter	Well					
	D-1095, 10 miles west	D-3841, 10 miles east	D-1149, at the station	D-1150, at the station	D-1151, at the station	D-1152, at the station
Chloride, mg/L	13	17	20	35	22	23
Sulfate, mg/L	86	93				
Specific conductance, μmhos/cm	480	520	514	589	537	502
Total dissolved solids, mg/L	296	338				

[a]Well-head samples are from wells drilled to similar depths. Samples were collected from D-1095 and D-3841 in the 1994–95 water year (Phelps and Spechler 1997) and from the Northside Generating Station wells in the 1995–96 water year (USGS 1997).

percentage increase in total dissolved solids at Northside Generating Station, total dissolved solids at station wells might exceed 400 mg/L at times.

Older data are available for comparison with these more recent data. Comprehensive water quality data for well D-1149 were collected in September 1978 (USGS 1980), while more limited data were collected in October 1976 for wells D-228, D-1150, and D-1151 (Table 3.4.4). A comparison of the more recent data in Table 3.4.3 with the older data in Table 3.4.4 suggests that chloride concentrations and specific conductance have increased by about 10 and 20%, respectively, over the past 20 years in upper Floridan aquifer production wells at Northside Generating Station.

It is unlikely that the surficial aquifer would discharge into the upper Floridan aquifer at any time in the near future at Northside Generating Station. The only short-term scenario is one in which a casing fails while a deep cone of depression is developing around a producing upper Floridan aquifer well. However, well casings are periodically examined for leaks and, when necessary, the well casing is repaired or the well is plugged and abandoned. The potentiometric surface in shut-in wells would recover and—if a shut-in well has a failed casing—leakage would be upward from the upper Floridan aquifer to the surficial aquifer.

The following potentiometric data were obtained from four production wells (all drilled to a depth of 1,104 ft) at Northside Generating Station. In 1996, the potentiometric surface of the upper Floridan aquifer ranged from 17.0 to 41.7 ft above the land surface elevation of 10 ft amsl (USGS 1997). The potentiometric surface elevations were influenced by two factors [the time of the year and length of time since a particular well temporarily ceased production (i.e., was shut-in)]. The rate of potentiometric surface decline is between 0.33 and 0.75 ft per year (Phelps and Spechler 1997). Using the lowest potentiometric surface observed in 1996 (17 ft) and assuming that the water table

Table 3.4.4 Upper Floridan aquifer water quality in production wells at Northside Generating Station based on previous data[a]

	Well			
Parameter	D-228	D-1149	D-1150	D-1151
Specific conductance, μmhos/cm	415	425	440	460
Alkalinity, mg/L		160		
Bicarbonate, mg/L		190		
Hardness, mg/L	204	250	212	240
Calcium, mg/L		55		
Magnesium, mg/L		27		
Sodium, mg/L		14		
Potassium, mg/L		2		
Chloride, mg/L	18	24	20	20
Sulfate, mg/L		80		
Fluoride, mg/L		1		

[a]Water samples from well D-1149 were collected in September 1978. All other water samples were collected in October 1976.

coincides with the land surface, it would take between 21 and 50 years beyond 1999 for the potentiometric surface to fall below the land surface.

3.4.4 Groundwater Use

This section discusses groundwater use quantitatively for industrial, commercial, municipal, and private user categories in Duval County. Also, groundwater consumption at Northside Generating Station and its nearby neighbors (within 2 miles) is discussed.

Huff and McKenzie-Arenberg (1990) provides groundwater use data for Duval County from 1975 to 1988, and more recent groundwater use data through 1996 are provided by individual SJRWMD annual water use surveys (Figure 3.4.3). Total groundwater use increased from 152 Mgd in 1975 to 169 Mgd in 1988 (Huff and McKenzie-Arenberg 1990), but decreased to 151 Mgd in 1995 (Florence and Moore 1997). Total groundwater demand is expected to increase by 43 Mgd between 1995 and 2020 (Vergara 1998).

A comparison of 1988 and 1995 data shows that public use is increasing while all other categories of use are declining. Public use of municipal wells in 1988 and 1995, respectively, was approximately 95 and 100 Mgd; domestic or household use of private wells was 15 and 12 Mgd; agricultural use was 15 and 3 Mgd; and industrial use or electric power generation was 44 and 30 Mgd.

Vergara (1998) identifies southeastern Duval County as a priority water resource caution area. Northside Generating Station and the St. Johns River Power Park are adjacent to the northern boundary of this caution area. Caution areas are regions where existing and reasonably anticipated sources of water and conservation efforts may not be adequate to (1) supply water for all existing legal uses and reasonably anticipated future needs and (2) sustain the water resources and related natural systems.

Northside Generating Station and the St. Johns River Power Park pump groundwater for processes and systems requiring potable water. Treated groundwater is used for domestic and sanitary needs, various washes, miscellaneous equipment, advanced water treatment, boiler feedwater makeup, boiler and preheater washes, and fire protection. Although JEA is permitted to withdraw a maximum of 3 Mgd from the four deep wells in the upper Floridan aquifer at Northside Generating Station, groundwater consumption averaged 0.64 Mgd in 1996. The maximum allowable annual usage for the Northside facility is 730 Mgal/year, which is equivalent to 2 Mgd for each day of the year. The consumptive use permit was issued in 1993 and expires in 2000. The permit was modified in December 1996, but the allocation for groundwater consumption was not changed in the 1996 modification. St. Johns River Power Park also obtains its groundwater from onsite wells. Groundwater consumption by the Power Park averaged 3.57 Mgd in 1995 (Florence and Moore 1997).

Gate Maritime Properties, Inc., and the Jacksonville Port Authority, located within 2 miles of Northside Generating Station, are currently permitted to withdraw groundwater from the upper Floridan aquifer from a total of eight wells. Collectively, these two facilities are permitted to withdraw 1.3 Mgal/year, which is less than 1% of the permitted consumption rate at Northside Generating Station.

3.4.5 Soils

Where undisturbed by prior construction activity, soils in the area of Northside Generating Station are only slightly modified by weathering from the Pleistocene beach sands from which they were derived. They are predominantly unconsolidated, medium to fine quartz sand with lesser amounts of silt and even smaller amounts of clay to depths of greater than 20 ft. The water table is at or near the surface most of the year. Weathering processes such as oxidation and leaching are retarded where the soil is usually saturated. The only appreciable soil alteration results from the growth and decay of wetland vegetation.

3.4.6 Geologic Hazards

This section discusses the potential for subsidence, settlement, and erosion by storm surge. Also, the probability of damage from an earthquake and associated liquefaction is discussed.

3.4.6.1 Subsidence

Cover-collapse sinkholes are common to the west and south of Duval County, but they are rarely found at the surface in northeastern Florida (Beck and Sinclair 1986). Cover-collapse in central Florida and the southern reaches of the St. Johns River basin is a phenomenon where the near-surface Hawthorn and younger sands, silts, and clays collapse into solution cavities in the underlying Ocala Group. The size and severity of collapse at the surface is related to the thickness and bearing strength of the near-surface sediments. Collapse of the surface into buried Ocala Group sinkholes is possible but extremely rare in Duval County (Beck and Sinclair 1986). The greater thickness of the Miocene to Holocene sediments is believed to prevent cover-collapse sinkholes from propagating to the surface. When such features do reach the surface, they are not as severe. However, small-scale subsidence may occur over near-surface shell beds or limestone lenses of Miocene to Holocene age. One small topographic depression is located on the south side of the 40-acre dredge spoil site at Northside Generating Station. This depression may be a sinkhole or possibly a settlement feature caused by the loading of dredge spoil. Another small topographic depression that may have been caused by subsidence lies immediately south of the dredge spoil site.

3.4.6.2 Settlement and Erosion

Uniform sands in the vicinity of Northside Generating Station are not expected to experience long-term settlement or appreciable differential (uneven) settlement. Settlement occurs rapidly in free-draining sands. Unconsolidated sands that are located in critical areas may be eroded by infrequent storm-surge.

3.4.6.3 Earthquakes

The Northside Generating Station site contains medium- and fine-grained sands and silts below the water table that are susceptible to liquefaction (Seed and Idriss 1971). Such soils lose their strength under vibratory motion. There is a greater than normal risk of structural failure at such sites during a strong-motion earthquake.

Algermissen et al. (1990) used the entire history of earthquakes in eastern North America through 1988 to produce probabilistic ground motion estimates. These estimates are the basis for Uniform Building Code (UBC) guidelines. All of Northern Florida is located in seismic zone 1 of the UBC (ICBO 1995). Earthquakes have 10 and 63% probabilities of producing peak ground accelerations (PGAs) in excess of 0.05 g at least once in 50 and 500 years, respectively, on rock foundations anywhere in seismic zone 1. The UBC design PGA for seismic zone 1 is 0.075 g.

