2.0 ENVIRONMENTAL DESCRIPTION[1]

2.1 Station Location

The Grand Gulf Nuclear Station is located in Claiborne County in southwestern Mississippi. The site is on the east bank of the Mississippi River at river mile marker 406, approximately 25 miles south of Vicksburg, Mississippi and 37 miles north-northeast of Natchez, Mississippi. The Grand Gulf Military Park borders a portion of the north side of the property. The community of Grand Gulf is approximately 1.5 miles to the north. The town of Port Gibson is about 6 miles southeast of the site.

The Universal Transverse Mercator Grid Coordinates for the location of the new reactor(s) on the site are approximately N3,542,873 meters, and E684,021 meters.

The property boundary shown on Figure 2.1-1 encompasses approximately 2100 acres of property that makes up the Grand Gulf Nuclear Station (GGNS) site. The actual site property area may be slightly less than this value due to erosion of the east bank of the Mississippi River north of the existing GGNS barge slip (Figure 2.1-2). Stabilization of this section of the river bank has been completed. A site area of 2100 acres will be used throughout this report.

The site and its environs, consisting primarily of woodlands and farms, are about equally divided between two physiographic regions. The western half of the site is in the Mississippi Alluvial Valley, consisting of materials deposited by the Mississippi River and extending eastward from the river about 0.8 mile. This area is generally at elevations of 55 to 75 feet above mean sea level (msl). Two oxbow lakes, Hamilton Lake and Gin Lake, are located in the western portion of the site. These lakes were once the channel of the Mississippi River and had an average depth of approximately 8 to 10 feet according to Reference 2. The eastern half of the plant site (in the undeveloped areas surrounding the existing plant and its facilities) is rough and irregular, with steep slopes and deep-cut stream valleys and drainage courses. Ground elevations in this portion of the plant site range from about 80 feet above msl to more than 200 feet above msl inland. Elevations of about 400 feet above mean sea level occur on the hilltops east and northeast of the site. Grade elevation for the existing Grand Gulf Nuclear Station plant structures is 132.5 feet above mean sea level. (Reference 1)

2.1.1 References

1. Grand Gulf Nuclear Station Updated Final Safety Analysis Report, UFSAR.
2. Mississippi Power and Light Company, Grand Gulf Nuclear Station Units 1 and 2, Final Environmental Report (FER), as amended through Amendment No. 8.

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[1] This ESP Environmental Report makes use of material provided in the GGNS Final Environmental Report (FER) (Reference 2) where considered appropriate. When such material (text) is used (verbatim from the FER) in this Environmental Report, it is shown in italics.

2.2 Land

The Grand Gulf Nuclear Station site is located within Claiborne County Mississippi. It is bordered on the west by the Mississippi River, on the north by Warren County, on the east by Hinds and Copiah Counties and on the south by Jefferson County.

The site is accessible by both river and road. The major highways in the area are found mainly east and south of the site, a number of county roads service the area. U.S. Highway 61 and State Highway 18 connect Port Gibson with Natchez, Jackson and Vicksburg.

This section describes, in general terms, the GGNS site and land in the vicinity of the GGNS site.

2.2.1 The Site and Vicinity

The property boundary shown on Figure 2.2-1 encompasses the approximately 2100 acres that make up the GGNS site. System Energy Resources, Inc. currently controls the entire GGNS site for the purpose of generating electricity; however, some of the area within the boundary may be used for other purposes, such as hunting and fishing. SERI has authorized Entergy Operations to maintain control of ingress to and egress from the GGNS site property.

The approximate number of acres potentially affected by a new facility at the GGNS ESP Site can be found in Table 2.2-1.

The GGNS site area is accessible by both river and road, although transportation routes are limited within the site vicinity. The major highway within the vicinity is U.S. Highway 61 which passes by the GGNS site to the east-southeast. U. S. Highway 61 parallels the Mississippi River from New Orleans, Louisiana to St. Louis, Missouri, and is approximately 4.5 miles from the site at the closest point. From the town of Port Gibson the highway goes north to Vicksburg, MS, and southwest to Natchez, MS. A section of the Natchez Trace Parkway passes approximately 6 miles southeast of the GGNS site running southwest towards Natchez, Mississippi, and to the northeast to Jackson, Mississippi (Figure 2.2-3). Mississippi Highway 18 runs east from Port Gibson to Jackson. There are a number of county and rural roads within the site vicinity (Figure 2.2-2).

The land within the vicinity of the site is mainly rural. The land use within the vicinity of the site is made up of forest and agriculture lands (Figure 2.2-3). The nearest population concentration is located in the town of Port Gibson, which lies 6 miles southeast of the site. There are a number of recreational land use areas within the vicinity of the site.

- The Grand Gulf Military Park - Located approximately 1-1/2 miles north of the site, contiguous to the GGNS site.
- The Warner-Tully YMCA Camp - Approximately 108 acres of land located approximately 3-1/2 miles northeast from the site. The YMCA camp is open from late May to the end of August. (Reference 3)
- Lake Claiborne - A private development of residential and recreational facilities located approximately 3-1/2 miles east of the site.
- Lake Bruin State Park - A 53 acre state park located on the shore of Lake Bruin, LA, approximately 9.5 miles west/southwest of the site.

The Mississippi River is an important transportation corridor, primarily for the shipment of industrial and commercial products and to a lesser extent, commercial boating. The Claiborne

County Port Commission built a small port on the Mississippi River at river mile 404.8 in Claiborne County. The mean depth of channel and berth at Port Claiborne is 14 ft. Services provided at this port are mooring assistance, stevedore, dryage and deepwater berths. Port cargo includes forest products, pulpwood, feed grains, and agricultural products (Figure 2.1-1). (References 1, 5).

There is no rail service in the vicinity of the GGNS site and there are no active railroad tracks that traverse the GGNS site or the vicinity surrounding the site.

The nearest gas-transmission pipeline is 4.75 miles east of the site (Figure 2.2-4). Operating pressure of the 4-inch-diameter pipe is 225 psi. The pipeline was installed in 1955 at a minimum depth of 3 feet. The two closest isolation valves are located at 5.5 miles east and 7.5 miles east-northeast of the site. The pipeline is presently carrying natural gas, and there is no future plan to carry a different product. (Reference 10)

2.2.1.1 Surface Rights

System Energy Resources, Inc. (SERI) has acquired and will maintain surface ownership of all the land within the GGNS plant site property boundary, with the following exceptions (Reference 12):

1. South Mississippi Electric Power Association (SMEPA) has a 10 percent undivided interest in the GGNS Unit 1 power block area. This is a 94-acre tract containing the cooling towers, containment buildings, and other major plant structures. SMEPA also owns a 10 percent undivided ownership interest in two very long and narrow strips of land (7 l/2 and 5 acres, respectively) on which the GGNS Unit 1 water supply and discharge piping is located.
2. Entergy Mississippi, Inc. owns the 52-acre GGNS plant switchyard area on the site. However, under a 1999 agreement with MP&L (now Entergy Mississippi, Inc.), SERI has authority to exercise complete control and determine all activities on Entergy Mississippi, Inc. property and easements on the site, including exclusion of Entergy Mississippi, Inc. personnel and third parties. SERI has transferred such rights to Entergy Operations.

   Entergy Operations has unrestricted access to the switchyard area. For GGNS Unit 1, Entergy Operations performs all routine switchyard activities, operates the main generator breakers and 34KV breakers, and maintains the main, ESF, and BOP transformers. Entergy Operations is also responsible for all security functions within Entergy Mississippi, Inc. property at GGNS.
3. A two-acre residential property which is totally surrounded by the plant site property boundary in the southwest sector of the site is privately owned (Figure 2.2-1).

There are no active railroads or navigable waterways that traverse the site. One county roads run through the GGNS plant site property; Bald Hill Road cuts through the south-southeast, south, south-southwest, and southwest sectors of the plant site. Another county road (unpaved) traverses the plant site property in the north, north-northwest, northwest, west-northwest, and west sectors, providing access to the two lakes on the property. Two Entergy Mississippi, Inc. transmission lines traverse the GGNS plant site property. There are no other industrial, commercial, institutional, or residential structures on the site.

Entergy Operations allows access to parts of the plant site property for recreational purposes. The site is posted to ensure awareness of access restrictions by individuals.

2.2.1.2 Mineral Rights

The joint owners of the Grand Gulf Nuclear Station (GGNS) own or control 89 percent of the mineral rights within the GGNS Unit 1 plant exclusion area, and all the mineral rights within the power block area. Third parties own a small portion of the mineral interests on the site. (Reference 12)

There is no activity at the GGNS plant site to explore for, drill for, or otherwise extract minerals. Past unsuccessful exploratory activities on or near the GGNS plant site and the geological character of the subsurface structure in the vicinity of the GGNS plant site indicate that commercial mineral production appears unlikely in the foreseeable future. This has been confirmed in a geological appraisal, dated January 1987. (Reference 12)

In addition, under Mississippi law, prospective mineral developers have no legal right to use physical force or to create a public disturbance to gain access to a property in order to explore for or to extract minerals. Furthermore, they would be prohibited from drilling any oil or gas well until a permit is issued by the State Oil and Gas Board following a notice and public hearing. Since SERI and SMEPA own, and Entergy Operations controls, substantially all of the minerals on the site, SERI and Entergy Operations would attend any hearings and would have the opportunity to object to the drilling and/or the location of any potential well. (Reference 12)

2.2.1.3 Easements

SERI and SMEPA own all the surface rights at GGNS except the plant switchyard, which is owned by Entergy Mississippi, Inc. A number of easements over the GGNS property are in effect. (Reference 12)

2.2.2 Transmission Corridors and Offsite Areas

Entergy Mississippi, Inc. has transmission lines that traverse the GGNS plant site property. There are no other industrial, commercial, institutional, or residential structures on the site. There are two types of transmission lines, 500 kV and 115 kV within the vicinity that service the area. There are approximately 71 miles of transmission lines that include about 1,645 acres of rights-of-way. The transmission lines are made up of 3 segments: (Figure 2.2-5)

Transmission Line	Length
Baxter Wilson	= 22 miles
Franklin	= 43.6 miles
Port Gibson	= 5.5 miles
Total	= 71.1 miles

The land use within the transmission corridors consists of forest and agriculture lands. The 71.1 miles of transmission lines and the type of land use within the 3 segments can be found in Table 2.2-2 and Figure 2.2-3.

The existing GGNS switchyard was built with provision for a second unit's (Unit 2) equipment installation and operation. This portion of the switchyard would be used, with modifications as required, for a new facility's switching equipment and connection to existing transmission line(s). The existing transmission lines would be utilized for a new facility as discussed in Section 3.7.

2.2.3 The Region

Transportation infrastructure within the region includes the Mississippi River, U.S Interstate Highway 20, of which a portion lies approximately 28 miles north of the GGNS site, and U.S. Interstate Highway 55 a portion of which lies approximately 40 miles east of the GGNS site. Interstate Highway 20 runs east-west connecting Vicksburg with Jackson, Mississippi to the east and Monroe, Louisiana to the west. Interstate Highway 55 runs north-south connecting Jackson with Memphis, Tennessee to the north and to Interstate Highway 10 just west of New Orleans to the south. U.S. Highway 65 runs north to south in Louisiana and lies approximately 9 miles to the west of the site, connecting to U.S. Highway 84 approximately 27 miles to the southeast of the site. Figure 2.2-6 shows the locations of airports, federal highways and railroads in the area.

