# Kennedy Generating Station

*Jacksonville, Florida*
*Basin: Lower St. Johns*
*HUC: 03080103*

### Executive Summary

The Kennedy Generating Station (Kennedy Generating) site is on the west bank of the St. Johns River in Jacksonville, Florida. From 1909 to 1966, a wood preserving and treating facility was operated at the site. Leaks, spills, and poor waste management practices at the wood preserving and treating facility have lead to the release of hazardous substances from the site to groundwater beneath the site and sediment in the St. Johns River. The habitat of concern to NOAA at the site is the St. Johns River, which provides habitat for NOAA trust resources including anadromous, catadromous, and estuarine fish species.

### Site Background

The Kennedy Generating Station (Kennedy Generating) site is on the west bank of the St. Johns River in Jacksonville, Florida at latitude 30° 21' 45" and longitude 81° 37' 30" (Figure 1). The Kennedy Generating site encompasses two parcels owned by the Jacksonville Electric Authority; a north parcel and a south parcel, which combined are 21 hectares (53 acres) (Figure 2). In 1910, Jacksonville Electric Authority purchased the north parcel and constructed a power generating plant that is still active. Jacksonville Electric Authority acquired the south parcel in 1977 to extend their power plant operations.

From 1909 to 1966, several different owners operated a wood preserving and treating facility on the south parcel. Products used at the facility for wood treating and preserving include creosote, zinc-meta-arsenite, chromated zinc chloride, a coal tar additive of unknown composition, and pentachlorophenol (PCP) (CH2M Hill 2003). Aerial photos of the site from 1959 show creosote storage tanks, treating cylinders, a treated lumber storage area, and a loading dock on the east side of the south parcel, near the river. Treated wood was shipped and chemicals used during the preserving and treating process were received at the loading dock (CH2M Hill 2003).

After the south parcel was sold to the Southern Railroad in 1966, the wood treating and preserving facility was dismantled and the property was cleared of all buildings and other structures. During the dismantling of the wood treating and preserving facility, approximately 30,000 to 50,000 gallons (110,000 to 190,000 liters) of creosote sludge from the creosote storage tanks were combined with wood shavings and buried in the northeast corner of the south parcel (CH2M Hill 2003). After the wood treating and preserving facility was dismantled, the south parcel was inactive until Jacksonville Electric Authority took over ownership in 1977.

Under the ownership of Jacksonville Electric Authority, the south parcel was primarily used for treatment and storage of wastewater from the power generating plant on the north parcel. During different periods, the wastewater was dealt with in different ways. From 1977 to 1985, the wastewater was stored in four unlined surface impoundments in the south-central portion of the south parcel. When the surface impoundments were