There are no state of Florida or local seismic building codes. However, the Southern Building Codes Conference recently published a set of standard codes for the southeastern United States (SBCC 1997). A PGA of 0.05 g would produce minor damage to structures founded on rock and designed to resist earthquakes. Somewhat greater damage would occur to structures founded on unconsolidated sediments. Seed and Idriss (1971) consider a PGA of 0.05 g to be somewhere near the threshold of liquefaction in medium- to fine-grained and loose sand that is located below the water table.

The Charleston, South Carolina, earthquake of 1886 probably produced the strongest ground motion of record in northeastern Florida. The modified Mercalli intensity (MMI) of this earthquake was estimated at V to VI in Jacksonville, based on newspaper accounts of eye-witness perceptions (Bollinger 1986). Although an earthquake with an MMI of VI is capable of causing wide-spread panic, the only damage is likely to be fallen plaster and damaged chimneys.

There is a historical record of mild earthquakes in Florida (EVSC 1981a). An earthquake with an epicentral MMI of V struck near Jacksonville in August 1900. A similar earthquake in the future would be felt in the region surrounding Northside Generating Station. However, damage would be minor and confined to older, poorly constructed buildings. The largest earthquake in Florida struck Gainesville in 1879 with an MMI of VI in the epicentral area. Although this earthquake was widely felt along the Atlantic coast from Savannah, Georgia, to Daytona Beach, Florida, the only damage reported was plaster falls in a few older homes in St. Augustine.

3.5 FLOODPLAINS, STORM SURGE, AND WETLANDS

3.5.1 Floodplains

The 100- and 500-year floodplains along the St. Johns River for the area including and surrounding Northside Generating Station have been identified by the Federal Emergency Management Agency (FEMA 1989). The elevations of the 100- and 500-year floodplains are 7 and 10 ft amsl, respectively. Water storage provided by the vast array of tidal marshlands east and north of Jacksonville limits the extent of flooding that could occur along the lower St. Johns River near Northside Generating Station (COE 1961).

Most of the land for the existing and proposed power blocks is located above the 500-year floodplain because it is at an elevation that slightly exceeds 10 ft amsl (USGS 1992b). A small portion of this land along the southern edge of the existing and proposed structures could be inundated by an approximate 100- to 500-year flood to depths averaging less than 1 ft (i.e., nuisance flooding).

The St. Johns River Power Park’s coal conveyer that originates on Blount Island, the water intake flume, and the discharge collector basin are elevated structures that cross the floodplain. The coal conveyer is elevated above the 500-year floodplain. The intake flume and collector basin would be either partially or completely submerged during an approximate 500-year flood. The base of the vertical turbine pumps that supply cooling water to the condensers are above the 500-year floodplain.

The existing and proposed fuel and sorbent unloading facilities are located within the 100-year floodplain. These structures either have or would have the capability to moor and unload large ships and comply or would comply with all applicable regulations governing the design, installation, and maintenance of marine/harbor facilities. Some of the ancillary structures, piping, and equipment related to the operation of these facilities also are located either totally or partially within the 100-year floodplain.

3.5.2 Storm Surge

Florida is located in one of the most hurricane-prone regions of the United States. A hurricane is a tropical storm whose wind velocities equal or exceed 74 mph. Damage from hurricanes is caused by intense precipitation, extreme winds, and wind-induced tides and wave action known as storm surge, which can result in flooding, erosion, and washout. Hurricane Dora (September 1964) was the first hurricane north of Stuart, Florida, to strike perpendicular to the coast of Florida from the Atlantic Ocean since the Great Hurricane of 1880 (Rabon 1970; Williams and Duedall 1997). Damage at Jacksonville caused by Dora exceeded that of either Andrew (1992) or Hugo (1989).

Sustained winds attributed to hurricane Dora were 125 mph at St. Augustine and 82 mph at the Jacksonville airport (Rabon 1970; Williams and Duedall 1997). Rainfall during the 4-day storm exceeded 10 in. over a 10,000-mile^2 area—an estimated 50-year, 4-day storm. A 10-ft storm tide caused extensive erosion and inundation of the beaches and coastline near Jacksonville. Beach roads were washed out and buildings were swept into the sea.

Hurricane Dora also caused considerable wind-induced flooding along the St. Johns River in Jacksonville (Rabon 1970; Williams and Duedall 1997). High winds caused massive utilities failure, and numerous trees were uprooted. Total damage was estimated at $250 million dollars (more than $1 billion in 1990 dollars).

The maximum water surface elevation recorded at the Main Street Bridge (22.7 miles upstream from the mouth of the river) in Jacksonville was 5.21 ft amsl; this elevation occurred on September 10, 1964 during hurricane Dora (USGS 1997). Northside Generating Station is located approximately 10 miles upstream from the mouth of the river (EVSC 1981a). Using the storm tide elevation of 10 ft amsl at the mouth of the St. Johns River as a reference, the maximum water surface elevation that occurred in the vicinity of the station during hurricane Dora was 7.9 ft amsl (obtained using linear interpolation based on the relative distances from the mouth of the river). This amount is less than the elevation of approximately 10 ft amsl at the base of Northside’s existing turbine building.

Other hurricanes have caused elevated water surface along the St. Johns River at Jacksonville that were less than the storm surge observed during hurricane Dora (COE 1961): (a) 4.8 ft amsl, October 13–21, 1944; (b) 3.0 ft amsl, October 7–9, 1946; and (c) 4.7 ft amsl, October 15–19, 1950. Waterfront areas in downtown Jacksonville experienced minor flooding during the 1944 and 1950 hurricanes.

The somewhat inland location of Northside Generating Station is partially protected from storm surge by the narrow coastal strip, comprising the beach and beach ridge, which lies between the Atlantic Ocean and Intracoastal Waterway (COE 1961). The beach ridge along the dune line has an average elevation in the range from 10 to 12 ft amsl. Marshlands east and north of Jacksonville serve to absorb tides and limit the extent of flooding. Historically, hurricanes have tended to move parallel to the coast of Florida and bypass Jacksonville.

A design hurricane-tide elevation in the range from 4 to 6 ft amsl has been quoted for the Jacksonville riverfront (COE 1961). This range does not include wave run-up and ponding on lands along the waterfront. The city of Jacksonville is preparing storm surge maps, which have not yet been issued.

The JEA has an emergency plan ready for implementation that provides for mobilization of the necessary resources to respond quickly and effectively to a major disaster such as a hurricane (JEA 1996b,c). The advanced preparation and planned response protect personnel, minimize property damage, and minimize the time required to restore electrical service to the community if damage does occur.

3.5.3 Wetlands

The delineated wetlands in the vicinity of the proposed project are shown in Figure 2.1.7. The freshwater habitats that are an integral component of wetland ecosystems in the vicinity of Northside Generating Station consist of two creeks, their associated hardwood swamps, and small isolated gum swamps. Types of terrestrial habitat or communities within the hardwood swamps include cypress, bottomland hardwood, and bayhead. These freshwater systems are typical of similar habitats throughout the region where fluctuations in water levels and stream flow with time are the primary factors that determine or regulate the abundance and diversity of freshwater organisms residing in these systems. The hardwood swamps drain into the salt marsh via small streams and provide some nutrient and organic food sources for organisms in the upper salt marsh/tidal creek complex. The water level varies seasonally in these freshwater habitats with depths up to 20 in. occurring during wet seasons and with standing water restricted to local depressions in dry periods. The isolated gum swamps occur in the area as small depressions within the pine flatwood vegetation types. These swamps are important to the surrounding pine flatwoods in that they aid in drainage and in nutrient regeneration. Water retention in this community type is also seasonal, being prevalent during wetter months and subsiding dramatically during the drier periods. The fauna of these freshwater systems are adapted to the fluctuating water levels characteristic of these habitats. Within the hardwood swamp (which also includes the cypress, bottomland hardwood, and bayhead habitats and their associated creeks), 5 species of mammals, 12 bird species, 3 reptile species, and 9 species of amphibians (mostly frogs) have been observed. Some of the dominant herbaceous plant species in the hardwood and cypress swamps include bladderworts, duckweed, pickerelweed, and cattails.

3.6 ECOLOGICAL RESOURCES

This section summarizes and provides an overview of the ecological resources, including aquatic and terrestrial ecosystems, in the vicinity of Northside Generating Station. Of particular importance is the 46,000-acre Timucuan Ecological and Historic Preserve that borders the site to the east. Because detailed descriptions of the ecological resources, including extensive species lists, are available in other documents previously prepared for Northside Generating Station and the St. Johns River Power Park (EVSC 1981a,b; JEA 1976; EPA 1981), the purpose of this section is to identify the major ecological habitats and community types on and near the site, provide a brief description of the major aquatic and terrestrial resources associated with these habitat types, and discuss the functional relationships between these habitats and communities in terms of how they relate to each other as integrated ecological systems. The amount of detail provided for each of the ecological components described below generally reflects the potential level of effect that the proposed project could have on each of these components. For example, the proposed project is not anticipated to affect any of the terrestrial habitat types in the site vicinity; but the potential to impact aquatic resources is much higher. Therefore, more detail is provided for the aquatic systems.