The Mississippi River, which passes about 1.1 miles west of the existing plant, provides another route of transportation. The nearest river port facility is Port Claiborne at river mile 404.8 (Figure 2.1-1). A larger river port facility can be found north of the site near river mile 437 in Vicksburg, Mississippi; this port is a United States Customs port of entry.

The regional land use is mainly forest and agricultural lands. Land area usage information for Claiborne County and the adjoining counties is presented below (Reference 11).

County / Direction	County Land Area in Commercial Forests	County Land Area
Claiborne	68%	494 sq. mi.
Copiah / East, Southeast	70%	779 sq. mi.
Hinds / Northeast	37%	875 sq. mi.
Jefferson / South	72%	523 sq. mi.
Warren / North	56%	597 sq. mi.

There are two types of transmission lines, 500 kV and 115 kV, that serve the region. Natural gas pipelines are found throughout the region but only one gas line exists within the site vicinity. This pipeline lies about 4.75 miles east of the GGNS site and runs parallel to U.S. Highway 61 in a north-south direction. (Figure 2.2-4, Reference 10)

The state of Mississippi is divided into 9 districts for reporting agricultural information by the Mississippi Agricultural Statistics Service. The GGNS site area is located in District 7. The Counties included in this district are Adams, Amite, Claiborne, Copiah, Franklin, Hinds, Lincoln, Warren and Wilkinson. (Reference 5)

Year 2001 production estimates for corn, cotton, soybeans, and wheat for Claiborne County and District 7 are presented in Table 2.2-3. The average yields for these crops for the years 1997 through 2001 are presented in Table 2.2-4.

Information from the Claiborne County Extension office at the present time indicated that there are approximately 300 to 400 head of cattle within a 6 mile radius of the site, and most of the cattle are located southwest of the plant. There are no milk cows or swine within Claiborne County (Reference 7). Estimates of heads of livestock sold for 2002 in Claiborne County and District 7 are presented in Table 2.2-5.

Agricultural crop yields and livestock production for Tensas Parish, Louisiana, and Louisiana agricultural District 3 (30) which lie across the Mississippi River to the west of the GGNS site are presented in Tables 2.2-6 through 2.2-8.

2.2.4 References

1. URL, Mississippi Development Authority September 2002, http://www.mississippi.org/maps/resources.htm.
2. URL, Mississippi Automated Resource Information System, September 2002, http://www.maris.state.ms.us/land_use.html.
3. URL, Mississippi Department of Transportation, September 2002, http://www.mdot.state.ms.us/business/maps/map_online.htm.
4. URL, Kansas City Southern Railroad, September 2002, http://www.kcsi.com/system_map.pdf.
5. URL, Mississippi Agricultural Statistics Services, USDA National Agricultural Statistics Service, Agricultural Statistics Data Base, 2002, http://www.nass.usda.gov:81/ipedb/ .
6. URL, Louisiana State University AgCenter Research and Extension, October 2002, http://www.lsuagcenter.com/.
7. Covington, Cliffton, Claiborne County Extension Office, personal communication October 16, 2002.
8. URL, Mississippi Department of Environmental Quality, Office of Geology, September 2002, http://minerals.usgs.gov/minerals/pubs/state/ms.html.
9. URL, Louisiana State University AgCenter Research and Extension, Tensas Parish Office, October 2002, http://www.lsuagcenter.com/parish/tensas/agriculture.htm.
10. Morgan, Nathan, Union Gas, Port Gibson, MS, personal communication, November 2002.
11. URL, Mississippi Development Authority Community Profiles, http://www.mississippi.org/doing_busn/site_selectors/comm_profiles.htm.
12. GGNS Updated Final Safety Analysis Report (UFSAR).
13. Mississippi Power and Light Company, Grand Gulf Nuclear Station Units 1 and 2, Final Environmental Report (FER), as amended through Amendment No. 8.
14. Robert Goodson, County Agent with the LSU Ag Center Extension Service, personal communication, February 2003.
15. NASS Agricultural Statistics Database, Quick Stats, County Level Data for Louisiana, URL http://www.nass.usda.gov:81/ipedb/

2.3 Water

The site for the Grand Gulf Nuclear Station (GGNS) is on the east bank of the Mississippi River in the vicinity of river mile 406, approximately 25 miles south of Vicksburg, Mississippi, and 6 miles northwest of Port Gibson, Mississippi. The Universal Transverse Mercator (UTM) Grid Coordinates for the center of the location of the power block area for a new facility is approximately N3,542,873 meters and E684,021meters. The site is bounded on the west by the Mississippi River and on the east by loessial bluffs forming part of the hilly region that extends from Vicksburg to Baton Rouge, Louisiana. The barge slip used during construction of GGNS Unit 1 is located at river mile 406.4. Plant grade for the GGNS Unit 1 facility is 132.5 ft. msl.

The following sections describe the hydrological, physical, chemical, and biological characteristics of the hydrologic environment in the vicinity of the Grand Gulf site. The hydrologic environment is divided into surface water and ground water environments. The characteristics of each of the two separate environments are described separately.

2.3.1 Hydrology

The existing GGNS Unit 1 plant utilizes a natural draft and an auxiliary linear mechanical draft cooling tower for dissipating the main condenser heat load. The plant makeup and service water is supplied by a series of radial collector wells located in the floodplain parallel to the Mississippi River. During normal operation of GGNS Unit 1, plant service water is discharged to the circulating water system to supply the required circulating water system makeup water. The circulating water system blowdown for the existing GGNS Unit 1 plant is discharged to the discharge basin and from there is discharged by a single pipeline to the Mississippi River. Emergency service water is provided from concrete basins. (Reference 2)

Plant makeup (cooling tower makeup and other raw water needs) for a new facility would be supplied from the Mississippi River via an intake structure located on the east bank of the river and on the north side of the existing barge slip. Emergency cooling water (ultimate heat sink) for a new facility would be provided from closed-cooling systems which utilizes enclosed basins with mechanical draft cooling towers, or similar heat removal mechanisms, and would not be reliant on the source of water from the river intake, with the possible exception of normal makeup.

Effluent from a new facility would be combined with that from the GGNS Unit 1 facility, and the combined effluent would be discharged into the river downstream of the intake such that recirculation to the embayment area and intake pipes would be precluded.

2.3.1.1 Surface Water

2.3.1.1.1 Mississippi River

The dominant hydrologic feature in the vicinity of the site is the Mississippi River (Figures 2.3-1 and 2.3-2). … *The drainage pattern of the Mississippi River is that of a river in a stage of maturity with meanders and oxbow lakes. The average water surface slope of the Mississippi River in the vicinity of the site is between 0.1 and 0.4 feet/mile.*

The Mississippi River floodplain adjacent to the site is relatively low and flat with elevations ranging from 55 to 75 ft. At the plant site, the natural floodplain is about 60 miles wide. However, the flow is confined to a width of about two to four miles by high bluffs on the east bank and man-made levees on the west bank, with a top levee elevation ranging from 101 to 103 feet. The river has a width of about one-half to one mile during dry seasons. The width can increase to about four miles during floods. (Reference 2)

The proposed location for a new facility (Figure 2.3-1) is on the bluffs approximately 1 mile east of the river and adjacent the GGNS Unit 1 site (grade elevation is 132.5 ft msl for Unit 1), well above the water levels in the Mississippi River as summarized below:

Item	Elevation (ft. msl)
U. S. Army Corps of Engineers design project flood elevation	102.1 (References 3 and 6) [96.2 ft as reported in Reference 2]
Existing grade of west bank levee (GG Project design flood elevation)	*103*
100-yr flood elevation	*91.4*
Mean annual flood elevation	*76.5*
Low Water Reference Plane for RM 406	37.5 (Reference 4) [34 ft as reported in Reference 2]
Low water elevation (lowest recorded at Vicksburg projected to Grand Gulf)	*28*

*The Mississippi River is known to have undergone, and is presently undergoing, lateral shifting near the Grand Gulf region. This is evidenced by the presence of oxbow lakes, low lying swamps, and sand bars. The river divides itself around Middle Ground Island, rejoining at approximately River Mile 408 (*Figures 2.3-2 and 2.3-3*). In order to stabilize the river alignment, the Corps of Engineers has carried out extensive river control work in this area. This includes construction of submerged dikes across the western channel for diverting flow to the eastern channel*, construction of revetments composed of an articulated concrete mattress under water, and stone (riprap) paving above the water. Figure 2.3-3 shows hydrographic details of the Mississippi River at Grand Gulf.

Figure 2.3-4 *shows the rating curve for the Mississippi River at the Grand Gulf site. The rating curve at the site is based on the rating curve at Vicksburg. It is obtained by correlating the stages at Vicksburg and at the site during the period 1972 to 1974, and using the data from water surface profiles … . The discharges at the two locations are assumed equal, since there are no major tributary streams between these locations except the Big Black River, which has a runoff of less than 1 percent of the Mississippi River flows at Vicksburg.*

The Corps of Engineers has completed revetments along the east and west river banks, including the east bank that borders the GGNS site, to maintain the river channel (Reference 4). The Grand Gulf revetments in the two sections from approximately river mile 400.5 to 405.0 and 408.5 to 409.6 were completed in the 1960s and 1970s. The intervening section, which includes the river stretch near the GGNS site, was left unprotected to undergo erosion until it attained an acceptable alignment. The section on the east bank along the GGNS site boundary was completed in stages from the mid-1970s to the early 1980s, with a small gap at the existing GGNS barge slip (References 1, 5). It is expected that these measures will stabilize the Mississippi River shoreline near the site. The Corps of Engineers has no plans for additional construction in the immediate vicinity of the site except for occasional maintenance of the existing structures (Reference 6). The Corps of Engineers continues to evaluate the need for additional shoreline work, and would be expected to make improvements as considered appropriate. However, those actions would not be expected to impact site suitability.

In addition to changes in river alignment, the cross section of the Mississippi River undergoes changes with the river discharge. Figure 2.3-5 *shows channel cross sections, during and after the flood in 1973, about 1000 feet downstream of the barge slip into which the blowdown is discharged (*Figure 2.3-1*). These changes occur mainly in the river bottom far from the blowdown discharge structure. Furthermore, the bottom elevation of the barge slip at its junction with the river is 39.23 ft msl, about 40 feet above the river bed. The barge slip bed near the blowdown discharge structure is concrete lined and the side slopes are riprapped. No scouring is, therefore, expected near the blowdown discharge structure.*

It will be required to coordinate with the Corps of Engineers and/or other appropriate regulatory agencies and obtain permits for construction of the embayment and intake structure when the final design of the intake structure and its exact location are defined. The design and placement of the embayment and intake structure will be in accordance with the Corps guidance, MDEQ and EPA requirements, and good engineering practice. The final location and design of the embayment and intake structure would be chosen such that there would be inconsequential interference, if any, with the pumping ability of the existing GGNS Unit 1 radial wells.