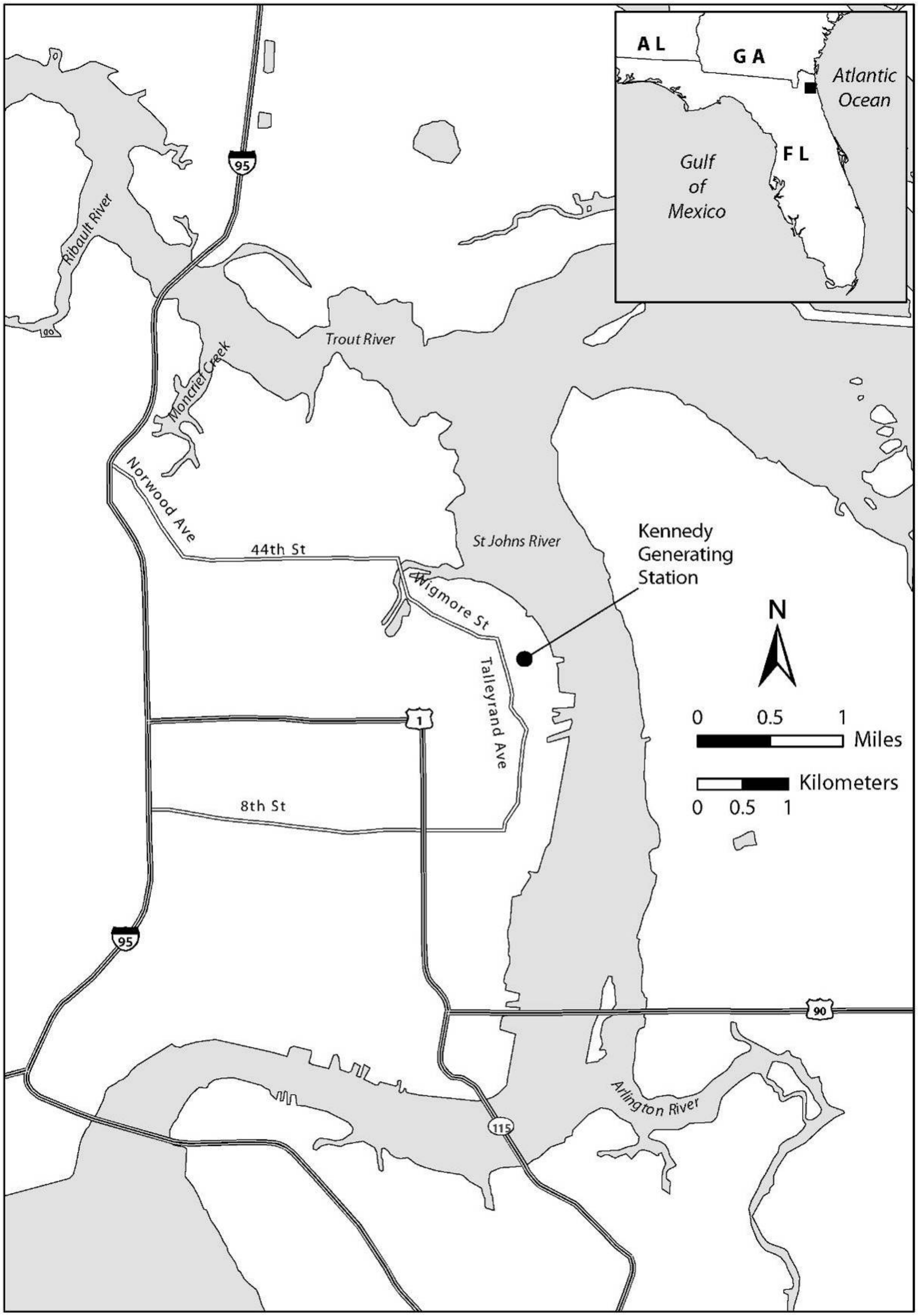


Figure 1. Location of the Kennedy Generating Station site, Jacksonville, Florida.