3.6.1 Terrestrial Ecology

Northeastern Florida is categorized as southern mixed forest, which is characterized by tall forest with broadleaf deciduous and evergreen species. Nine major types of terrestrial habitat or communities occur in the vicinity of Northside Generating Station including pine flatwoods, grassy scrub, grassy scrub/pine flatwoods, hardwood swamp, hardwood hammock, bottomland hardwood, bayhead, and cypress swamp (EPA 1981). Isolated gum swamps also occur in the area as small depressions within the pine flatwoods. The salt marsh systems that border San Carlos Creek and other tidal estuaries in the area are also considered terrestrial communities; however, because they are transitional habitats between terrestrial and aquatic systems and because of their high ecological importance, the ecology of these systems is described in Section 3.6.2.

Both game and non-game species of wildlife are associated with these terrestrial and wetland communities in the vicinity of the site. Game species include whitetail deer, eastern gray squirrel, marsh rabbit, and bobwhite quail. Some of the more common non-game species include raccoons and opossums; river otters are observed less frequently.

3.6.2 Aquatic Ecology

The aquatic ecosystems in the vicinity of Northside Generating Station are typical of southeastern coastal ecosystems and consist of two major habitat or community types: the St. Johns River estuary and the tidal creeks and their associated salt marsh estuaries. These two ecosystems are relatively distinct in terms of their hydrodynamic, physicochemical, and biological character.

The tidal creek and salt marsh systems in the area of Northside Generating Station are contiguous with the extensive southeast coastal marsh system and are well recognized for their ecological and commercial importance. Salt marsh systems provide several ecological services to the surrounding estuarine communities. These habitats function as nursing, spawning, and/or feeding areas for several species of commercially and recreationally important fish and shellfish species such as shrimp, crabs, seatrout, and menhaden. The salt marsh system also (1) helps to filter and process pollutants, nutrients, and sediments; (2) functions as an aquifer recharge zone; and (3) helps to maintain a proper balance of salinity regimes in wetland areas.

Tidal flow and salinity regimes are the primary factors that dictate and regulate the structure and function of the biological communities of these salt marsh/tidal creek systems. Tidal flow provides nutrients and materials to organisms residing within the tidal creek/salt marsh complex and transports organic food sources and other nutrients to other areas of the estuarine system. Black needle rush and salt marsh cord grass are the predominant vegetation types that ultimately form the primary energy base of the food chain, particularly for many invertebrates and detritivore species (organisms that primarily eat decaying organic matter). The salt marsh systems that directly border the St. Johns River, such as those that occur along the river channel of the Blount Island area, are somewhat disturbed because of channelization, sea walls, and rip rap embankments. Extensive, relatively undisturbed tidal marshes, however, border San Carlos Creek in the vicinity of Northside Generating Station.

In addition to the emergent macrophytes (plants that extend above the water surface) such as black needle rush and cord grass, periphyton (algae attached on underwater rocks and pilings) also contribute to the organic matter base of the salt marsh/tidal creek food web. Periphyton serve, for example, as forage for grazers such as gastropod molluscs and fiddler crabs. On a seasonal basis, some of the organic matter production within the tidal creek/salt marsh complex is retained within the system, providing a food base for many invertebrate and some fish species. Submergent macrophytes (plants that do not extend above the water surface) such as seagrasses are generally absent in the back channel of the St. Johns River, primarily because of (1) unfavorable turbidity and salinity regimes which limit their distribution and (2) the disturbed shorelines and channelization which hinder their growth.

The benthic communities of the estuarine systems in the site vicinity are dominated by macroinvertebrates that are characteristic of southeastern estuarine ecosystems. There are two distinct assemblages of macroinvertebrates inhabiting the estuarine systems in the vicinity of Northside Generating Station: those associated with the fine mud and sand substrates of the tidal creeks, such as polychaetes and amphipods; and those residing in the silt and mud substrates of the St. Johns River, such as the small clam, *Mulinia* sp. Within the St. Johns River, many mollusc species have undergone severe reduction of potential habitat as a result of dredge and fill activities in construction and maintenance of the Intracoastal Waterway and the ship channel (Brody 1993). Densities of benthic invertebrates in both the St. Johns River and the tidal creeks/salt marsh systems are relatively low with scattered, high-density patches of several opportunistic species (Brody 1993). The smaller invertebrates such as amphipods and polychaetes serve as forage for bottom-feeding fish such as spot and croaker while the macroinvertebrates such as shrimp and crabs are preferred by predators such as redfish, sea trout, black drum, and flounder. Also, of commercial importance, are the blue crab and three species of shrimp which utilize the tidal creek/salt marsh complex during much of their life history for feeding, growth, and protection from predators.

Even though zooplankton are not an important component of the food web in the tidal creeks and salt marshes, they are the dominant food source for most species of larval and juvenile fish in the St. Johns River estuary. Copepods, cladocerans, and larval forms of benthic organisms such as barnacles and polychaetes (meroplankton) are the dominant zooplankton in the St. Johns River. Whereas the base of the food chain in tidal salt marshes and wetlands is primarily detritus (decaying organic matter) and periphyton, the food chain in the St. Johns River is supported mainly by phytoplankton and zooplankton (Brody 1993). Phytoplankton and zooplankton are consumed by not only larval fishes, but zooplankton also serve as the primary food of some ecologically important adult species such as anchovy and silversides and the filter-feeding menhaden. These species, in turn, serve as important prey for intermediate-level predators such as seatrout and bluefish.

The St. Johns River estuary supports an abundant and varied fish community including seasonal and permanent residents (menhaden, weakfish, silver perch, spot, croaker, spotted seatrout), anadromous species (shad, striped bass), and occasional oceanic species that pass through the area (e.g., bluefish, jacks). Of the 113 fish species that have been identified in the area (EPA 1981), several are recreationally and commercially important and use the salt marsh/tidal creek areas near Northside Generating Station for feeding and nursery grounds.

Mean densities of total fish larvae, including shrimp and crab larvae, were found to be 16,000/1,000 m^3 in the tidal creeks and about 10,000/1,000 m^3 in the back channel of the St. Johns River (EVSC 1981a). The most common species of ichthyoplankton were weakfish, spot, menhaden, spotted seatrout, croaker, silver perch, and black drum. Both blue crabs and penaeid shrimp post-larvae are seasonally common constituents of the meroplankton (included in ichthyoplankton in terms of total densities) (JEA 1976; EVSC 1981a).

3.6.3 Threatened and Endangered Species

Although suitable habitat exists for 21 species of terrestrial and aquatic wildlife that are listed as threatened, endangered, or species of special concern by the U.S. Fish and Wildlife Service and the Florida Game and Fresh Water Fish Commission, species actually observed in the site vicinity include the shortnose sturgeon (federal and state endangered), green sea turtle (federal and state endangered), gopher tortoise (state, species of special concern) (detected indirectly by its burrows), snowy egret (state, species of special concern), tricolored heron (state, species of special concern), wood stork (federal and state endangered), brown pelican (state, species of special concern), and manatee (federal and state endangered) (Foster Wheeler 1998a).

West Indian manatees have been the subject of increasing scrutiny since the passage of the U.S. Marine Mammal Protection Act of 1992 and the Endangered Species Act of 1973. Manatees reside year-round in waters of southern Florida and in northern waters of the state during the summer. Manatees occupy a variety of marine, estuarine, and freshwater habitats and are found in both turbid and clear water in depths of at least 3 ft. In coastal areas, manatees tend to travel in water up to 20 ft deep and typically avoid swift currents. Being herbivorous, manatees feed primarily on freshwater plants, submerged seagrasses, and plants along shorelines. Manatees are regularly observed in the site vicinity during warmer months and have occasionally been observed during the winter. The manatee population in the Jacksonville area consists of one group that remains in the area throughout the winter and another group that migrates south with the onset of cooler weather. The survival of the group that remains during the winter appears to be dependent on artificial thermal discharges in the Jacksonville area (Brody 1993). Based on aerial surveys from 1994 to 1996, manatees have been sighted on 11 occasions during the spring and summer in the St. Johns River within 2 miles of the Northside Generating Station intake and discharge area (Table 3.6.1); all but one of these sightings were upstream of the intake and discharge area. In addition, one unofficial sighting of manatees in San Carlos Creek during the summer of 1997 has been reported. Of the 11 official aerial sightings, manatees were traveling through the area on 8 occasions, were observed feeding on 2 occasions, and were resting on 1 occasion. Two of these observations included not only adults but also their calves.