2.3.1.1.2 Local Streams

The upland region in which the Grand Gulf site is located contains numerous streams. The drainage is of the dendritic pattern, being characterized by irregular branching of tributary streams in many directions. Several such streams flow from the uplands into the oxbow lakes or the Mississippi River. The average channel gradients in the uplands are on the order of 40 to 60 feet/mile. Ground elevations range between 100 and 250 feet msl.

Of immediate relevance to the plant site are two small and steep streams, Stream A and Stream B (Figures 2.3-7 and 2.3-8). Stream A, to the north of the site and adjacent to the proposed power block location for a new facility is perennial, draining basin A with an area of 2.8 sq miles (Reference 1). Stream B, to the south and adjacent to the existing GGNS Unit 1 plant facilities is intermittent, draining basin B with an area of 0.6 sq miles (Reference 1). The surface runoff from streams A and B discharges into sediment basins A and B, then into Hamilton Lake in the floodplain of the Mississippi River.

The stream to the south, draining Basin B, was rerouted around the Unit 1 plant site and a 15-foot culvert was placed at its outlet to safely carry local floods and site drainage. The channel has been concrete-lined up to an expected water surface elevation resulting from a 100-year rainfall. For the most part the natural drainage patterns have not been changed; where modifications have been made, they are to increase drainage efficiency. The stream to the north, draining Basin A, which receives most of its water from the watershed outside the plant area was not rerouted. However, a 12-foot culvert was placed under the access road to connect Stream A to the Mississippi River flood plain. (Figure 2.3-8, References 1, 2)

The plant yard for a new facility would be graded such that runoff is directed away from existing site buildings, and away from buildings for a new facility. Use of the two streams for directing runoff from new facility areas and buildings is anticipated, to the maximum extent possible.

2.3.1.1.3 Local Lakes

There are a number of lakes in the vicinity of the site as well as several swamps and slack-water areas. The lakes are mostly of the oxbow type. Those situated between the levees and the river channel have indirect or direct seasonal connections with the river and are submerged during floods. However, their hydrologic characteristics have no influence on the plant site. (Reference 2)

Hamilton and Gin Lakes are located on the site. They are surrounded by slack-water areas and have partially active connections with the Mississippi River. The areal extent and depth of water in these lakes vary seasonally. The size of Gin and Hamilton lakes is estimated to be approximately 55 acres and 64 acres, respectively, based on an aerial photograph of the site taken in December 2001 (Figure 2.4-2). The FER reported Hamilton and Gin Lakes to be relatively small and shallow. These lakes were once the channel of the Mississippi River and had an average depth of approximately 8 to 10 feet according to Reference 2.

Hamilton and Gin Lakes were connected by a stream channel running through the wetlands between the lakes. However, due to construction of the haul road, this connecting channel has been modified and the flow in the lakes is connected by a series of culverts under the haul road in the vicinity of the old stream channel. Figure 2.3-9 *shows the lake and Mississippi River stage hydrographs in the vicinity of the site.*

Gin and Hamilton Lakes have a direct connection with the Mississippi River when the water levels in the river are at or above elevation 63 and 56 ft msl, respectively. The Mississippi River at the site has a water level elevation of 56 to 63 ft msl on the average during February through June. On the basis of the flow duration analysis (Reference 7) *of the Mississippi River near Vicksburg, Mississippi (period 1931-1967), it is estimated that the river water level at the Grand Gulf Nuclear Station will exceed elevation 56 ft msl and 63 ft msl about 36 percent of the time, respectively.*

The Corps of Engineers bank stabilization measures at GGNS have been completed, and have not affected the connection of the above lakes to the Mississippi River. The bank stabilization measures consist of placing articulated concrete mattresses under water up to low water level and stone (riprap) paving above the water. (Reference 1)

A flooded man-made borrow pit is located north of the barge slip; the borrow pit was created during construction of the existing GGNS Unit 1 plant. The borrow pit does not appear to be hydrologically connected to Gin Lake or to Hamilton Lake except during periods of high water when all are inundated by the Mississippi River. The borrow pit includes an area of about 16 acres based on the photograph of Figure 2.4-2. Depth of this lake is not known.

Five small ponds in the upland portion of the site were probably originally constructed to water livestock. The ponds are small (approximately ¼- to ½-acre each).

2.3.1.1.4 Physical Properties of Surface Waters

<u>Flow Velocity</u>

The U. S. Army Corps of Engineers has made limited velocity measurements on the Mississippi River in the vicinity of the site. Pertinent data on the locations and velocities measured are presented in Table 2.3-1. *Measured average velocities in the channel vary from 3.7 to 6.7 fps, corresponding to river discharges of about 425,000 and 1,493,000 cfs, respectively.*

Mississippi River current velocities at various depths were measured on September 25, 1975, at five stations located on a cross-river transect about 1,000 feet downstream of the barge slip as shown on Figure 2.3-10 (Reference 8). *The velocities ranged from 1.3 fps near the bottom to a maximum of 3.5 fps near the surface. Surface velocities near the river banks were about 2 fps, whereas they were over 3 fps midstream. The river discharge was about 293,000 cfs with an average velocity of about 2 fps.*

Velocity measurements based on observations from 1973 to 1989 were obtained from the Corps of Engineers (Reference 9) for Tarbert Landing (River Mile 306.6). Mean velocity measurements ranged from 2.6 fps to 7.6 fps at the surface, and from 2.3 fps to 6.8 fps at 60 percent depth.

Water Temperature

As part of the environmental field measurements programs, water temperature measurements were carried out for the Mississippi River near the Grand Gulf site and for Gin and Hamilton Lakes for the base period November 1972 to November 1973. During this period, the temperature ranged from 40 degrees F to 84 degrees F. The temperature values at the site were found to be almost identical to those recorded at Vicksburg, Mississippi, where long-term data exist. The Mississippi River water temperatures are, therefore, used for assessing long-term behavior of the water temperature. The water temperature of the Mississippi River at Vicksburg seldom falls below the freezing point.

Table 2.3-2 summarizes Corps of Engineers temperature ranges from 1962-1979. Table 2.3-3 summarizes USGS temperature data and discharge measurements recorded at the USGS station at Vicksburg for the period 1973 to 1999. For the period 1973 to 1999, the maximum temperature measured was 89.6 degrees F and the minimum was 34.7 degrees F. River temperature values at the site as reported in the GGNS FER are almost identical to those recorded at Vicksburg, Mississippi, where long-term data exist. The Mississippi River water temperatures at Vicksburg are, therefore, useful for assessing long-term impacts on the river.

Figure 2.3-11 *presents vertical temperature profiles at four stations (for locations of these stations see* Figure 2.3-10*) based on temperature measurements taken on February 19, 1973. The rates of temperature change with depth are extremely small, and the river can be considered well-mixed from top to bottom.*

Thermal monitoring was conducted as part of the 2002 National Pollutant Discharge Elimination System (NPDES) permit renewal application (Reference 10) as shown on Table 2.3-4. Monitoring locations are shown on Figure 2.3-12. This data confirms the results of the 1973 sampling that the rate of temperature change with depth in the main channel of the river is extremely small. In addition, the temperature readings upriver and downriver of GGNS show little variation.

Streamflow and Flood Characteristics

The Mississippi River has three major tributaries upstream of the site (the Missouri, Ohio, and Arkansas Rivers) and one downstream (the Red River). Floods occurs in the Lower Mississippi River chiefly as a result of flooding in its tributaries. The flood season extends from mid-December to July. The number of peaks, duration of near-peak flow, and the flood volume during a year vary greatly. Rivers of the Mississippi basin have numerous flood control and navigational control structures including levees, navigational locks, and dams.

Flood discharges at Vicksburg during six of the highest recent floods are summarized in Table 2.3-5. Updated information on floods at Vicksburg (Reference 6) indicates that no flood since the construction of GGNS have exceeded the discharge of the 1973 flood. Water surface profiles for the floods on the Mississippi River between Arkansas City and Red River Landing for the 1937 flood are shown in Figure 2.3-13. Based on these flood discharges and the profile for the 1937 flood, the highest recorded water level was about 40 ft below the GGNS Unit 1 plant grade of 132.5 ft.

Floods in the Lower Mississippi River are confined on the west bank by a system of levees. The levees are designed to contain the U. S. Army Corps of Engineers design project flood with design freeboards. In the vicinity of the Grand Gulf site the water surface elevation corresponding to the design project flood is 102.1 feet msl (References 3 and 6).

Hydrographs for the Mississippi River showing maximum, minimum, and average stages at Vicksburg, Mississippi, (based on data collected from 1932 to 2000) and at Natchez, Mississippi, (based on data collected from 1940 to 2000) are shown in Figures 2.3-14 and 2.3-15. Figure 2.4-16 illustrates the annual maximum instantaneous peak streamflow at Vicksburg from 1858 to 1999. Seasonal variations in streamflow of the Mississippi River are evident in the maximum daily flows observed at Vicksburg, Mississippi during the period 1932 - 1988 presented in Table 2.3-6. (References 1 and 7) *The major flows usually occur during the months of March and April*.

Low-water conditions at the site were studied on the basis of stream-flow records at Vicksburg Gaging Station. The minimum daily flows observed at Vicksburg, Mississippi during the period 1932 - 1979 are presented in Table 2.3-7*. In addition, data on minimum river stages expressed in ft MSL are included. The minimum flow observed during the period of record was 99,400 cfs on November 1, 1940. The corresponding historical low-flow elevation at the site is about 28 ft. During the same year, the mean 30-day low flow was 108,000 cfs.*

The minimum daily flows from Reference 20 observed at Vicksburg, Mississippi during the period 1932 - 1988 are also presented in Table 2.3-7. The minimum flow observed during the period 1932 to 1988 for the USGS station was 100,000 cfs on November 1, 1939. The minimum flow observed during the period from 1930 to 2000 was 93,800 cfs on August 31, 1936, according to Corps of Engineers data[1] (Reference 32). This data is consistent with the data used in the analysis for GGNS Unit 1 licensing.

Table 2.3-8 *gives the 1-, 7-, and 30-day low flows for different recurrence intervals at Vicksburg (obtained from the U. S. Geological Survey). The 7-day, 10-year low flow is 129,000 cfs.*

According to information provided by the U.S. Army Corps of Engineers, the Low Water Reference Plane for river mile 406 is 37.5 feet msl (Reference 4). The Low Water Reference Plane is based on the average stage from 1982-1991 representing the discharge equaled or exceeded 97 percent of the time (Reference 3).

No systematic data on the long-term flow characteristics of streams A and B are available on a long-term basis. However, some flow measurements were made during 1973 (References 8 and 13), *and these are summarized in* Table 2.3-9*. During rainstorms, the two streams convey the surface runoff from the plant and the surrounding area. The quantity and quality of the*

[1] Data for the year 2000 is still described as preliminary by the Corps of Engineers.

surface runoff into these streams will not be affected significantly during plant operation, since the patterns of natural drainage have not been significantly changed.

GGNS is required to conduct surface water sampling and flow measurements in accordance with NPDES permit number MS0029521, Reference 14. The outflow from sediment basins A and B was measured once every quarter, and the instantaneous flow data for 1999-2001 is presented in Table 2.3-10, sheets 4 and 5. The yearly maximum flow for sediment basin A (outfall 013) ranged from 0.410 million gallons per day (MGD) in 1999 to 4.400 MGD in 2001, and the yearly average flow ranged from 0.218 MGD in 1999 to 2.135 MGD in 2001. The yearly maximum flow for sediment basin B (outfall 014) ranged from 0.270 MGD in 1999 and 2001 to 0.450 MGD in 2000, and the yearly average flow ranged from 0.190 MGD in 1999 to 0.315 MDG in 2000.