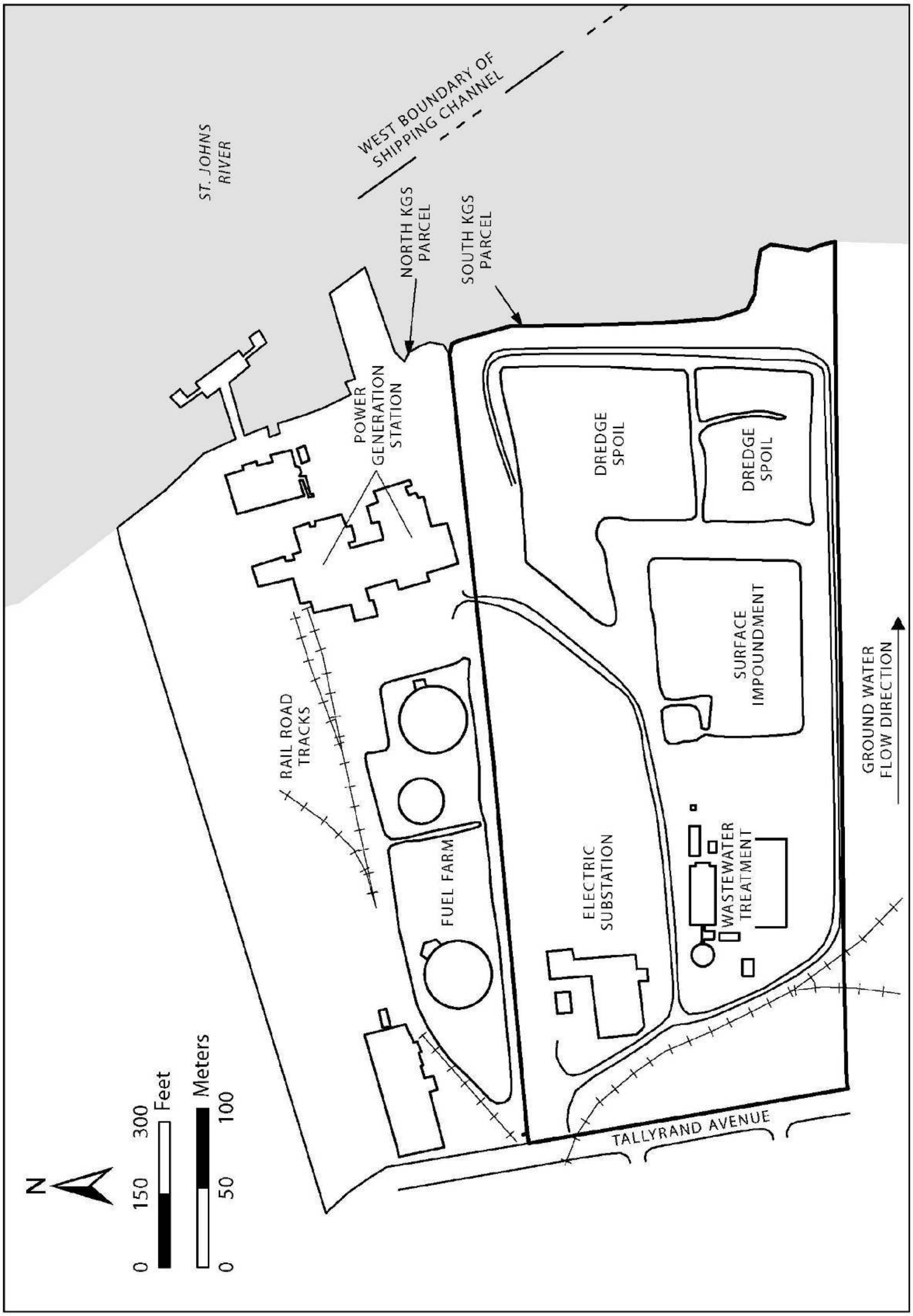


Figure 2. Detail of the Kennedy Generating Station property.

constructed, the interior walls were lined with limestone. Evaporation, neutralization from the limestone, and sedimentation of the wastewater occurred in the surface impoundments. Between 1984 and 1986, wastewater was sent through a neutralization unit on the north parcel before it was discharged into the surface impoundments (CH2M Hill 2003). After 1986, wastewater was diverted to a wastewater treatment plant that was built in the southwest corner of the south parcel before it was discharged into the surface impoundments. After 1991, wastewater was no longer stored in the surface impoundments. In 1995, sludge from the surface impoundments was excavated and disposed of off-site (CH2M Hill 2003).

Currently an electric substation, a wastewater treatment plant, the remnants of surface impoundments associated with wastewater treatment, and dredge spoil impoundments are present on the south parcel (CH2M Hill 2003). The dredge spoil impoundments contain materials removed from the St. Johns River during maintenance dredging of the channel.

### Contaminant Release

Leaks, spills, and poor waste management practices at the wood preserving and treating facility have lead to the release of hazardous substances from the Kennedy Generating site to habitats of concern to NOAA. Wastewater from the preserving and treating process was placed in small tanks for a short period and then was discharged into the St. Johns River through a wooden channel. Creosote that was spilled near the treating cylinders was pumped to the creosote storage tanks with a sump. If the sump overflowed, creosote would discharge to a ditch, which flowed to the St. Johns River. In the 1960s, any creosote that spilled from the creosote storage tanks was retained in the bermed area surrounding the storage tanks.

Investigations of the Kennedy Generating site, which began in 1983, have found contaminants associated with the wood preserving and treating facility in soil and groundwater collected from the south parcel, and sediment collected from the St. Johns River. A Resource Conservation and Recovery Act (RCRA) facility investigation was completed in 2003 (CH2M Hill 2003). Table 1 and the following discussion summarize the analytical results of the RCRA facility investigation and compares the contaminant concentrations to appropriate screening guidelines. The screening guidelines for groundwater are the ambient water quality criteria (AWQC; USEPA 2002) and the USEPA Region 4 ecological screening values (Region 4 ESVs; USEPA 2001). The screening guidelines for sediment are the effects range-low (ERL) values and the effects range-median (ERM) (Long et al. 1998), and the Region 4 ESVs (USEPA 2001). The screening guidelines for soil are the Region 4 ESVs (USEPA 2001).