Table 3.6.1. Sightings of manatees in the St. Johns River within 2 miles of the Northside Generating Station intake and discharge area

Date	Adults	Calves	Observed activity
April 26, 1994	1	0	Traveling
May 12, 1994	1	0	Traveling
May 14, 1994	1	0	Resting
May 26, 1994	1	0	Traveling
June 11, 1994	1	1	Traveling
May 16, 1995	1	0	Feeding
May 30, 1995	2	0	Traveling
August 8, 1995	1	0	Traveling
June 21, 1996	1	0	Feeding
July 29, 1996	1	0	Traveling
August 19, 1996	1	1	Traveling

Gopher tortoises reside on the Northside Generating Station site, and numerous burrows have recently been observed in the uplands area north of Ostner Road and east of the dredge spoil site around the combustion turbine tank farm. Preferred gopher tortoise habitats are dry, well-drained soils such as may occur within the xeric (dry) pine flatwoods areas or on sandy berms around dredge spoil and other sandy sloping structures. Burrows of gopher tortoises can harbor other protected species including eastern indigo snakes and gopher frogs, even though neither species has been observed on the site or in the site vicinity. Wood storks feed in the salt marshes next to the site, and snowy egrets and tricolored herons have been observed feeding along the shorelines of adjacent creeks and the St. Johns River. Brown pelicans frequent the site vicinity on a regular basis and also feed in the shallow estuarine systems adjacent to the site.

Although suitable habitat exists in the site vicinity for 26 protected plant species, only the hooded pitcher-plant (state threatened) is included in the Florida Natural Areas Inventory (Foster Wheeler 1998a). The preferred habitat of this species is acidic soil associated with pine savannas and bogs; this habitat is found in peaty-sandy ditches in the site vicinity.

3.6.4 Biodiversity

The biodiversity of an ecosystem or community is defined by the variety or richness of the natural biotic environment in terms of the number of habitat types and/or species. The biodiversity in the site vicinity can be characterized as relatively high because of the nature and variety of community types present and the presence and influence of several marine vertebrate and invertebrate species from the Atlantic Ocean via the St. Johns River. This variety of community and habitat types dictates that a large number and variety of organisms will also occur as a result of their adaptation to and their close association with each of these habitat types. Major community types that occur in the site vicinity are (1) the upland terrestrial systems including the freshwater wetlands and creeks, (2) the salt marsh/tidal creek systems which are major transitional zone systems between terrestrial and aquatic communities, and (3) the St. Johns River estuary complex. Each of these major ecosystems is relatively distinct in terms of its hydrodynamic and physiochemical character and, therefore, many of the organisms associated with these systems are unique in terms of their ecological adaptation and tolerance to existing environmental conditions. These three major ecosystem types in the site vicinity are linked hydrodynamically and ecologically, functioning as an integrated ecological ecosystem. For example, the upland freshwater wetlands provide freshwater (and therefore help to regulate the salinity regimes) and some nutrient and organic food (detrital) input into the salt marsh/tidal creek complex. The salt marsh system, in turn provides food, shelter, and breeding areas for several ecologically and commercially important fish and invertebrate species which migrate into the salt marsh and tidal creeks from the St. Johns River. Contributing to this rich biodiversity in the area are also the transient or occasional mammal and bird species that utilize these systems for feeding, breeding, or shelter.

3.7 CULTURAL RESOURCES

Seventy-five sites in Duval County are listed in the *National Register of Historic Places*; 72 of them are individual historic or archaeological sites and three are historic districts. Although the Northside Generating Station site has never been comprehensively surveyed for cultural resources (F. Keel, Florida Division of Historical Resources, personal communication to S. Marshall, Foster Wheeler Environmental Corporation, January 21, 1998), at least one previously identified archaeological site (8Du91) was destroyed by plant construction (EPA 1981). That site, known as San Carlos Creek A, is described in state records as a "refuse area," which was located on the east bank of San Carlos Creek at the first point of high land touched by the creek (L.A. Kammerer, State Historic Preservation Office, Florida Department of State, personal communication to M. Schweitzer, ORNL, February 9, 1999). The results of other studies show that the area in the vicinity of the proposed project is rich in archaeological resources. Nearby sites that have been identified include an extremely large (about 2,000 × 660 ft) shell midden (a mound or pile of discarded materials typically consisting of food remains and various artifacts) on Pelotes Island, less than 3 miles east of Northside Generating Station; numerous sites around Browns Creek and Clapboard Creek, within 3 miles of Northside Generating Station; approximately 20 sites on the mainland north of Blount Island, less than 2 miles from Northside Generating Station; and over 30 prehistoric sites on Fort George Island, located about 9 miles east of Northside Generating Station (JPDD 1994).

Further corroboration of the potential for undiscovered archaeological resources at the proposed project site is provided by a study of the adjacent St. Johns River Power Park that was performed in 1980 prior to plant construction. A reconnaissance survey identified 11 archaeological sites and further investigation indicated that the sites are Orange Period (2000–1000 B.C.) and Savannah Period (700–1500 A.D.) middens (shell and nonshell) and that there were also two 19th century structures. According to the Florida State Historic Preservation Officer (SHPO), 8 of the 11 archaeological sites are eligible for the *National Register of Historic Places* as the St. Johns River Power Park Archaeological District because of their cultural significance. In late 1981, the Secretary of the Interior concurred that the St. Johns River Power Park Archaeological District is eligible for listing in the *National Register* (EPA 1981).

3.8 SOCIOECONOMICS

This discussion of existing socioeconomic conditions focuses on Duval County, in which Northside Generating Station is located (Figure 2.1.1). In addition to being the site of proposed construction and operations activities, this heavily populated county has more than enough housing and public services available to attract any workers that might move to the area as a result of the project. The city of Jacksonville and Duval County merged in the late 1960s to form the consolidated city of Jacksonville, which encompasses nearly the entire land area of Duval County. The only portions of the county that are not part of the consolidated city are the three beach communities (Atlantic Beach, Jacksonville

Beach, and Neptune Beach) located east of the Intracoastal Waterway and the small community of Baldwin in the far western portion of the county.

3.8.1 Population

Table 3.8.1 shows current population for Duval County and its five municipalities and how those numbers have changed over time. The consolidated city of Jacksonville, with nearly 712,000 residents, accounts for almost 95% of the county's total population. The other four municipalities house the remainder of the county's inhabitants, with Jacksonville Beach having the largest population of the four and Baldwin having by far the smallest. Between 1980 and 1990, Duval County experienced substantial growth, although it did not keep pace with Florida as a whole. Within the county, Atlantic Beach and Neptune Beach grew at a much greater rate than did the other municipalities and Duval County overall. Between 1990 and 1997, Duval County and Jacksonville continued to grow at roughly the same annual rate they had experienced throughout the 1980s, outstripping all the other municipalities in the county except for Jacksonville Beach and coming close to Florida's 1990–95 annual growth rate.

Table 3.8.1. Current population and change over time for Duval County, its municipalities, and Florida

Location	1980 population	1990 population	Percent change 1980–90	1995/1997 population[a]	Percent change 1990–95/97
Duval County	571,003	672,971	+17.9	754,048	+12.0
Atlantic Beach	7,847	11,636	+48.3	12,908	+10.9
Baldwin	1,526	1,450	−5.0	1,556	+7.3
Jacksonville	540,898	635,230	+17.4	711,933	+12.1
Jacksonville Beach	15,462	17,839	+15.4	20,520	+15.0
Neptune Beach	5,248	6,816	+29.9	7,131	+4.6
Florida	9,739,992	12,937,926	+32.8	14,166,000	+9.5

[a]County and municipality populations are estimates by Jacksonville Planning and Development Department for April 1, 1997. State population is an estimate by the U.S. Bureau of the Census for 1995.

Sources: U.S. Bureau of the Census 1981; U.S. Bureau of the Census 1991; U.S. Bureau of the Census 1996; JPDD 1997b.

According to projections made by Jacksonville's Planning and Development Department (JPDD 1996b), growth in Jacksonville and Duval County will continue for the remainder of this decade at roughly the same pace as it has since 1980. At this rate, the consolidated city of Jacksonville will be home to nearly 735,000 residents in 2000 and Duval County's population will exceed 777,000. The growth rate is expected to slow somewhat after that, but the city still predicts that the populations of Jacksonville and Duval County will be approximately 790,000 and 835,000, respectively, in 2010. The ratio of city to overall county population is projected to remain essentially unchanged.

3.8.2 Employment and Income

In 1996, the average size of Duval County's resident labor force was 368,467 (Table 3.8.2), with nearly 94% of these people living in the consolidated city of Jacksonville. The unemployment rate in both Jacksonville and Duval County was 3.8%, substantially below the statewide rate of 5.1%. Although Duval County residents did better than Floridians overall in terms of unemployment, their 1995 average per-capita income of $22,337 was slightly less than the statewide average of $23,031.