<u>Wetlands</u>

Reconnaissance visits to GGNS were made in August and October of 2002 to assess wetlands and other ecological resources. The oxbow lakes, borrow pit, upland ponds, and stream channels all support associated wetlands. Details of this assessment are provided in Section 2.4, and a brief summary follows.

Bottomland hardwood forests like those observed at GGNS may also be characterized as seasonally flooded wetlands. This habitat type covers approximately 885 acres, or most of the GGNS site bottomland between the Mississippi River and the bluff line.

Emergent wetlands are located near the periphery of Gin and Hamilton Lakes. In August 2002, emergent wetlands along the shorelines occupied approximately 30 acres.

Scrub-shrub wetlands occur in two distinct areas. One of these wetland areas developed relatively recently on a former bottomland field. The other scrub-shrub wetlands occur on the north, northwest, and south ends of Gin Lake and on the west bank of Hamilton Lake, and encompass approximately 10 acres.

Stream A and Stream B support permanently flooded wetlands. Ephemeral drainage channels on the upland areas on the eastern portion of the site support seasonally flooded wetlands of very small size.

2.3.1.2 Ground Water

2.3.1.2.1 Regional Conditions

The region of ground water investigations discussed herein encompasses the area east of the Mississippi River within approximately a 25-mile radius of the plant site (Figure 2.3-2). The region includes most of Claiborne County and bordering areas of Warren, Hinds, Copiah, and Jefferson Counties, Mississippi. The area west of the Mississippi River is excluded from this study because the river forms an effective hydrologic boundary. (Reference 2)

Geologic formations dip south across the region at an average of 26 ft per mile and strike approximately east-west. The regional water table slopes southward and generally conforms to the attitude of geologic structure and land surface. The water table is 50 to 100 ft below land surface in the upland areas and is at or near the surface in the lowland areas (Reference 15). The stratigraphic position of the regional geologic formations, along with a brief description of their physical and waterbearing characteristics, is presented in Table 2.3-11. (Reference 2)

The principal sources of ground water occur in the Holocene Mississippi River alluvium, Pleistocene terrace deposits, and the Miocene series, primarily the Catahoula Formation. Other less prominent aquifers occur in the Citronelle Formation (Pliocene-Pleistocene), Forest Hill Formation (Oligocene), and the Cockfield Formation (Eocene) (References 7 and 15). *Water-bearing formations below the Catahoula are rarely used in the vicinity because of their great depth and generally poor quality of the water.*

Holocene Mississippi River Alluvium

The Mississippi River alluvium is the most prolific waterbearing unit in the region. The alluvium, up to 200 ft in thickness, generally consists of a basal, coarse-sand and gravel zone grading upward into silt and clay. Recharge is derived from precipitation in areas where surficial deposits are permeable and from adjacent formations. (Reference 2) The Mississippi River, tributary streams, and lakes also contribute recharge during high-water levels (Reference 16).

Ground water availability is restricted to the Mississippi River Valley because the aquifer is about 75 miles wide between Vicksburg, Mississippi, and Monroe, Louisiana. Groundwater level measurements from 1965 to 1994 for a well completed in the alluvial aquifer in Vicksburg are presented in Table 2.3-12 and a hydrograph is presented in Figure 2.3-17.

Pleistocene Terrace Deposits

Terrace deposits underlie the Holocene alluvium locally and blanket the upland areas bordering the Mississippi River and its larger tributaries. In the uplands, the terrace deposits are commonly overlain by Pleistocene loess. Terrace deposits are similar in lithology to Holocene alluvium and vary regionally from 0 to 120 ft in thickness. Rural domestic wells are completed at shallow depths in these deposits along the Mississippi River and its main tributaries and yield several gallons per minute (Reference 15). Recharge to the terrace deposits is from underflow and downward seepage through overlying loess. (Reference 2)

Miocene Series

Aquifers of the Miocene series underlie the entire region. The Miocene series consists of three stratigraphic units: Pascagoula, Hattiesburg, and Catahoula Formations. The Pascagoula and Hattiesburg Formations are important as aquifers only in the extreme southeastern portion of the region. Permeable zones within the Catahoula Formation are the source of water for the majority of public and private wells in Claiborne, Copiah, and Jefferson Counties, and they supply several small wells in southern Hinds and Warren Counties. The depth to Miocene aquifers varies greatly over the region from near surface in the north to about 1100 ft in southern areas. The Catahoula Formation consists of lenticular deposits of sand, clayey silt, and sandy-silty clay, locally cemented. Sand layers are predominantly fine-grained and range in thickness from a few inches to more than 100 ft (Reference 15). The recharge area for the Catahoula lies to the north in Warren and Hinds Counties beneath the alluvial plain and loess bluffs. (Reference 2)

Groundwater level measurements from 1910 to 1996 for a well completed in the lower Catahoula formation in Port Gibson are presented in Table 2.3-13, and a hydrograph is presented in Figure 2.3-18.

In 1988 the EPA issued a final determination that the Southern Hills Regional Aquifer System was the sole or principal source of drinking water for 14 counties in southwest Mississippi (Figure 2.3-19), including Claiborne, Copiah, Hinds, Jefferson, and Warren Counties (Reference 17). The Pascagoula, Hattiesburg, and Catahoula formations are part of the Southern Hills Regional Aquifer System (Reference 18) Sole Source Aquifer.

Federal financially assisted projects which have the potential to contaminate the designated sole source aquifer are subject to EPA review. Federal financial assistance is defined as any financial benefits provided directly as aid to a project by a department, agency or instrumentality of the federal government in any form, including contracts, grants, and loan guarantee (Reference 19). The U.S. Department of Energy (DOE) is participating with U.S. power generating companies to conduct a regulatory demonstration project for Early Site Permit (ESP) applications to the Nuclear Regulatory Commission (NRC) in accordance with 10 CFR Part 52. The Secretary of Energy unveiled the Nuclear Power 2010 initiative aimed at building new nuclear power plants in the United States before the end of the decade. The President's National Energy Policy calls for the expansion of nuclear energy as part of the nation's energy policy as part of the means to achieve energy security in America while finding clean, affordable alternatives to carbon emitting power plants. Implementation of the Nuclear Power 2010 regulatory demonstration activities is an important first step toward achieving expanded use of nuclear energy. DOE has been working with the nuclear industry in an effort to identify the issues and barriers affecting future near-term deployment of new nuclear power plants. DOE has chosen a two-phase government/industry cost-shared project to demonstrate the ESP licensing process. Entergy is participating in this government/industry cost-shared project (DOE Agreement Number DE-FC07-02ID14413) and is, therefore, receiving federal funds in support of this ESP application process.

2.3.1.2.2 Plant Site Conditions

<u>Description of Aquifers and Recharge Sources</u>

Geologic and foundation exploratory borings indicate that the site is mantled by permeable Holocene and Pleistocene sediments. Holocene alluvial sand, clay, and gravel deposits are located *immediately under the floodplain or western portion of the site, with several feet of organic silty clay forming the surface over most of the area.* Alluvium thickness, as determined by borings, generally ranges from 95 to 182 ft. The greatest thickness of gravel generally occurs at the base of the alluvial deposits just above the Catahoula formation. (Reference 2) *In the area between the Mississippi River and Hamilton and Gin Lakes, alluvial sands and gravels extend to depths of about 100 feet below the surficial clay deposits.*

East of the lakes, the sand and gravel deposits become thinner and intermingle with silt and clay lenses. A clay lens (remnant of an ancient Mississippi River meander) lies beneath Hamilton and Gin Lakes. It extends downward to within 20 feet of the top of the Catahoula at some locations, thus limiting the thickness of the alluvial sands and gravels. Ground water within the floodplain alluvium occurs under unconfined conditions, with water levels generally within 5 to 20 feet of ground surface. The Mississippi River controls ground water levels in the floodplain to a large extent. Figure 2.3-20 shows boring and piezometer locations. Hydrogeologic cross sections of the floodplain area are shown on Figures 2.3-21 and 2.3-22.

The eastern upland area of the site is blanketed by 22 to 82 feet of Pleistocene loess. The loess deposits generally lie above the regional water table. However, saturated zones were encountered at a few locations just above the contact between the loess and the underlying terrace deposits. These are localized occurrences in areas where terrace clay lenses form impermeable surfaces on which downward migrating water accumulates.

The loess deposits are underlain by 0 to 151 feet of Pleistocene terrace deposits consisting of discontinuous lenses and layers of sand, gravel, silt, and clay. Ground water within the terrace deposits occurs under unconfined and perched conditions. Perched water tables were encountered at various depths in the areas indicated on Figure 2.3-22. *In the general vicinity of* *the station, the Catahoula forms a ridge-like feature which rises to about El. 90 feet msl. The top of this feature is about 20 feet above the regional water table elevation. At certain locations on this feature, it appears that recharge from precipitation percolates through the terrace deposits and accumulates on the relatively impermeable Catahoula surface before reaching the regional water table. At other locations, such as OW201 and OW208* (Figure 2.3-20), *perched water tables result where terrace clay lenses form impermeable basins in which downward migrating ground water collects.*

The Catahoula is continuous across the entire site and lies beneath the alluvium and terrace deposits, and, at a few locations, directly beneath the loess. It consists of lenticular beds of fine sand, silty clay and clayey silt, with occasional silt and fine sand seams, locally indurated. Ground water occurs in the sand strata in the upper portion of the formation. Water-bearing zones within the lower portion of the formation consist of thin, fine-grained sand layers (usually less than 10 feet thick) which are contained between thick clay or clayey silt layers.

Values of permeability (hydraulic conductivity), total and effective porosity, bulk density, storage coefficient, and dispersion and distribution (sorption) coefficients for the various deposits represented at the site are given in Tables 2.3-14 and 2.3-15. Table 2.3-16 provides information on hydraulic conductivities and transmissivities of terrace deposits.