#### Groundwater

Several metals were detected in groundwater at the site at concentrations greater than the AWQCs and Region 4 ESVs (Table 1). Of the metals, arsenic was detected most frequently. The maximum concentration of arsenic was one order of magnitude greater than the AWQCs and Region 4 ESVs and was detected in a sample collected from the northeast corner of the south parcel. Maximum concentrations of chromium and lead were detected in groundwater collected from wells in the south central portion of the south parcel. The maximum zinc concentration was detected in a groundwater sample collected approximately 150 m (492 ft) from the St. Johns River.

Table 1. Maximum concentrations of contaminants of concern detected at the Kennedy Generating Station site (CH2M Hill 2003). Contaminant values in bold exceed at least one screening guideline.

| | Soil (mg/kg) | | Water (µg/L) | | | Sediment (mg/kg) | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Contaminant** | Soil | USEPA Region 4 Values[a] | Ground-water | AWQC[b] | USEPA Region 4 Values[a] | Sedi-ment | ERL[c] | ERM[c] | USEPA Region 4 Values[a] |
| **METALS/INORGANICS** | | | | | | | | | |
| Arsenic | **1,700** | 10 | **2,000** | 36 | 36 | **33** | 8.2 | 70 | 1 |
| Chromium[d] | **120** | 0.4 | **150** | 50 | 103 | 47 | 81 | 370 | 52.3 |
| Lead | **240** | 50 | **64** | 8.1 | 8.5 | **84** | 46.7 | 218 | 30.2 |
| Zinc | **1,100** | 50 | **600** | 81 | 86 | **140** | 150 | 410 | 124 |
| **PAHs** | | | | | | | | | |
| Acenaphthene | **190** | 20 | **3,800** | 710[e] | 9.7 | **1,200** | 0.016 | 0.5 | 0.33 |
| Acenaphthylene | 31 | NA | ND | 300[e,f,g] | NA | **57** | 0.044 | 0.64 | 0.33 |
| Anthracene | **750** | 0.1 | **4,300** | 300[e,f,g] | NA | **700** | 0.0853 | 1.1 | 0.33 |
| Benz(a)anthracene | 150 | NA | **2,000** | 300[e,f,g] | NA | **280** | 0.261 | 1.6 | 0.33 |
| Benzo(a)pyrene | **66** | 0.1 | ND | 300[e,f,g] | NA | **110** | 0.43 | 1.6 | 0.33 |
| Benzo(b)fluoranthene | 81 | NA | **820** | 300[e,f,g] | NA | **120** | 1.8[h] | NA | NA |
| Benzo(k)flouranthene | 67 | NA | **820** | 300[e,f,g] | NA | **110** | 1.8[h] | NA | NA |
| Chrysene | 140 | NA | **2,000** | 300[e,f,g] | NA | **270** | 0.384 | 2.8 | 0.33 |
| Dibenz(a,h)anthracene | 58 | NA | ND | 300[e,f,g] | NA | **8.3** | 0.0634 | 0.26 | 0.33 |
| Fluoranthene | **280** | 0.1 | **27** | 16[e] | 1.6 | **1,600** | 0.6 | 5.1 | 0.33 |
| Fluorene | 230 | NA | **3,800** | 300[e,f,g] | NA | **1,100** | 0.019 | 0.54 | 0.33 |
| Indeno(1,2,3-cd)pyrene | 62 | NA | ND | 300[e,f,g] | NA | **20** | 0.6[h] | NA | NA |
| 2-Methylnaphthalene | ND | NA | **960** | 300[e,f,g] | NA | **990** | 0.07 | 0.67 | 0.33 |
| Naphthalene | **660** | 0.1 | **16,000** | 2,350[e,f] | 23.5 | **1,600** | 0.16 | 2.1 | 0.33 |
| Phenanthrene | **230** | 0.1 | 10,000 | NA | NA | **1,500** | 0.24 | 1.5 | 0.33 |
| Pyrene | **260** | 0.1 | **3,600** | 300[e,f,g] | NA | **1,100** | 0.665 | 2.6 | 0.33 |
| Total PAHs | ND | 1.0 | **18,000** | 300[e,f,g] | NA | **10,000** | 4.022 | 44.792 | 1.684 |
| **DIOXINs/FURANs** | | | | | | | | | |
| TEQ (Toxic Equivalent Value)[i] | **8.1 x 10$^{-4}$** | 3.2x10$^{-6}$ | **1.8 x 10$^{-5}$** | NA | 1.2 x 10$^{-5}$ | ND | 3.6 x 10$^{-6}$[h] | NA | 2.4 x 10$^{-6}$ |

a: USEPA Region 4 recommended ecological screening values (USEPA 2001). Screening values used for groundwater are saltwater surface water values.