Table 3.8.2. Employment and income for residents of Jacksonville, Duval County, and Florida

Location	Labor force, 1996	Number employed, 1996	Number unemployed, 1996	Unemployment rate, 1996 (%)	Per-capita income, 1995 ($)
Jacksonville	345,540	332,307	13,233	3.8	N/A
Duval County	368,467	354,629	13,838	3.8	22,337
Florida	6,938,000	6,586,000	352,000	5.1	23,031

Source: University of Florida 1997.

Table 3.8.3 shows how employment within Duval County was distributed among key economic sectors in 1996. The services sector, which accounted for nearly 30% of all Duval County jobs, was by far the largest. Other important categories were retail trade (18.5% of all jobs) and the finance, insurance and real estate sector (11.8% of total employment). And when federal, state, and local government numbers are added together, they account for 12.8% of all jobs within the county. Because of the large number of people employed in Duval County, even a relatively small sector like construction (5.6% of all workers) provides a large number of jobs (22,179).

3.8.3 Housing

As of 1990, there were over 257,000 occupied housing units in Duval County and more than 27,000 vacant units (Table 3.8.4). Almost 94% of these units were located within the Jacksonville city limits. Sixty-two percent of Duval County's occupied units were owner-occupied and the remaining

38% were occupied by renters. Of the vacant units countywide, 4,665 were for sale and 14,049 were for rent. The median value of an owner-occupied unit within Duval County was $64,000

Table 3.8.3. Employment by economic sector in Duval County, 1996

Economic sector	Number of workers[a]	Percent of all workers
Agriculture, forestry, and fishing	2,985	0.8
Mining	N/A	N/A
Construction	22,179	5.6
Manufacturing	29,589	7.5
Transportation, communications, and public utilities	27,841	7.1
Wholesale trade	24,417	6.2
Retail trade	72,906	18.5
Finance, insurance and real estate	46,654	11.8
Services	116,912	29.6
Federal government	16,855	4.3
State government	7,189	1.8
Local government	26,384	6.7
Other	560	0.1
Total	394,675	100.0

[a]These numbers describe all those working in Duval County, regardless of place of residence.
Source: University of Florida 1997.

and the median monthly rent was $355. Although precise updates are not available, it is likely that these cost figures have increased substantially since 1990. Data released by the Jacksonville Planning and Development Department (JPDD 1997a) indicate that the average construction value of all single family homes built in the city of Jacksonville during the first half of 1997 was slightly more than $110,000; this number reflects material and labor costs but does not include land cost or profits.

Between April 1990 and April 1997, there was a net increase of 35,445 housing units in Duval County, with 94% of these located within the city of Jacksonville and the remainder in the county's other four municipalities (JPDD 1997b). Of the total units added countywide, just over 72% were single family dwellings, slightly more than 23% were multi-family units, and less than 5% were mobile homes. In the beach communities, there was a higher percentage of multi-family units and a much lower percentage of mobile homes than for the county as a whole. Although it is still too early to tell if it is a trend or an anomaly, the number of building permits issued for multi-family units countywide was substantially higher in 1996 and the first half of 1997 than it had been earlier in the decade (JPDD 1997a,c).

Table 3.8.4. Housing data for Jacksonville and Duval County[a]

	Jacksonville	Duval County
Number of occupied housing units	241,384	257,245
Percent of units occupied by owner	62.1	62.0
Percent of units occupied by renter	37.9	38.0
Number of vacant housing units	25,764	27,428
Number of vacant units for sale	4,356	4,665
Number of vacant units for rent	13,377	14,049
Median value owner-occupied unit, $	62,900	64,000
Median rent, $	353	355

[a]All data are for 1990.
Source: U.S. Bureau of the Census 1991.

3.8.4 Local Government Revenues

Duval County received over $2.3 billion in total revenues in fiscal year 1995, with the largest share (42.3%) coming from charges for services (Table 3.8.5). Other important revenue sources were taxes and impact fees (15.6%), state and other governments (7.0%), and the broad category of “other sources and transfers” (33.2%).

The tax revenues received by Duval County come from a variety of sources. Real property and tangible personal property in Duval County are taxed at the rate of approximately $2.22 per $100 of

Table 3.8.5. Revenue by source for Duval County, fiscal year 1995

Source	Revenue (× $1,000)	Percent of total revenue
Taxes and impact fees	361,588	15.6
Federal grants	35,148	1.5
State and other governments	162,838	7.0
Charges for services	979,592	42.3
Fines and forfeitures	9,135	0.4
Other sources and transfers	769,023	33.2
Total	2,317,324	100.0

Source: University of Florida 1997.

assessed value (FDR 1997). Property owned by government entities (such as JEA) is not subject to taxation, but JEA does make in-lieu-of-tax payments to the local government. Also, the interest of a private company in a public-private partnership (like the proposed project at Northside Generating Station) would be subject to taxation. In addition to the *ad valorem* property tax, there are several different sales taxes that benefit local communities. The state of Florida assesses a sales tax of 6.0%, a portion of which is shared with the local jurisdictions in which sales are made. There also are a number of local option sales taxes in Duval County: a 0.5% transit system surtax on all sales up to $5,000; a 4% Tourist Development Tax on short-term living accommodations; and a 2% Convention Development Tax on short-term living accommodations (FLCIR 1997). Although there is no personal income tax in Florida, there is a corporate income tax of 5.5% assessed by the state.

3.8.5 Public Services

3.8.5.1 Education

During the 1995–96 school year, Duval County's 158 public schools had a total enrollment of 120,898 students in kindergarten through grade 12. The ratio of students to full-time-equivalent teachers was 24.89 to 1 in the elementary grades and 22.54 to 1 at the secondary level. The breakdown of public school teachers as of fall 1996 was as follows: 2,988 elementary school teachers; 2,204 secondary school teachers; 1,112 teachers for exceptional students; and 97 teachers in other categories (University of Florida 1997).

3.8.5.2 Utilities

The city of Jacksonville owns and operates two extensive potable water supply and distribution systems, known as the North Grid and the South Grid, as well as several small satellite systems. Since mid-1997, these city-owned facilities—as well as the city's wastewater treatment facilities—have been controlled and operated by JEA. There currently are about 8 functioning water treatment plants in the North Grid and 12 in the South Grid (F. Brown, JEA, personal communication to M. Schweitzer, ORNL, February 2, 1998). Table 3.8.6 shows that existing capacity exceeds average use in both the North and South Grids, leaving a substantial surplus in each. Nonetheless, the city plans to continue making improvements to its systems, as it has done in recent years, in order to meet future demand and improve water quality. In addition to the city facilities, there are some small investor-owned utilities operating in the city. Some rural portions of Jacksonville do not yet receive potable water from a centralized system, and residents of these areas get their water from individual wells. Outside of the Jacksonville city limits, the municipalities of Atlantic Beach, Baldwin, Jacksonville Beach, and Neptune Beach operate their own separate centralized water systems (JPDD 1993a).

The city of Jacksonville operates five regional wastewater collection and treatment districts, covering all of the urbanized areas within the city limits. In addition, there are a number of investor-owned utility companies operating in Jacksonville as well as several hundred private package

Table 3.8.6. Capacity and use of Jacksonville's potable water and sewage treatment systems
[Units are million gallons per day (Mgd).]

	Capacity	Average use	Surplus
Potable water system (as of 12/31/97)			
South grid	86.53	36.69	49.84
North grid	117.77	41.19	76.58
Sewage treatment system (as of 12/31/96)			
District 1	52.50	31.82	20.68
District 2	10.00	3.79	6.21
District 3	10.00	5.83	4.17
District 4	11.00[a]	9.93	1.07
District 5	5.00[b]	4.59	0.41

[a]A construction permit has been issued to expand the District 4 plant to a capacity of 15.00 Mgd.
[b]A construction permit has been issued to expand the District 5 plant to a capacity of at least 7.50 Mgd.
Source: F. Brown, JEA, personal communication to M. Schweitzer, ORNL, February 2, 1998.

treatment plants serving individual businesses (JPDD 1993b). Existing capacity and average use for each sewage treatment district are shown in Table 3.8.6. District 1 clearly has substantial surplus capacity, while average demand in Districts 4 and 5 is very close to existing treatment capacity. Construction permits have been issued for plant expansions in these last two districts. The city also plans to upgrade its District 3 plant, and it has the capacity to transfer up to 2 Mgd from District 4 to the District 1 treatment plant (F. Brown, JEA, personal communication to M. Schweitzer, ORNL, February 2, 1998). Jacksonville households and businesses that do not yet have centralized sewer service utilize individual septic systems. Outside the city, all four of Duval County's smaller municipalities have their own centralized sewage systems.