In the floodplain alluvium, the primary source of recharge is infiltration of precipitation; however, the Mississippi River provides recharge during high river stages. It is unlikely that any appreciable recharge is derived from Hamilton and Gin Lakes due to a thick clay/silt layer beneath the lakes. *The primary source of recharge to the terrace deposits is via percolation through the overlying loess.* The Mississippi River recharges the terrace deposits locally during high water (Reference 2). *Water-bearing zones within the Catahoula receive recharge from percolation through overlying terrace or alluvium.*

<u>Ground Water Levels and Movement</u>

There are three levels of ground water in the site area: 1) the regional water table in the Mississippi River alluvium and adjacent terrace deposits,

2) perched water tables in the terrace deposits, and

3) the potentiometric level of the confined aquifer within the Catahoula Formation (Figure 2.3-22). Ground water levels measured in selected piezometers and observation wells (Tables 2.3-17 and 2.3-18) are presented by hydrographs in Figure 2.3-23 (5 sheets) for the period 1972 through mid 1979. Observation well and piezometer locations are shown on Figure 2.3-20. Hydrographs of the water levels of Hamilton and Gin Lakes and the Mississippi River for the corresponding period are shown in Figure 2.3-9. (Reference 2)

In the site area the regional ground water table slopes gently westward, with local gradients dipping toward the major tributary valleys. The gradient steepens toward Hamilton and Gin Lakes. West of the lakes, the ground water table slopes toward the river at a gradient that varies with the prevailing river stage (Figure 2.3-20). The regional ground water table within the site property ranges from about El. 60 to 80 ft msl during normal river elevations. The normal ground water gradient in the floodplain and the bluffs is temporarily reversed during flood stages of the Mississippi River. Figure 2.3-24 shows the configuration of the ground water table at the site during the spring flood of 1973. The ground water contours represent the highest ground water levels recorded at the site during the period January 1972 to May 1976. (Reference 2)

Perched water zones occur in the area indicated on Figure 2.3-20 that corresponds to the area underlain by a ridge-like feature formed by the Catahoula Formation. The perched water levels range from El. 90 to 130 ft msl in the site area. The highest perched water level (130 ft) was recorded at observation well OW-201, located near the eastern site property line. Observation wells OW-6, OW-6A, OW-6B, OW-6C, OW-115A, OW-115B, OW-116, and OW-118 were constructed in the perched water zone in the vicinity of the existing GGNS Unit 1 power block area. The highest perched water level recorded in these wells was El. 112 ft msl at OW-6A (Figure 2.3-23, sheets 4 and 5). The observation wells and piezometers in the existing GGNS Unit 1 power block area were destroyed during excavation. Additional observation wells were later installed to monitor the perched water levels during plant construction (Figure 2.3-25). Hydrographs of these wells (#1 through #8, Figure 2.3-25), for the period 1974-1975, are shown in Figure 2.3-26 (5 sheets). The highest perched water level recorded during this period was El. 113 ft msl at the [Unit 1] ultimate heat sink location. These wells were also destroyed as excavation and installation of the tie back wall … progressed. These wells were replaced with six new monitor wells (MW-1 through MW-6), which were installed in the sand backfill inside the tie back wall (Figure 2.3-25) in 1976. Hydrographs for the replacement observation wells are shown on Figure 2.3-27 for the period September 1976 through January 1979 …. Hydrographs are not shown for observation wells MW-1 and MW-2, because these wells are located inside the portion of the GGNS Unit 2 excavation that was not backfilled during the period of record. Water levels during the period were below El. 93.2 feet and El. 90.5 feet, respectively (Reference 20). Hydrographs of water levels in MW-1 through MW-7 for the period 1979 to 1991 were developed for a ground water study completed in 1992 (Reference 20 …). …. (Reference 2)

In 1986, five wells (MW-8 through MW-12) were installed to monitor water levels in the circulating water pipe trench (CWPT) backfill and in the terrace deposits east of the [existing GGNS Unit 1] power block. The wells were installed to determine the cause of elevated ground water levels in DW-8. In addition, a supplemental dewatering well (DW-8a) was installed in the terrace deposits in the vicinity of DW-8. The locations of these wells are shown on Figure 2.3-25. …. (Reference 2)

[Fourteen] additional monitoring wells (MW-13 through MW-26) were installed in the backfill and terrace deposits in the existing GGNS Unit 1 cooling tower area and in the northern portion of the site in 1990. However, in 2001, four monitoring wells, MW-16, MW-17, MW-19 and MW-20 were subsequently removed for the installation of the Auxiliary Cooling Tower. The wells were installed in conjunction with studies to better define sources of ground water recharge and ground water flow patterns across the site. The locations of these wells are shown on Figure 2.3-25. …. Hydrographs of water levels in these wells were developed for a ground water study completed in 1992 (Reference 20 …). (Reference 2)

An assessment of the hydrographs shows that ground water levels within the existing GGNS Unit 1 power block and cooling tower areas at GGNS are at elevations greater than the surrounding regional levels. Ground water levels are generally between El. 100 and 105 feet in the northern portion of the area and between El. 105 feet and 110 feet in the southern portion of the existing GGNS Unit 1 power block. The elevated ground water levels roughly coincide with locations where the top of the Catahoula is above 70 ft. in elevation and follow the northwest trend of the Catahoula "ridge". The top of the Catahoula Formation exceeds 70 feet in elevation throughout most of the existing GGNS Unit 1 power block area and exceeds 100 feet between the power block and the cooling tower. This rise in elevation obstructs the regional ground water flow causing the ground water flow to diverge north and south of the site area. (Reference 2)

The top of the Catahoula formation is at a lower elevation in the proposed area for the power block of a new facility, and ranges between 50 feet elevation above msl on the eastern side of the area to 20 feet elevation below msl on the western side of the area. Therefore, the ground water levels are expected to be generally lower in the area of the new facility in comparison to those measured in the area of GGNS Unit 1 power block and cooling tower. A hydrogeologic cross section which indicates the approximate east and west boundaries of the proposed construction area for the power block of the new facility is shown on Figure 2.3-22.

The water levels shown on the hydrographs have also been influenced by operation of the dewatering wells during much of the period from their installation in 1979 and 1980 through 1991. The pumping masked the determination of the source and effects of recharge. Before March 1990, the pumping rates of these wells are not recorded, and, therefore, the degree to which they affected water levels could not be determined. However, for selected periods when the pumps were not in operation, and for the period after March 1990 when pumping rates for the dewatering wells were known, the hydrographs provided data that could be used to assess and predict long term ground water level patterns. (Reference 2)

The water levels in observation wells and piezometers constructed within the Catahoula Formation range from about El. 55 to 80 ft msl during normal river elevations. The highest water level recorded in observation wells or piezometers in the Catahoula during the period 1972 through 1979 was El. 113 ft msl at P-117A; however, the hydrograph of P-117A (Figure 2.4-23, Sheet 5) indicates that the piezometer was not functioning properly. Therefore, the El. 113 ft msl water level does not represent actual ground water conditions. Water levels higher than the overall regional water level and considerable water level variation during the period 1984 through 1991 have been experienced within the Catahoula Formation at OW-10, one of three regional monitoring wells open to the Catahoula Formation (Table 2.3-19). Water levels as high as El. 154.5 ft have been measured in this well. The cause of the fluctuation in water levels is generally attributable to damaged casing, damage to the surface seal, or ponding of water outside the casing (Reference 22). Water levels have gradually returned to typical regional water levels within a period of several months after repairs to the well casing or improvements in surface drainage were made. Similar fluctuations have not occurred in the other two monitoring wells used to measure water levels in the Catahoula Formation. (Reference 2)

The ground water levels in the site area are slightly modified as a result of the effects of radial collector well field pumpage, topographic modifications, relocation of surface drainage systems, and structure installation. A ground water contour map of the site area indicating expected average ground water conditions during the operating life of the existing GGNS Unit 1 plant is provided in Figure 2.3-28. (Reference 2) The contour map shows that average water levels are between El. 105 and 110 ft immediately south of the existing GGNS Unit 1 power block and between El. 100 and 105 ft in the northern portion of the existing GGNS Unit 1 plant area. Water levels are higher east of the cooling tower due to the low permeability of the geologic materials in that area.

Table 2.3-20 provides a summary of water levels in DW-7, DW-8, MW-12, and MW-13 based on monthly measurements from 1996 to 2001 (Reference 23). These wells are located in the Terrace deposits around the existing GGNS Unit 1 power block. The water levels in the dewatering wells are not completely representative due to effects of pumping that tend to have a localized effect of lowering the groundwater level.

2.3.2 Water Use

2.3.2.1 Surface Water

Area Use

According to information on water use for 1995 (Reference 24), total surface water withdrawals in Claiborne County were 0.47 million gallons per day (MGD), broken down as follows:

Quantity (MGD)	Usage
0.35	Irrigation
0.12	Livestock

No surface water usage in Claiborne County was reported for public supply, domestic self-supplied systems, mining, hydroelectric power, thermoelectric power, industrial or commercial uses. Detailed data pertaining to surface water use in Claiborne County and in adjacent Mississippi counties are presented in Tables 2.3-21a through 2.3-21i (Reference 24).

The nearest downstream user of Mississippi River water is Southeast Wood Fiber located at the Claiborne County Port facility, approximately 0.8 miles downstream of the Grand Gulf site. The maximum intake requirement for this facility is estimated to be less than 0.9 MGD for industrial purposes; however, none of this intake is used as potable water (Reference 25). There are only three public water supply systems in the state of Mississippi that use surface water as a source, and none of these are located within 50 miles of the GGNS site (Reference 26). There are no downstream or upstream intakes within 100 miles of the GGNS site that use the Mississippi River as a potable water supply (References 25 and 27). Tables 2.3-22 and 2.3-23 identify the nearby surface water users of the Mississippi River and the maximum rate of withdrawal from the Mississippi River. Since users on the Louisiana side of the river are outside the region of interest for the GGNS ESP Site evaluation (i.e., greater than 50 miles), maximum withdrawal rates for these users are not provided in Table 2.3-23.

The Corps of Engineers maintains a 9-foot depth at low water on the Mississippi River for navigational uses. The primary navigational use of the river is for freight shipments, with 204,321,000 short tons of freight traffic in 2000 for the section of the river between the mouth of the Ohio River to Baton Rouge (Reference 28). The Delta Queen Steamboat Company operates three paddle wheel tour boats on the Mississippi River, the Delta Queen, the Mississippi Queen and the American Queen. These three tour boats are scheduled to pass the GGNS site a minimum of 26 times during the 2003 season (Reference 29).

There is limited commercial fishing in the area, with most occurring on the Mississippi River, the Big Black River, and the Bayou Pierre River. Catfish is the most abundant catch. There are approximately twelve commercial fisherman who currently fish in the area (Reference 30).

Most sport fishing occurs in the months of April through September, with Saturday being the busiest day of the week. As many as 200-250 fishermen may be in the vicinity on weekends from April through September. The number of fishermen may drop to less than 150 on weekdays and depending on weather conditions (Reference 30).

Plant Use

Makeup to the normal heat sink cooling towers, balance of plant cooling systems (e.g., plant service water), and other raw water makeup needs for a new facility would be supplied by an intake structure located on the east bank of the Mississippi River at the location of the existing barge slip. The intake structure would include intake screens, pumps, etc., to convey the river water to a system of clarifiers or other type cleanup equipment before its use in the facility.

Normal makeup flow rate to the new facility would be approximately 50,320 gpm, and maximum expected makeup flow is approximately 85,000 gpm. Figure 2.3.29 is a water use diagram that illustrates specific uses of this makeup water, and amounts required. Using the most conservative minimum flow value at Vicksburg of 93,800 cfs (Section 2.3.1.1.4), the facility withdrawal would be about 0.2% of the minimum flow. Intake and embayment final design will consider the influence of sedimentation and littoral drift on the ability to provide the necessary makeup water.

The normal heat sink circulating water system for the new facility will be a closed-cycle type system using either hyperbolic natural draft cooling towers or mechanical draft cooling towers. Circulating water system flow through the cooling towers, on a per unit basis, is estimated at 865,000 gpm (Table 3.0-1).