b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2002). Marine chronic criteria presented.

c: Effects range-low (ERL) and effects range-median (ERM) were compiled by Long et al. (1998).

d: Screening guidelines represent concentrations for $Cr.^{+6}$

e: Lowest Observable Effect Level (LOEL) (USEPA 1986).

f: Chronic criterion not available; acute criterion presented.

g: Value for chemical class.

h: Marine apparent effects threshold (AET) for bioassays. The AET represents the concentration above which adverse biological impacts would be expected.

i: Maximum toxic equivalant value (TEQ) is provided. Each dioxin/furan is assigned a toxic equivalency factor (TEF) relative to 2,3,7,8 tetrachlorodibenzodioxin, which is the most toxic in this group of compounds. In order to determine the toxicity of a mixture of dioxin/furan compounds the measured concentration of the individual dioxin/furans is multiplied by its assigned TEF. The results are summed to produce a TEQ.

NA: Screening guidelines not available.

ND: Not detected or not calculated.

Polycyclic aromatic hydrocarbons (PAHs) were detected in groundwater from the site at concentrations greater than the AWQCs and Region 4 ESV (Table 1). The majority of the elevated PAH concentrations were detected in samples collected from the east side of the site; however 2-methylnaphthalene and naphthalene were detected at elevated concentrations in samples collected from the south central portion of the site. Of the PAHs, fluorene was detected most frequently and the maximum concentration exceeded the AWQC by one order of magnitude. The maximum concentrations of anthracene and pyrene also exceeded the AWQC by one order of magnitude. The maximum concentrations of benz(a)anthracene, chrysene, and naphthalene were six times greater than the AWQC. Maximum concentrations of acenaphthene and naphthalene exceeded the Region 4 ESVs by two orders of magnitude. The maximum concentration of total PAHs exceeded the AWQC by one order of magnitude.

<u>Sediment</u>

Arsenic and lead were detected in sediment at concentrations greater than the ERLs and the Region 4 ESVs (Table 1). The maximum arsenic and lead concentrations exceeded the ERLs by four and two times. respectively. Arsenic exceeded the Region 4 ESV by one order of magnitude. The locations of the maximum concentrations of arsenic and lead could not be determined from the information available for review at the time this report was prepared. Zinc was also detected in sediment at concentrations greater than the Region 4 ESVs.

PAHs were detected in sediment collected from the St. Johns River at concentrations greater than ERLs, ERMs, and Region 4 ESVs. Maximum concentrations of 12 PAHs were detected in sediment collected less than 122 m (400 ft) from the shoreline in the area where the loading dock once stood. Four maximum PAH concentrations were detected in sediment collected approximately 61 m (200 ft) downstream of the former loading dock. Benz(a)anthracene, benzo(a)pyrene, chrysene, fluoranthene, and fluorene were detected at concentrations greater than the ERL in over half of the sediment samples collected. All of the PAHs detected exceeded the ERL by at least one order of magnitude and eight PAHs also exceeded the ERM by at least an order of magnitude. The maximum concentration of total PAHs exceeded the ERL and Region 4 ESV by three orders of magnitude and exceeded the ERM by two orders of magnitude. In the nearshore area, PAHs have been detected at elevated concentrations as deep as 4.6 m (15 ft) below the sediment surface. The depth of sediment contamination had not been adequately assessed at the time this report was prepared.

<u>Soil</u>

Metals were detected in soil collected from the site at concentrations greater than the Region 4 ESVs. Maximum concentrations of arsenic, chromium, lead, and zinc were detected in samples collected from the southeast corner of the south parcel. The maximum concentration of arsenic exceeded the Region 4 ESVs by two orders of magnitude. Chromium and zinc were detected at concentrations one order of magnitude greater than the Region 4 ESVs. Chromium was detected in all the soil samples at concentrations greater than the Region 4 ESVs. Arsenic was detected in 65 percent of the samples at concentrations greater than the Region 4 ESVs.