3.8.5.3 Police and Fire Protection

The Jacksonville Sheriff's Office, which has approximately 2,400 employees and an overall budget of over $160 million, has jurisdiction over the consolidated city of Jacksonville. The Sheriff's Office has three directorates: Operations (which includes the Detective Division, Community Affairs Division, and two Patrol Divisions); Services; and Corrections (Jacksonville Sheriff's Office 1998). Each of the four smaller municipalities within Duval County has its own police department, which provides basic patrol services, but the Jacksonville Sheriff's Office provides these communities with specialized assistance such as detective services and crime lab operations (H. Reagan, Jacksonville Sheriff's Office, personal communication to M. Schweitzer, ORNL, January 30, 1998).

The Jacksonville Fire and Rescue Department has 49 fire stations, just over 1,000 employees, and a budget of nearly $70 million. The department's resources include 45 engine companies, 7 ladder companies, 12 tanker trucks, and 23 rescue units (JFRD 1998). Each of Duval County's four smaller municipalities has its own fire department, but the available resources vary considerable from community to community. The city of Jacksonville has mutual aid agreements with all the other fire departments in the county and provides specialized services and equipment to some of those smaller communities (T. Holmes, Jacksonville Fire and Rescue Department, personal communication to M. Schweitzer, ORNL, January 30, 1998).

3.8.6 Environmental Justice

Percentages of minority and low-income populations living in Duval County and Florida are provided in Table 3.8.7. Blacks are by far the largest minority group in Duval County, and the percentage of Blacks in the county is almost twice as large as in the state as a whole. There also is a higher percentage of Asians in Duval County than in Florida overall. However, 1990 Census data show that the percentages of Blacks and Asians living in the census tracts immediately surrounding the proposed site are much lower than in the state as a whole (between 0 and 1.9% for Blacks, and between 0 and 0.6% for Asians) (U.S. Bureau of the Census 1991). The percentage of people living below the poverty level is slightly less in Duval County (15.2%) than in all of Florida (15.9%); furthermore, in the census tracts immediately surrounding the proposed site, the percentage of the population living in poverty is substantially less (between 5.9 and 11.7%) than for either the county

Table 3.8.7. Minority and low-income population residing in Duval County and Florida[a]
[in percent]

Categories	Duval County	Florida
Black	27.5	15.1
Native American	0.3	0.4
Asian	2.8	1.7
Hispanic (all races)	3.4	14.0
Poverty status	15.2	15.9

[a]All data are for July 1, 1996, except for poverty status, which is for 1993.
Source: U.S. Bureau of the Census 1997; University of Florida 1997.

or the state. The percentage of Hispanics in Duval County is only about one-fourth of the statewide average.

3.9 TRANSPORTATION AND NOISE

3.9.1 Transportation

Figure 2.1.2 shows the major roads, rail lines, and water bodies in the vicinity of Northside Generating Station. These transportation features are discussed in the following subsections.

3.9.1.1 Roads

In Table 3.9.1, current peak hourly traffic, available capacity, and existing level of service (LOS) are listed for road segments that would probably be used by workers and truck drivers accessing Northside Generating Station during construction and operation of the proposed project. The main entrance to Northside Generating Station is on Heckscher Drive just east of State Route 9A, while the back entrance is accessed from New Berlin Road, adjacent to the back entrance to the St. Johns River Power Park. The main entrance to the Power Park is on New Berlin Road, a short distance north of its back entrance.

As Table 3.9.1 shows, existing LOS is Level C or better for all of the key segments except one, and substantial capacity is still available for those links. As defined in the *Highway Capacity Manual* (TRB 1994), an LOS of C is characterized by traffic flow that is at or near the posted speed but with maneuverability noticeably restricted. At LOS B, there is free flow with only slightly restricted maneuverability, while there is uninterrupted maneuverability at LOS A. The segment of Heckscher Drive slightly west of Northside Generating Station (from Drummond Point to State Route 9A) is currently operating at LOS E during its peak hour. At LOS E, flow is at or near capacity, maneuverability is severely restricted, and any disruption leads to flow breakdown and severe congestion, which is LOS F. This segment has available capacity for 89 vehicles per hour during its peak period.

Currently, about 200 passenger vehicles and 25 heavy trucks access Northside Generating Station daily. At the main entrance to the plant, Heckscher Drive is a four-lane divided highway. For vehicles accessing the plant from the west, there is a left turn lane on eastbound Heckscher directly across from the plant entrance, but there is no traffic signal. For vehicles accessing the plant from the east, there is no right turn lane into the plant from westbound Heckscher, but there is a paved shoulder that is wide enough to accommodate automobiles. When exiting Northside Generating Station onto westbound Heckscher, there is no official acceleration lane, but the aforementioned shoulder is wide enough to serve as a defacto acceleration lane for automobiles. For vehicles exiting the plant onto eastbound Heckscher, there is no acceleration lane, so vehicles must wait for traffic to clear before merging.

Table 3.9.1. Key road segments in the vicinity of Northside Generating Station

Road segment	Roadway type	Number of lanes	Maximum capacity (trips per hour)	Peak hourly traffic	Capacity available (trips per hour)[a]	Existing level of service
Heckscher Drive from State Route 9A to Blount Island	Minor arterial	4	3,160	1,507	1,600	C
Heckscher Drive from Drummond Point (just west of Eastport Road) to State Route 9A	Minor arterial	2	1,580	1,255	89	E
New Berlin Road from Cedar Point Road to Heckscher Drive	Collector	2	1,410	424	901	C
State Route 9A from U.S. 17 to Heckscher Drive	Principal arterial	4	6,510	2,599	3,607	B
State Route 9A from Heckscher Drive to Merrill Road (just south of the St. Johns River)	Principal arterial	6	9,770	3,613	6,108	A

[a]Capacity available is slightly less than the difference between maximum capacity and peak hourly traffic because of allowances for reserve capacity.
Source: JPDD 1998.

Approximately 300 passenger vehicles access the Power Park daily, via its main entrance. About 65 heavy trucks (e.g., dump trucks bringing in limestone and container trucks hauling away fly ash) access the Power Park each day via its back entrance, just south of the main entrance.

At several places in the vicinity of Northside Generating Station, road traffic experiences periodic delays as a result of on-grade railroad crossings. Delays of 5 to 10 min are not uncommon, and these can last up to 30 min if trains are uncoupling and recoupling. One such on-grade crossing is on New Berlin Road, just north of the back entrances to Northside Generating Station and the St. Johns River Power Park and just south of the Power Park's main entrance. Other crossings in the vicinity of the plant include Alta Road just north of South Route 9A, Eastport Road just south of Faye Road and also just east of U.S. 17, Baisden Road just west of Eastport Road, Busch Drive just west of U.S. 17, and U.S. 17 just north of Eastport and also just south of the Trout River.

3.9.1.2 Rail

The St. Johns River Power Park currently receives an average of three to four train loads of coal each week, for a total of six to eight one-way trips. The coal is transported in 90 car unit-trains under contract with the CSX rail line. The main CSX line travels south from Georgia, running parallel to U.S. 1/U.S. 23 in the Jacksonville area. Trains bound for the Power Park continue to run parallel to U.S. 1 after it splits with U.S. 23, heading east and then veering north after crossing U.S. 17. The coal trains continue northward, running next to U.S. 17, through the communities of Panama Park and North Shore (Figure 2.1.2). Approximately 4 miles north of the Trout River, a spur line diverges from the north-south CSX line and takes the coal trains on the last leg of their journey to the Power Park. This spur line, which passes along the northern edge of the residential community of San Mateo, roughly parallels Eastport Road and then Faye Road. The spur line enters the St. Johns River Power Park just east of New Berlin Road and continues south beyond the Power Park to Blount Island, crossing Heckscher Drive and the back channel of the St. Johns River (Figure 2.1.2).

At the Power Park, there is a rail loop encircling much of the property. This loop can accommodate coal trains and allow them to uncouple and recouple without blocking New Berlin Road. In the past, however, it was not uncommon for CSX to uncouple and recouple trains outside the Power Park's boundaries, despite the presence of the onsite tracks, resulting in substantially longer delays of road traffic than would otherwise occur. CSX recently discontinued this practice, and the car change-outs are now conducted on the Power Park's property 24 hours per day. However, any resumption of offsite train uncoupling and recoupling would cause a resumption of the traffic delays.

In addition to the rail loop that encircles the St. Johns River Power Park, there also is a short set of tracks that branches off from the spur line slightly north of Northside Generating Station and runs parallel to the eastern boundary of the Northside property. This short line is occasionally used to transport large equipment that cannot be moved by truck to Northside Generating Station. It has never been used for fuel deliveries and has no fuel-unloading facilities.