Effluent from a new facility would be combined with that from the existing GGNS Unit 1 facility, and would be discharged into the river downstream of the intake such that recirculation to the embayment area and intake pipes would be precluded. Dilution and distribution of the discharge heat as well as other effluent constituents are affected by both the design of the discharge structure and the flow characteristics of the receiving water. Detailed design of the discharge structure would include appropriate consideration of the river conditions at the location of the discharge.

The Corps of Engineers and the State of Mississippi do not currently restrict the quantity of water that can be withdrawn from the Mississippi River. The Mississippi Department of Environmental Quality issues permits for surface water withdrawals that are effective for 10 years. The permit may then be renewed for an additional 10 years (Reference 25).

The new facility owner would be required to coordinate with the Corps of Engineers and obtain permits from appropriate regulatory agencies for construction of the embayment and intake structure when the final design of the embayment and intake structure and its exact location are defined. The design and placement of the embayment and intake structure will be in accordance with the Corps of Engineers guidance, MDEQ and EPA requirements, and good engineering practice.

Emergency cooling water for a new facility would be provided from separate enclosed cooling system(s) which utilize basins with mechanical draft cooling towers, and which would not be reliant on the source of water from the river intake, with the possible exception of normal (non-emergency operation) makeup water supply. Therefore, low river water conditions would not impact the ability of the emergency cooling water systems and the ultimate heat sink to provide the required cooling for normal operations, anticipated operational occurrences and emergency conditions.

The final location for the embayment and intake structure would be chosen such that there would be inconsequential interference, if any, with the pumping ability of the surrounding existing GGNS Unit 1 radial wells. The existing GGNS Unit 1 radial well No. 5 is located about 250 ft. to the south of the existing barge slip and has one lateral line which extends directly beneath the barge slip inlet area. This lateral line is located at a depth of about (-) 40 ft. msl, which is well below the depth of excavation which would be required for a river intake (estimated at about 10 ft. msl).

2.3.2.2 Ground Water

Area Use

According to information on water use for 1995 (Reference 24), total groundwater withdrawals in Claiborne County were 33.9 MGD, broken down as follows:

Quantity (MGD)	Usage
1.25	Public Supply
0.23	Domestic (Self-Supplied)
0.12	Irrigation
0.08	Livestock
32.05	Thermoelectric Power (GGNS)
0.17	Commercial

No groundwater usage was reported in Claiborne County for mining, hydroelectric power, or industrial uses. Detailed data pertaining to groundwater use in Claiborne County and in surrounding counties for 1995 are presented in Tables 2.3-21a through 2.3-21i.

Public water supply wells in Claiborne County (excluding GGNS) are supplied by the Catahoula formation with well depths ranging from 166 to 960 feet (Reference 32). Table 2.3-24 provides information on public and industrial wells in Claiborne and surrounding counties (Reference 33). Nine active public water supply systems were located in Claiborne County as of May 2002, not including GGNS (Reference 34). The closest area of concentrated ground water withdrawal is the Port Gibson municipal water system about five miles southeast of the site. Pumpage for Port Gibson is provided by five wells completed in the Catahoula Formation and withdrawals average 0.85 MGD (Reference 35). The Port Gibson municipal system is the largest in the county, serving a population of 4,845, and details of the Port Gibson wells are provided in Table 2.3-25.

Aside from GGNS, the primary use of ground water in Claiborne County is for public supply purposes with a small percentage used for domestic water, irrigation, and livestock. Within a two-mile radius of the plant site, essentially all ground water is used for domestic purposes. Therefore, aside from plant use, future ground water demands in the vicinity of the site may be estimated on the basis of projected population growth.

According to the population projections (SSAR 2.1.3), the population within a two-mile radius of the plant is projected to be 58 people by the year 2070 (excluding GGNS plant personnel). Based on published USGS sources (Reference 36), users of self-supplied water systems typically use 45 gpd. If the entire projected population utilizes groundwater as a source, the estimated groundwater withdrawal within a two-mile radius of the plant by the year 2070 will be 2,610 gpd. Table 2.3-26 provides a listing of water wells within a four-mile radius of GGNS (Reference 33).

Plant Use

Plant service water for the existing GGNS Unit 1 plant is supplied from radial collector wells located in the floodplain that parallels the Mississippi River. The collector wells are designed to derive water from the Mississippi River via induced infiltration. (Reference 2)

Three wells completed within the Catahoula formation are currently used to supply water for general site purposes including potable, sanitary, air conditioning and landscape maintenance. Two of the wells are in routine use and have electric pumps, and the third well is a backup well with a diesel pump. The backup well (north construction well) was installed in 1976 to supply water for construction purposes, and the remaining two wells (north drinking water well and south drinking water well) were installed in 1995 and 1996 to replace a well that had become inoperable. During GGNS Unit 1 refueling outages, the two wells operate at near full capacity. Therefore, these existing wells would not have adequate production to supply the water needs for a new facility.

GGNS Unit 1 currently submits an Annual Water Use Survey to the Mississippi Department of Environmental Quality (MDEQ). According to the most recent data available for the 2001 calendar year (Reference 37), the facility currently has 18 water wells with a total of 1.13E+10 gallons pumped in 2001. This total includes the four radial collector wells rated at 21,332 gpm; three wells used for general site purposes rated at 513, 535, and 577 gpm; and dewatering wells.

Makeup (cooling tower makeup and other raw water needs) for a new facility would be supplied from the Mississippi River via an intake located on the east bank of the river and on the north side of the existing barge slip. Groundwater may be utilized for other general plant purposes including potable, sanitary, fire protection, air conditioning, and landscape maintenance. The expected average consumption of groundwater for these uses (for a new facility) is approximately 1,310 gpm (Table 3.0-1). The expected maximum consumption of groundwater for these uses is approximately 3,570 gpm (Table 3.0-1). The installation of additional wells in the Catahoula formation for these purposes would be necessary.

Construction activities for the existing GGNS facilities required approximately 500,000 gpd (gallons per day), or 350 gpm of water, for concrete batch plant operation, dust suppression, and sanitary needs (Reference 2).

It is anticipated that construction of a new facility would require a similar quantity of water. The recommended planning number for tapwater consumption for workers in hot climates is 3 gpd for each worker (Reference 38). Based on the maximum construction worker population of 3,150 people indicated in Table 3.0-1, the tapwater consumption is estimated at 9,450 gpd. The installation of an additional well may be required for construction purposes. A state permit will be required for the groundwater well installation(s).

2.3.3 Water Quality

Ground water and surface water samples were collected in 1972 as part of the initial assessment for the existing GGNS Unit 1 plant for chemical analyses to evaluate the chemical character of local water resources (References 8 and 39). Ground water samples were obtained from test and observation wells on site and from selected private wells within the limits of the well survey. Surface water samples were taken from the Mississippi River and Bayou Pierre. (Reference 2)

Recent sampling data was obtained from published sources and from results of ongoing monitoring programs at GGNS and is discussed below.

2.3.3.1 Surface Water

Results of chemical analyses of 1972 surface water samples and a description of the sampling locations are presented in Table 2.3-31. (Reference 2) The surface water samples are low in dissolved solids and less mineralized than ground water sampled in the site locality.

Surface water quality data for the Mississippi River was also obtained from USGS sampling points near GGNS. The USGS data includes information for Vicksburg dating from 1961 to 1999, for river mile 390 in 1976, for river mile 405 in 1980, and for river mile 402 in 1996. This surface water sampling data is provided in Tables 2.3-27, 2.3-28, 2.3-29, and 2.3-30.

The 1998 Section 303(d) list of impaired waterbodies for Mississippi was reviewed (Reference 40) for locations within Claiborne County. No impaired waterbodies were listed in Claiborne County.

GGNS is required to conduct surface water sampling in accordance with water pollution control permit number MS0029521, Reference 41. Figure 2.3-12 shows the outfall sampling locations, and Table 2.3-10 provides recent sampling data.

Outfall 1 discharges into the Mississippi River via the GGNS Unit 1 discharge basin. For 2000-2001, the daily maximum temperature (measured continuously) at this outfall occurred in July 2000. Monthly average water temperatures were lowest in the winter months (December 2001 and December 2000), and were highest in the summer months (July 2001 and August 2000).

Outfall 13 includes effluent from sediment Basin A that enters an unnamed tributary thence into Hamilton Lake. The flow rate, pH, and total suspended solids (TSS) are measured quarterly, and for 1999-2001 the maximum flow measured was 4.400 MDG. The average flow ranged from 0.218 MGD in 1999 to 2.135 MGD in 2001. The minimum pH measured during this period was 7.07, and the maximum was 8.45. The maximum TSS concentration was 97.00 parts per million (ppm).

Outfall 14 includes effluent from sediment Basin B that enters an unnamed tributary thence into Hamilton Lake. The flow rate, pH, and total suspended solids (TSS) are measured quarterly, and for 1999-2001 the maximum flow measured was 0.450 MGD. The average flow ranged from 0.190 MGD in 1999 to 0.315 in 2000. The minimum pH measured during this period was 7.79, and the maximum was 8.77. The maximum TSS concentration was 26.00 ppm.

Other outfalls are located on the site, but these outfalls ultimately feed into the outfalls and streams included in the above discussion.

2.3.3.2 Ground Water

Results of chemical analyses of groundwater samples and a description of the sampling locations are presented in Table 2.3-31.

Chemical analyses of samples taken from the Mississippi River alluvial aquifer indicate the water is a sodium-calcium bicarbonate type, high in total dissolved solids (358 to 604 ppm). Samples of ground water from the terrace deposits are a calcium-magnesium bicarbonate type with a total dissolved solids (TDS) *content of 277 to 442 ppm. The total dissolved solids concentration of a water sample from the Catahoula Formation is 460 ppm. ....*

Additional USGS well sampling data for wells in the Catahoula Formation in Claiborne County and the Mississippi River alluvial aquifer in Claiborne County and Warren County are presented in Table 2.3-32.

Water quality sampling was conducted for the Mississippi River and for the radial wells completed in the alluvial aquifer in 1988, as summarized in Table 2.3-33. This data indicates that water quality in the alluvial aquifer had not changed significantly since the initial sampling was conducted in 1972. In 1972, TDS ranged from 358 to 604 ppm, and in 1988 TDS ranged from 461.9 to 557.9 ppm. In 1972, the pH ranged from 7.3 to 8.0, and in 1988 the pH ranged from 7.04 to 7.24.

Three groundwater wells completed in the Catahoula Formation are currently used to supply water for general site purposes including potable, sanitary, air conditioning, and landscape maintenance. Two wells are used on a routine basis and the third well is used as a backup. A fourth well was plugged due to silting problems. These wells are located on the western boundary of the bluffs area near the Energy Services Center (ESC) building (Figure 2.1-1), and pre-treatment sampling is conducted on a routine basis. Recent water quality sample data for these wells is included in Table 2.3-34. This data indicates that water quality in the Catahoula aquifer had not changed significantly since the initial sampling was conducted in 1972. In 1972, TDS was 460.0 ppm, and in recent sampling TDS ranged from 420.0 to 435.0 ppm. In 1972 the pH was 8.3, and in recent sampling pH ranged from 7.1 to 8.2.

2.3.4 References

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2.4 Ecology

The primary reference for this section is the GGNS Final Environmental Report (FER) issued by Mississippi Power and Light in 1973 (Reference 1). The FER summarizes ecological field data collected at the site from June 1972 to August 1973 prior to construction of Unit 1.