Fifteen PAHs were detected in soil collected from the south parcel. The maximum concentrations of all PAHs were detected on the east side of the south parcel. Maximum concentrations of anthracene, fluoranthene, naphthalene, phenanthrene, and pyrene exceeded the Region 4 ESVs by three orders of magnitude. Benzo(a)pyrene was detected at a concentration two orders of magnitude greater than the Region 4 ESVs screening guideline in a sample collected from the southeast corner of the south parcel. The maximum acenaphthene concentration was more than nine times greater than the Region 4 ESVs screening guideline. Region 4 ESVs were not currently available for comparison with the remaining PAH concentrations that were detected in the soil samples.

Pathways

Contaminants have been released to habitats containing NOAA trust resources by several possible pathways including direct discharge, groundwater migration, and runoff.

Direct discharge of contaminants likely occurred when the wood preserving and treating facility was in operation. Wastewater at the facility was discharged directly into the St. Johns River (CH2M Hill 2003). This wastewater likely contained PAHs, metals, and other chemicals used for preserving and treating wood. Contaminants may also have been spilled into the St. Johns River when preserving and treating chemicals were received at the loading dock.

When the wood treating and preserving facility was dismantled creosote sludge mixed with wood shavings was buried in the northeast corner of the south parcel (CH2M Hill 2003). PAHs may have leached from the sludge into the surrounding groundwater, which then discharged into the St. Johns River. Groundwater beneath the site flows to the east into the St. Johns River at approximately 0.02 m (0.05 ft) per day (CH2M Hill 2003).

Most surface water runoff at the site flows east into the St. Johns River. Some runoff from the site flows into a drainage ditch that separates the north and south parcels. The location of the drainage ditch could not be determined from the information available for review at the time this report was prepared. Runoff also may flow into a low-lying area south of the site and then discharge into the St. Johns River. The low-lying area is a former drainage ditch that has been filled (CH2M Hill 2003).

The locations of the maximum concentrations of arsenic and lead could not be determined from the information available for review at the time this report was prepared.

## NOAA Trust Resources

The habitat of concern to NOAA at the site is the St. Johns River. The St. Johns River is approximately 512 km (318 mi) in length and originates in Indian River County, Florida. The St. Johns River flows from south to north and parallels the east coast of Florida. The St. Johns River connects to the Atlantic Ocean in northeast Florida approximately 29 km (18 mi) downstream of the site.

The section of the river near the site, referred to as the Lower St. Johns River, has a deep and well-defined channel. The Lower St. Johns River is tidally influenced and during periods of low tide the water flows downstream at average speeds of 0.5 m/s (1.6 f/s)(FDEP 2005). This reach of the river is considered mesohaline, with salinities ranging from 15 to 25 parts per thousand (ppt). The Lower St. Johns River is a major transportation route for ships going to the Port of Jacksonville.

NOAA trust resources present in the Lower St. John River include anadromous, catadromous, and estuarine fish species (Table 2). Atlantic croaker, pinfish, southern flounder, spotted seatrout, striped mullet, and weakfish are abundant in the estuarine reach of the St Johns River during their adult, larvae, and juvenile life stages. Bay anchovy, Atlantic silversides, and mummichogs are abundant in the lower St. Johns River during all life stages. Sheepshead are commonly found in the lower St. Johns River during all adult and juvenile life stages (Nelson et al. 1991).

Table 2. NOAA trust resources present in the lower St. Johns River near the Kennedy Generating Station site (Nelson et al. 1991; FFWCC 2005; GSMFC 2004).