Total train traffic on the CSX line paralleling U.S. 17 currently averages about 115 one-way trips per week. On the spur line that runs from U.S. 17 to the St. Johns River Power Park and beyond to Blount Island, train traffic averages approximately 78 one-way trips per week. About seven of these trips are made by coal trains going to and from the Power Park and about the same number of trips are made by trains traveling to and from the Cedar Bay Plant, near Eastport Road. The remaining trains (approximately 64 trips) transport automobiles and other goods from Blount Island, where they arrive via water (Robinson Engineering Group 1998a).

3.9.1.3 Marine

In addition to the coal it receives by rail, the St. Johns River Power Park receives coal and petroleum coke by barge and ship. The waterborne solid fuel comes to an unloading facility on the south side of Blount Island and is transported from there to the Power Park via elevated conveyor (Fig 2.1.2). Although the existing facility is adequate to handle current shipment volumes, it would require expansion if the amount of solid fuel brought in by water were increased to serve the proposed project. Northside Generating Station currently receives waterborne shipments of fuel oil that come to the fuel terminal on the north shore of the St. Johns River back channel. From there, the fuel oil is piped to the fuel storage tank farm located southeast of the turbine building. The existing unloading facility is not adequate to accommodate solid fuel shipments in addition to the fuel oil it handles, and there currently is no conveyor to transport solid fuel from the back channel to the generating station.

3.9.2 Noise

A noise survey was performed to assess the existing noise environment in the vicinity of Northside Generating Station (JEA 1998a). The survey was conducted from noon on February 12 until noon on February 13, 1998, at four locations between 0.5 and 1 mile from Northside Generating Station (locations 1–4 in Figure 3.9.1). These locations are considered representative of noise-sensitive receptors in different directions from the facility; locations 2 and 3 are adjacent to residences. During the survey, both Northside units (Units 1 and 3) and one of the two St. Johns River Power Park units were operating.

Data obtained from measurements during the 24-hour period included equivalent noise levels (the average of each minute) and hourly values of the L10, L50, and L90 (the number following the "L" is the percent of time during the hour that a particular level is exceeded). In addition, three sets of ten different octave band levels were measured: one in the morning, one in the afternoon, and one between 1 a.m. and 3 a.m. when ambient levels were anticipated to be the lowest. The octave band measurements were short samples taken during the absence of intrusive sounds, such as noise generated from traffic. Therefore, they are representative of the background spectrum to which Northside Generating Station contributes. Because large power plant fans produce a hum at about 500 Hz, measurement at this frequency when Northside Generating Station is operating at or near

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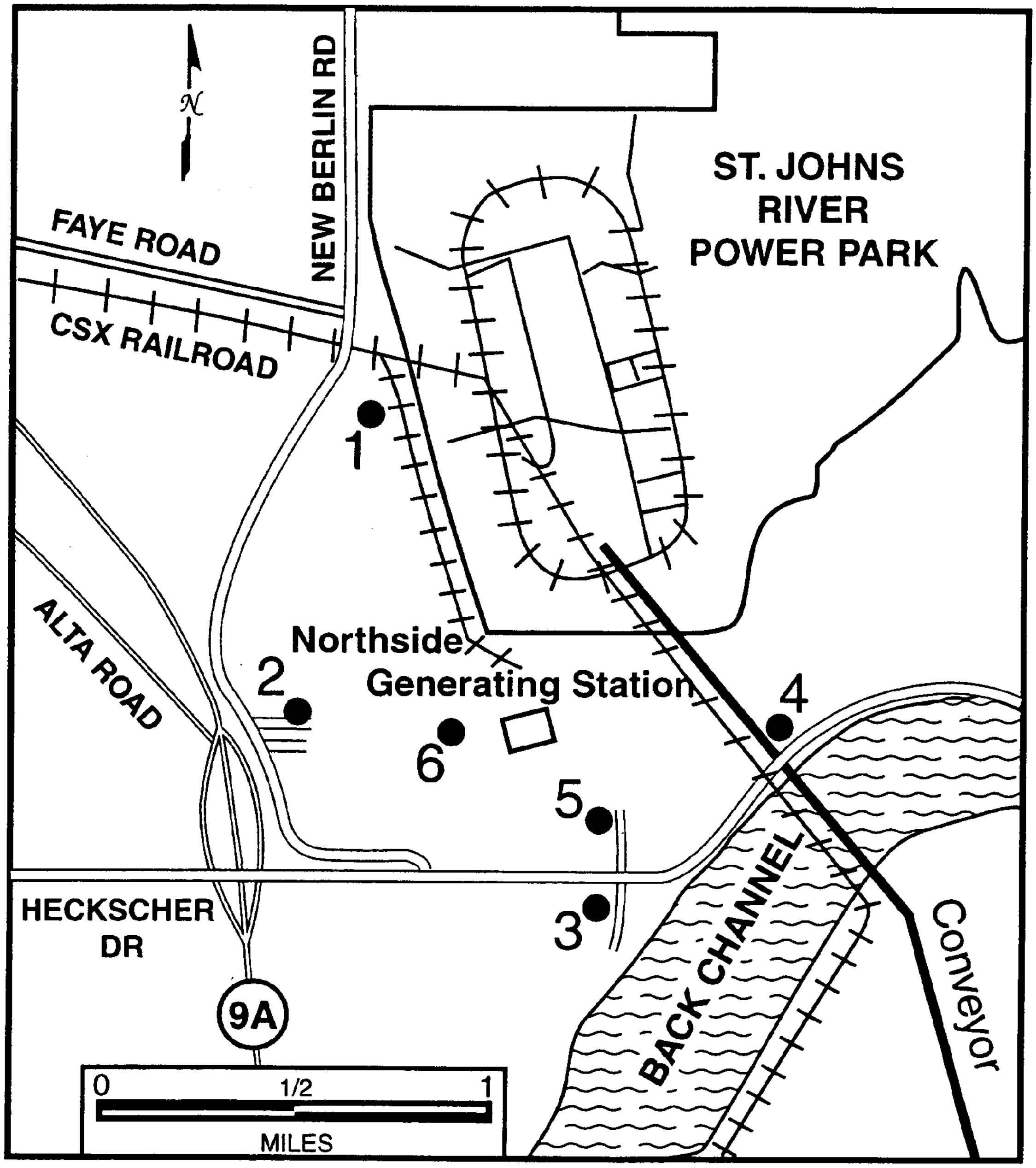


Figure 3.9.1. Location of ambient noise monitoring sites around Northside Generating Station. Locations 1, 2, and 4 were used in the February 1998 survey, locations 5 and 6 were used in the May 1998 survey, and location 3 was used in both.

peak load and when other noise sources are minimized provides a good measure of the power plant's maximum contribution to the noise spectrum.

Because vehicular traffic was found to be the most substantial source of noise in the area, locations farther from the traffic were less noisy overall. Location 1 was the quietest of the four locations. Noise from Northside Generating Station was not distinguishable from that produced by the nearby St. Johns River Power Park. The octave band data appear typical of background spectra, with higher levels in the lower frequencies and lower levels in the higher frequencies. The only influence of the power plants that can be identified is in the 500-Hz band at locations 1 and 3. At these locations, the level in the 500-Hz band is slightly higher than those of the two adjacent bands at 250 and 1,000 Hz, approximately 1 to 2 dB(A) above that which would be expected. Typical 500-Hz nighttime levels were approximately 41–46 dB(A), while daytime levels were in the 55–60 dB(A) range.

A supplemental noise survey was performed from noon on May 12 until noon on May 13, 1998, to document levels of existing noise at locations nearer Northside Generating Station than locations in the original survey and to provide the basis for the noise level to be used in the design of the proposed project (JEA 1998b). During this survey, both Northside units and both Power Park units were operating. Measurements were taken at three locations (locations 3, 5, and 6 in Figure 3.9.1), two of which (locations 5 and 6) were closer than locations in the first survey; location 3 used in the original survey was also used in the supplemental survey to provide a link between the two surveys (i.e., differences in levels measured at location 3 during the two surveys might explain unexpected results at the two new locations). Location 5 was at the south boundary of the Northside property near several residences that are the closest to the plant, approximately 0.3 mile (1,600 ft) southeast of the existing turbine building. Atmospheric conditions during this survey were more variable than during the first survey, but the noise measurement procedures were the same.

Unlike the results of the first survey, analysis of the octave band spectra did not show the influence of the power plant. However, during calm winds and when traffic was minimally present, the contribution of the plant to background levels was determined to be 51 dB(A); daytime noise levels were in the 55–60 dB(A) range. As an illustration, Figure 3.9.2 contains equivalent noise levels (the average of each minute) for a 24-hour period at location 5 (at the south boundary of the Northside property near several residences that are the closest to the plant). The noisiest times are associated with vehicular traffic along Heckscher Drive. During the late evening and early morning, when traffic is light, the noise level is reduced to approximately 50 dB(A). The pattern in Figure 3.9.2 is typical of all locations; variations at other locations are primarily a function of their proximity to highway traffic. The results of the two noise surveys indicate that Northside Generating Station is operating within the Noise Pollution Control Rules of 60 dB(A) for nighttime levels (Jacksonville Environmental Protection Board 1995).