Reconnaissance visits to the site were made during the weeks of August 19-24 and October 29-November 1, 2002. The purpose of these visits was two-fold: (1) to describe wetlands and other "waters of the United States" within the GGNS site, and (2) to qualitatively assess the ecological resources on the GGNS site for comparison with the characterizations presented in the FER, to assist in determining if the ecological conditions had significantly changed during the intervening years since the GGNS Unit 1 FER surveys were done. Some general observations were also made during the site visits regarding the types of animals present on the site. The conclusion from these qualitative assessments is that the descriptions in the FER adequately describe the condition at the GGNS site, for the purposes of this ESP application. It was evident that there was little additional development on the site in previously undisturbed areas, and that the vast majority of the site has been left undisturbed in the intervening years (Figure 2.4-2).

Figure 2.4-1 is an aerial photograph of the GGNS site and vicinity taken in 1971, prior to construction of Unit 1. For comparison, Figure 2.4-2 is an aerial photograph taken in 2001. It shows Unit 1 and the proposed construction areas for a new facility. It is interesting to note that the main channel of the Mississippi River on the north side of the barge slip has moved to the east in the intervening 30 years as evidenced by the property line extending into the river. The United States Army Corps of Engineers (USACE) has stabilized the banks of the river with the construction of revetments, so further erosion of the eastern bank is not anticipated (Section 2.3.1.1.1).

Wetlands and other waters of the U.S. fall within the jurisdictional control of the USACE, which regulates any activity resulting in discharge and fill to such waters. Wetlands, as defined by the U.S. Fish and Wildlife Service Wetland Delineation Manual (Reference 2), are areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

Waters of the U.S. are broadly defined as waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including: waters which are subject to the ebb and flow of the tide; the territorial sea; interstate waters and wetlands; all other waters (such as intrastate lakes, rivers, streams and wetlands), if their use, degradation or destruction could affect intrastate or foreign commerce; tributaries to waters or wetlands identified above; and wetlands adjacent to waters identified above.

There was no new quantitative field data collected during the reconnaissance visits to the GGNS site. In this Environmental Report, current features of the GGNS site are described where recent observations differ from or contribute new information to the descriptions in the FER. Therefore, detailed species lists and other discussions that simply reiterate the FER are not presented here. The focus is instead on the overall quality of habitats on the GGNS site and on changes that may have occurred within them since the earlier study.

2.4.1 Terrestrial Ecology

GGNS is located in a rural area of southwestern Mississippi along the east bank of the Mississippi River. The GGNS site is roughly bisected by a north-south trending line of bluffs located parallel to and about 1.1 miles east of the river at the north end of the site and about 2.4 miles east of the river at the south end of the site. Because of the bluffs, terrain at the GGNS site varies from seasonally inundated bottomlands west of the bluff line along the river, to uplands atop the bluffs. About one-half of the total acreage at GGNS is bottomland, including forested, shrub, and emergent marsh wetlands. The other half of the site supports upland habitat types in areas not cleared during construction of Unit 1.

Seven vegetation types were identified on the site in the FER, in addition to aquatic habitats such as lakes, ponds, streams, and the Mississippi River. These vegetation types are (1) (upland) oak-American elm bluff deciduous forest, (2) (upland) oak-sweetgum bluff deciduous forest, (3) bottomland sugarberry-green ash deciduous forest, (4) non-forested bottomland, (5) (bottomland) swamp privet-black willow shrub swamp, (6) (upland) bluff fields, and (7) bottomland fields.

The first two of these plant communities are distinguished from each other by minor differences in species composition. These differences are unimportant when describing the habitat value of the forest stands. Accordingly, they are combined in this report as upland forest.

The FER distinguished between non-forested bottomland at GGNS and bottomland fields. Thus, the non-forested bottomland was presumably marsh. No open marsh along the bank of the Mississippi River was observed during the 2002 reconnaissance visits. However, emergent marsh occurs along the shoreline at the south and north ends of Hamilton Lake and the south end of Gin Lake (Section 2.4.1.1.2.1).

Other recent observations suggest that the vegetation types present on the site in the early 1970s are also the types generally present today. Although no quantitative studies were performed, the spatial distribution of some vegetation types has either expanded or contracted, depending on the area. For example, cleared fields in both upland (presumably grazing land) and bottomland (presumably crop land) areas on site in the 1970s are now developing into the early stages of forest through secondary plant succession. Secondary succession describes the natural process whereby land once cleared by man for pasture or cropland (or other forces such as wildfire or storm) slowly regenerates into forest based on seeds carried to the area from elsewhere. In most cases, forest succession is relatively orderly and, therefore, predictable. In the case at GGNS, upland fields appear to be succeeding into loblolly pine stands while an abandoned field in the bottomland now supports a dense, monotypic growth of sycamore saplings.

A remnant stand of upland mixed pine-hardwoods was observed in an area adjacent to the eastern end of the plant site and north of the existing electrical switchyard (Figure 2.4-3). The FER did not discuss this vegetation community; however, its apparent age suggests that it was present during the original forest sampling program. This further suggests that the mixed pine-hardwood community was then, like now, very limited in extent at GGNS.

2.4.1.1 Terrestrial Habitats

Onsite terrestrial habitats now, as in the 1970s, can, in general, be classified as upland and bottomland forest, upland and bottomland clearings (now succeeding into forest), and upland and bottomland wetlands. The current distribution of terrestrial habitat types is shown in Figure 2.4-3.

Also shown on Figure 2.4-3 are areas cleared of vegetation during construction of Unit 1. In addition to the site of the Unit 1 power reactor and its support buildings, parking lots, lay-down areas, and other structures. Cleared areas on site include a Heavy Haul Road, a two lane, hardsurface roadway built to connect the plant site to the barge slip on the river. Construction materials delivered by barge were transported along this road to the plant site.

Also cleared were the sites of five radial wells along the Mississippi River bank that supply cooling water to the existing plant. They are connected to Heavy Haul Road by an unimproved roadway. Other unimproved roads link Hamilton and Gin Lakes and provide access to the lakes for recreational fishermen. Also cleared were areas for a borrow pit, served by another unimproved road, now largely overgrown, and a firing range used by plant security personnel. As illustrated in Figure 2.4-3, most of the cleared area at GGNS is in the upland portion of the site.

During 1972 and 1973, as reported in the FER, at least 420 species of vascular plants representing 285 genera and 105 families were observed on the GGNS site. There were sixty-four species of trees, all except three species being deciduous. The species composition of understory vegetation growing on the site varied seasonally with the largest number of plants occurring during the summer. Two forest types were identified on the site during the preconstruction investigation: bottomland deciduous hardwood (palustrine, forested, seasonally flooded wetland), including Grand Gulf Island forest, and loessial bluff deciduous hardwood. Swamp privet was the only dominant tree species that was not commercially valuable in the bottomland deciduous hardwood forest, while all dominant species in the loessial bluff deciduous hardwood forest were commercially valuable. Plants that were commonly found in the forests on GGNS are listed in Table 2.4-1.

Subjective evaluation of wildlife habitat is based on the assumptions that (a) vegetation structure including species composition and physiognomy (the outward appearance of the stand) is sufficient to define its suitability for wildlife, (b) a positive relationship exists between vegetation diversity and wildlife species diversity, and (c) vegetation species composition and primary productivity directly influence wildlife population density.

When compared to other vegetation types, hardwood forests usually demonstrate especially diverse species composition. Generally, as these stands increase in age, they also develop a vertical herb, forb, shrub, mid-story and canopy structure. Diverse species composition and well-developed vertical structure provide numerous ecological “niches” that are occupied by especially diverse wildlife populations. Bottomland hardwoods are also highly productive in part because of annual inundation by flood water that continually replenishes soil nutrients.

Species and structural diversity of a hardwood forest is of special importance to satisfying the ecological requirements of numerous bird species. Additionally, such stands provide migration corridors and stop-over habitat for neo-tropical and short-distance migrants. Likewise, they provide travel corridors for mammals and habitat for other resident ground-level dwellers.

Of special significance in hardwood habitats is production of beechnuts, acorns, and other similar food-stuffs, collectively termed "mast". Mast is eaten by a variety of wildlife species. And, as they age, hardwoods also develop numerous cavities of varying size, as was observed at GGNS, that are important as dens or roosts.

Field data on mammals were gathered in 1973 by direct field observations, hunter bag check trapping, nightlight counts and tallying road kills. Table 2.4-2 presents the common species of mammals encountered during the 1972-73 survey. The whitetail deer was the largest mammal occurring on the GGNS site during the 1972-73 survey. Field observations indicated that deer were numerous on the site.

White-tailed deer were hunted on the site during the 1972-1973 hunting season according to the FER. Public access for hunting was not permitted during construction. Hunting was resumed after construction but was again curtailed after September 11, 2001. GGNS facility employees, members of the GGNS bow hunting club, are allowed to hunt on the site property using only archery equipment. During the October 2002 reconnaissance visit to the GGNS site two areas were observed in which disking and seeding with grass appeared to have occurred fairly recently. One was in a natural clearing in a bottomland stand east of Radial Water Well No. 1. The other was in a former bottomland field northwest of the plant site near Gin Lake. In both cases, the treated acreage was small relative to the overall size of the property. Both were probably created to attract deer to the area for harvest. There are private hunt clubs located immediately adjacent to GGNS.

Numerous signs, predominantly tracks, indicate the continuing presence of a substantial deer population in both upland and bottomland forests. Indications of relatively recent use of the bottomlands and onsite streams by beaver were also observed. Present in both upland and bottomland were numerous tracks of raccoon, skunk, and other unidentified small mammals. Wild turkey tracks occurred in uplands. Bottomlands are used by hogs. Whether these are feral domestic hogs or javalena is unknown. Thus, both bottomland and upland habitats at GGNS evidently support a relatively diverse and abundant wildlife population now as they did in the 1970s.

Field observations using several different systematic methods were employed to inventory birds on the site during the 1972-1973 censuses. With the exception of two species, the white ibis and Louisiana heron, all bird species observed on or near the site were regular inhabitants in the area (Reference 3). Common bird species observed seasonally in both the loessial bluff and bottomland forest communities are identified in Table 2.4-3. Bird species seasonally occurring within 50 feet of the edge of a field were considered to inhabit the field-forest ecotone and are also presented in Table 2.4-3

Water-dependent bird species observed in 1973 on Hamilton and/or Gin Lakes are presented in Table 2.4-4. Of these species, only the wood duck, great blue heron, and belted kingfisher were permanent residents. With the exception of the American coot and the pied-billed grebe, the remaining species of water birds were primarily summer residents. The American coot and the pied-billed grebe occurred in the area only during the fall, winter, and early spring. Utilization of the lakes by water-dependent species was seasonal. During the summer and early fall of 1972 and late spring of 1973, fewer than ten individuals of any single species were concurrently observed on the lakes (Reference 1).