| **Species** | | **Habitat Use** | | | **Fisheries** | |
|---|---|---|---|---|---|---|
| Common Name | Scientific Name | Spawning Area | Nursery Area | Adult Habitat | Comm. | Rec. |
| **ANADROMOUS FISH** | | | | | | |
| American shad | *Alosa sapidissima* | | ♦ | ♦ | | |
| Shortnose sturgeon | *Acipenser brevirostrum* | | | ♦ | | |
| Striped bass | *Marone saxatilis* | ♦ | ♦ | ♦ | | ♦ |
| **CATADROMOUS FISH** | | | | | | |
| American eel | *Anguilla rostrata* | | ♦ | ♦ | | |
| **MARINE/ESTUARINE FISH** | | | | | | |
| Atlantic croaker | *Micropogonias undulatus* | | ♦ | ♦ | ♦ | |
| Atlantic silverside | *Menidia menidia* | ♦ | ♦ | ♦ | | |
| Bay anchovy | *Anchoa mitchilli* | ♦ | ♦ | ♦ | | |
| Mummichog | *Fundulus heteroclitus* | ♦ | ♦ | ♦ | | |
| Pinfish | *Lagodon rhomboides* | | ♦ | ♦ | | |
| Sheepshead | *Archosargus probatocephalus* | ♦ | ♦ | ♦ | ♦ | |
| Southern flounder | *Paralichthys lethostigma* | | ♦ | ♦ | | ♦ |
| Spotted seatrout | *Cynoscion nebulosus* | | ♦ | ♦ | ♦ | ♦ |
| Striped mullet | *Mugil cephalus* | | ♦ | ♦ | ♦ | ♦ |
| Weakfish | *Cynoscion regalis* | | ♦ | ♦ | ♦ | |
| **INVERTEBRATES** | | | | | | |
| Blue crab | *Callinectes sapidus* | ♦ | ♦ | ♦ | ♦ | ♦ |
| Brown shrimp | *Farfante penaeus aztecus* | | ♦ | | ♦ | |
| Eastern oyster | *Crassostrea virginica* | ♦ | ♦ | ♦ | | |
| White shrimp | *Litopenaeus setiferus* | | ♦ | | ♦ | |

Several migratory fish species are present in the lower St Johns River (Table 2). Adult and juvenile blueback herring and American shad are common in the vicinity of the site (Nelson et al. 1991). The catadromous American eel is abundant in the estuary as an adult and during larval and juvenile stages. Striped bass are common in the tidally influenced portions of the lower St. Johns River during all life stages. A small number of shortnose sturgeon, which are listed as a federally threatened species, are present in the lower St Johns River as adults (Nelson at el. 1991).

Several invertebrates are present in the estuarine reach of the St. Johns River (Table 2). American oyster and blue crab are abundant in the lower St. Johns River during all life stages. Brown and white shrimp are abundant in the estuary as juveniles and during their larval stage (Nelson et al. 1991). Sampling has shown that sediment adjacent to the site supports an invertebrate population composed mostly of oligochaetes and polychaetes (CH2M Hill 2003).

Atlantic croaker, striped mullet, spotted seatrout, sheepshead, and weakfish are fished commercially in the lower St. Johns River and its tributaries. Invertebrates that were harvested commercially in significant numbers include blue crab, brown shrimp, and white shrimp (FFWCC 2005). Species commonly fished recreationally near the site include spotted seatrout, southern flounder, striped bass, striped mullet, and blue crab (GSMFC 2004).

Evidence of Injury

In 1997, consultants working on behalf of Jacksonville Electric Authority collected ten sediment samples from the river and characterized the benthic community in the samples (CDM 1997). The benthic community characterization indicated that sediment adjacent to the site generally contains low numbers and low diversity of benthic organisms. Two of the samples collected adjacent to the site contained large numbers of *Streblospio benedicti*, a benthic organism that is often dominant in areas with poor water quality.

In 1998, sediment samples were collected from the lower St. Johns River as part of a study to determine appropriate disposal options for sediment dredged from the shipping channel (PPB 1998). Elutriate and whole sediment bioassays were conducted on the sediment samples. The inland silverside *Menidia beryllina*, the mysid shrimp *Mysidopsis bahia*, and the sea urchin *Strongylocentrotus purpuratus* were used for the elutriate bioassays and the infaunal amphipod *Leptocheirus plumulosus* and the mysid shrimp *Mysidopsis bahia* were used for the whole sediment bioassays. The results of the bioassays conducted with sediment collected adjacent to the Kennedy Generating site indicate that the sediment at this location is toxic to aquatic life. The results for the elutriate bioassays were 0% survival for *Mysidopsis bahia* and *Menidia beryllina,* and 3% fertilization of *Strongylocentrotus purpuratus.* The results of the whole sediment bioassays were 0% survival for both *Leptocheirus plumulosus* and *Mysidopsis bahia.* Results of bioassays conducted with sediments collected just upstream and downstream of the Kennedy Generating site do not demonstrate toxicity. The biossay results for the sediment station adjacent to Kennedy Generating site were very different from the bioassays results for sediment from other areas of the river.

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