During the scoping process, local residents and community organizations expressed concern related to the existing noise associated with ongoing rail traffic through the local area, specifically

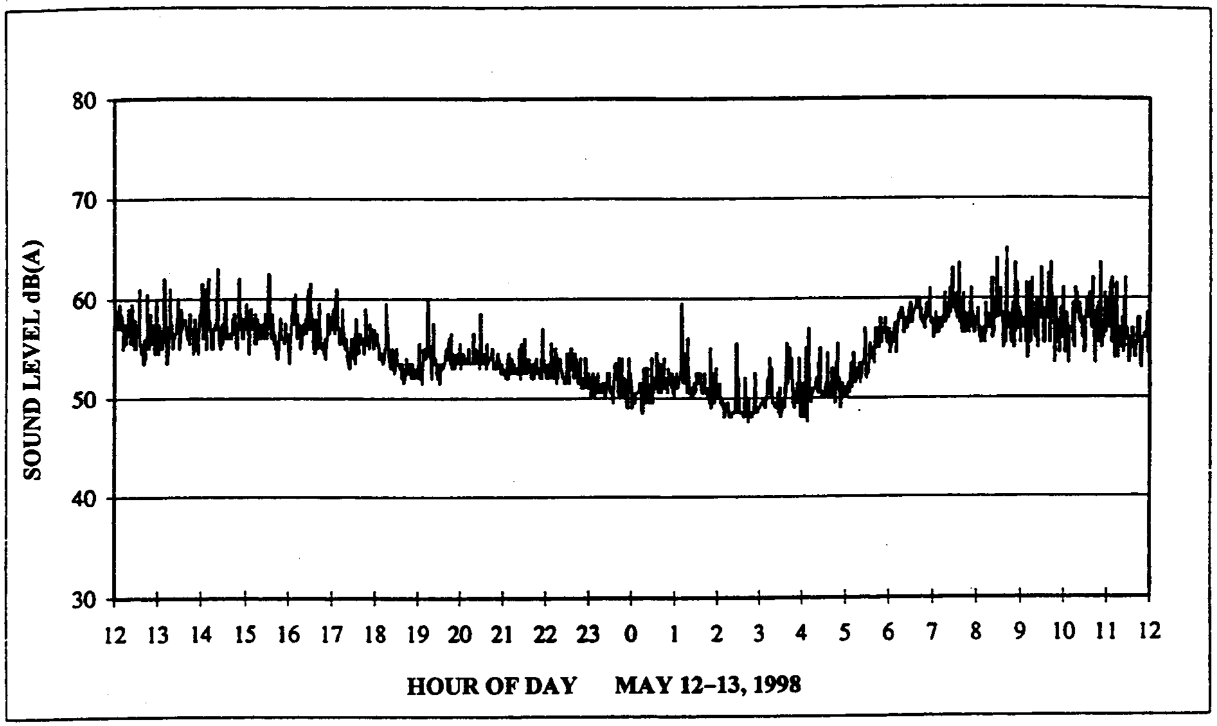
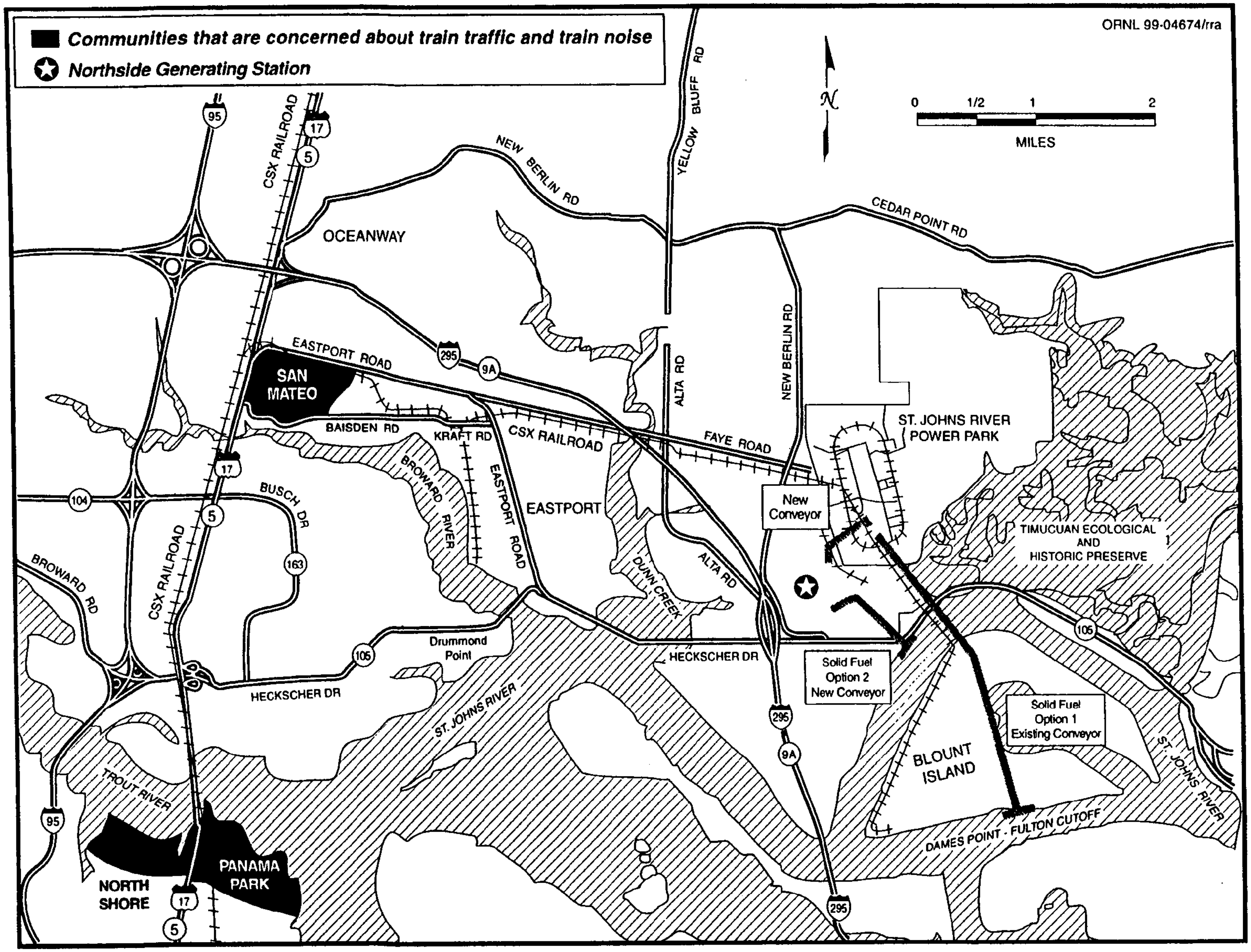

80
70
60
50
40
30
SOUND LEVEL dB(A)
12 13 14 15 16 17 18 19 20 21 22 23 0 1 2 3 4 5 6 7 8 9 10 11 12
HOUR OF DAY MAY 12–13, 1998

Figure 3.9.2. Equivalent noise levels (the average of each minute) for location 5, at the south boundary of the Northside property near several residences that are the closest to the plant. *Source:* JEA 1998b.

the communities of Panama Park, North Shore, and San Mateo (Figure 3.9.3). The frequency of rail traffic through the area is described in Section 3.9.1.2. A local resident who spoke at the public scoping meeting held on December 3, 1997, stated that he had measured the volume of train whistles at 108 dB(A) at his property line and the volume of rattling train cars at up to 85 dB(A) at his property line.



Communities that are concerned about train traffic and train noise
Northside Generating Station
ORNL 99-04674/rra
N
0 1/2 1 2
MILES
OCEANWAY
SAN MATEO
EASTPORT
ST. JOHNS RIVER POWER PARK
TIMUCUAN ECOLOGICAL AND HISTORIC PRESERVE
New Conveyor
Solid Fuel Option 2 New Conveyor
Solid Fuel Option 1 Existing Conveyor
BLOUNT ISLAND
DAMES POINT - FULTON CUTOFF
ST. JOHNS RIVER
TROUT RIVER
NORTH SHORE
PANAMA PARK
Drummond Point
HECKSCHER DR
EASTPORT ROAD
BAISDEN RD
KRAFT RD
CSX RAILROAD
FAYE ROAD
BROWARD RIVER
BROWARD RD
BUSCH DR
DUNN CREEK
ALTA RD
NEW BERLIN RD
YELLOW BLUFF RD
CEDAR POINT RD
95
17
5
295
9A
104
105
163

Figure 3.9.3. Communities that are concerned about train traffic and train noise in the area surrounding Northside Generating Station.