Table 2.4-5 identifies the vultures, hawks, falcons, and owls observed on or near the GGNS site in 1973. This table includes upland game birds. Black and turkey vultures were permanent residents on the site. The red-tailed hawk and red-shouldered hawk were permanent residents on the site; the broad-winged hawk was resident on the site only during the summer; and the marsh hawk, American kestrel and sharp-shinned hawk occurred on the site only during migration. With the exception of the marsh hawk (an inhabitant of grasslands and marshes), woodlands and wooded margins were the preferred habitat for the hawks observed. The Mississippi kite was abundant in the Grand Gulf area and was observed on the site from April until September. The largest breeding populations of the Mississippi kite in the United States occurred along the Lower Mississippi River valley; the kite nests in tall trees, particularly cottonwood, growing along stream bottoms. All of the owl species were observed on or near the site during the preconstruction study period, and all were permanent residents in this section of Mississippi (Reference 3). The permanent residents of upland game birds that occurred on site were the mourning dove, bobwhite, and wild turkey. The mourning dove was also the most abundant of the upland game species. Although the Grand Gulf site contained suitable wild turkey habitat (hardwood forest), only two wild turkeys were observed on the site.

The numerous mid-level and canopy-dwelling bird species observed during the 2002 reconnaissance visits were consistent with those reported in the FER. None were unusual or unexpected, although numerous Rock dove (*Columbia livia*), also known as the domestic or feral pigeon were observed. This species was not reported in the FER. Rock dove is an introduced species and is attracted to man-made structures of all sorts. They were observed perched atop and flying near the emergency service water reservoirs at GGNS where they probably nest.

2.4.1.1.1 Bottomlands

Bottomland hardwood forests like those at GGNS may also be characterized as palustrine, forested, seasonally flooded wetlands. This habitat type covers approximately 885 acres, or most of the GGNS site bottomland between the Mississippi River and the bluff line. It surrounds the borrow pit north of the barge slip and extends throughout the area along both sides of Heavy Haul Road, except where the roadsides are mowed and maintained. As with other wetland types on site, the habitat characteristics of bottomland hardwood areas fluctuate seasonally as levels of inundation vary.

In the case of bottomland forest at GGNS (as with old bottomland stands elsewhere), the ground-level herb, forb, and shrub layer is typically sparse due to the closed canopy. Canopy closure prevents sunlight from penetrating to the forest floor. Additionally, annual inundation by Mississippi River floodwater in spring, and at other times during the year, retards growth of ground-level vegetation.

Typically, openings created by storms, natural tree-fall, logging, and/or cultivation eliminate or thin the canopy and allow penetration of sunlight. Sunlight promotes the growth of sedges, grasses, and other ground-level vegetation like Panicum (*Panicum spp.*), Lizard’s tail (*Saururus cernuus*) and Trumpet creeper that were observed there.

Openings also allow development of an ecotone (or edge) between the clearing and the forest. Ecotones are usually inhabited by species not necessarily resident in either the clearing or the forest. This increases the overall biodiversity of the site. The FER stated that large fields and other forest openings occupied about 10% of the bottomland area in the 1970s. Due to canopy closure and secondary succession, openings now probably constitute a lower percentage of the bottomland at GGNS than they did earlier.

Like other hydric soils, bottomland soil at GGNS is a complex of Bowdre silty clay, Tunica silty clay loam, and Crevasse fine sandy loam (Soil Survey of Claiborne County, Mississippi, 1963). These areas were moist at the time of the 2002 reconnaissance visits. The soil texture was silty clay or silty clay loam.

2.4.1.1.2 Other Wetlands

Cowardin et al. (Reference 2) describe wetlands by system, class, and subclass. The fresh water systems are riverine, lacustrine, and palustrine. The riverine and lacustrine systems encompass freshwater lakes and streams. The palustrine system includes nontidal wetlands dominated by trees, shrubs, or emergent vegetation. Lacustrine systems are situated in topographic depressions or dammed river channels. They exceed 20 acres in size and lack 30% aerial coverage of emergent vegetation.

The palustrine system includes five vegetated classes considered wetlands: (1) aquatic bed, (2) moss-lichen, (3) emergent (dominated by plants that rise above the surface of the water), (4) scrub-shrub (dominated by sapling trees and shrubs), and (5) forested.

Water regime modifiers include temporarily flooded, saturated, seasonally flooded, semi-permanently flooded and permanently flooded. This method of describing wetlands was not used in the 1970s when the FER was prepared. However, it has since become widely used and recognized as authoritative.

2.4.1.1.2.1 Emergent Wetlands

Palustrine, emergent, seasonally flooded wetlands are located near the periphery of both Gin Lake and Hamilton Lakes (Figure 2.4-3). These wetlands are limited in aerial extent and dominated by grasses and sedges (*Panicum rigidulum and Carex spp.)*. The level of inundation varies seasonally and from year to year, hence its subclassification as seasonally flooded.

Soils in these areas are a complex of Bowdre silty clay, Tunica silty clay loam, and Crevasse fine sandy loam (Reference 4). Both Bowdre and Tunica series soils appear on the hydric soils list for Claiborne County. These areas were completely saturated at the time of the August, 2002 reconnaissance.

The bottomland areas at GGNS, including the emergent wetlands are flooded annually in the spring and, unpredictably, at other times when storms cause flooding in the lower Mississippi River basin. Watermarks on trees in the adjacent forest vary from 10-20 feet in height.

In August 2002, emergent wetlands along the shorelines occupied approximately 30 acres (Figure 2.4-3).

2.4.1.1.2.2 Scrub-Shrub Wetlands

A wetland identified as palustrine, seasonally flooded scrub-shrub developed relatively recently on a former bottomland field east of Gin Lake (Figure 2.4-3), probably cultivated in the past for forage. The 1971 aerial photograph (Figure 2.4-1) show this field to be free of woody vegetation. American sycamore (*Platanus occidentalis*) seedlings now dominate this approximate 70 acre area. The sycamores are probably less than ten years old and are uniformly about twenty feet in height. In November 2002, the perimeter of this area was found to have been recently cultivated to enhance deer habitat or to attract deer to the area for harvest. In recent years, farming at GGNS has ceased and formerly cleared sites are undergoing secondary succession. Woody vines such as southern dewberry (*Rubus trivialis*), and tall grasses, including Broomsedge bluestem (*Andropogon virginicus*), now also occupy these sites.

Soils in this area are commerce silt loam (Reference 4). Commerce soils are hydric and typically found on natural levees of the Mississippi River. At the time of the 2002 investigation, the soils were completely saturated with standing water in places.

Other scrub-shrub wetlands identified on the GGNS site are dominated by Black willow and Swamp privet and were documented in the FER. These wetlands occur on the north, northwest, and south ends of Gin Lake and on the west bank of Hamilton Lake. Willow now makes up a larger component of the shrub layer than does Swamp privet. Little herbaceous understory occurs on these sites, probably because of recurrent flooding in the spring. Button bush (*Cephalanthus occidentalis*) also occurred near the south end of Gin Lake. Shrub wetlands, dominated by the willow-privet plant community, encompass approximately 10 acres at the GGNS site. This acreage is less than the amount described in the FER, probably due to succession of some of the shoreline area into bottomland forest.

Soils in these areas are a complex of hydric Bowdre silty clay, tunica silty clay loam, and crevasse fine sandy loam (Reference 4) as discussed above. These areas were moist to completely saturated at the time of the 2002 investigation.

2.4.1.1.3 Uplands

Like bottomlands forest areas, upland forest habitats on the site suffer from canopy closure restricting growth of understory vegetation. Unlike bottomland forests, upland stands are not usually inundated for prolonged periods so flooding is less a limiting factor on growth of the herb and forb layer than is canopy closure. Accordingly, upland hardwoods at GGNS exhibit a more diverse plant community than bottomlands, both in structure and species composition.

The FER documented the occurrence of large upland fields and forest openings that occupied about 15% of the bluff area of the GGNS site in the 1970s. Construction of Unit 1 reduced the area of upland fields, thus they now constitute a lower percentage of the overall bluff area.

An upland hardwood stand immediately southwest of the cooling tower at GGNS has a closed canopy of predominantly old growth trees. This is a typical condition at the site where the forests have aged since studied in the 1970s. Unlike other areas on the property, however, this stand also exhibited evidence of past timber harvest. For example, numerous stumps occurred adjacent to the single-lane roadway in the forest. This roadway was probably a haul road over which loggers transported harvested trees.

Timber harvest in this stand and elsewhere at GGNS appears to have been suspended years ago, probably concurrent with original construction of Unit 1 on the site. Additionally, the logging operation appeared to be one of selective cutting (also termed "high-grading") during which trees of high commercial quality or economic value are individually removed.

Selective cutting is of limited value in rejuvenating hardwood stands because removal of individual trees usually fails to create openings of sufficient size at ground level to significantly increase ground cover. In this case, many of the marked trees on the site have also aged to the point where they are probably no longer of interest for commercial use. Although many trees were dead or dying, mast was plentiful.

2.4.1.2 Terrestrial Species of Special Interest

The FER reported the American alligator as the only Federally-listed threatened or endangered species inhabiting the site in the 1970s. However, the state and Federal lists of T/E species or others of “special interest” have expanded since then. Additionally, the alligator population has since expanded throughout its range. It is now a nuisance species in some locations and hunted in others. Accordingly, its status has been demoted from endangered to “threatened by similarity of appearance”.

During the 2002 reconnaissance visits, two alligators were observed, one in a small pond immediately adjacent to the waste water treatment unit on the GGNS site and the other small individual in the flooded borrow pit. Because alligators pose a nuisance and safety hazard to the GGNS site, plant management indicated that local wildlife agencies are occasionally asked to capture and relocate large alligators. According to plant management, this occurred during the summer of 2002.

To further investigate the possible occurrence of other species of special interest, the following federal and state agencies were contacted: the Jackson, Mississippi and Lafayette, Louisiana, Ecological Services Field Offices of the U.S. Fish and Wildlife Service (References 5 and 6), the Southeast Regional Office of the National Marine Fisheries Service (Reference 7), the

Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP) (Reference 8), and the Louisiana Department of Wildlife and Fisheries (LDWF) (Reference 9). These agencies reported on the possible occurrence of nine terrestrial species of special interest on or near GGNS (Table 2.4-6). Copies of these correspondences are presented in Appendix 2.4A.

Additionally, LDWF documented the potential occurrence of a colonial water bird nesting site in the area. MDWFP and LDWF provided locations of the sightings of several of the species. Those nearest GGNS are shown on Figure 2.4-4. With the exception of the alligator, not included in the list provided by USFWS because its status has been downgraded throughout its range, none of the Federal or state-listed species were observed during the 2002 reconnaissance trips. Each of the special interest species listed by these agencies is also discussed individually below.

2.4.1.2.1 Louisiana Black Bear

Two subspecies of black bear historically occupied Mississippi: the Louisiana black bear in the south and the American black bear in the north. The subspecies are indistinguishable by sight.

The FER reports sighting individual black bears on the site four times between February and April 1977, as well as observations of bear tracks and other sign. Based on the location of the GGNS site and considering the historic range of the subspecies, one must assume that the sightings were of the Federally threatened Louisiana black bear, also listed in Mississippi as "critically imperiled" within the state.

Hardwood forests at GGNS constitute prime bear habitat that is contiguous with other fairly large expanses of hardwood forest adjacent to the site. In addition to berries and other food plants, the numerous large, old trees in the forest provide cavities in standing timber and hollow logs for use by bears as dens. Additionally, shrubs and fallen trees serve as escape cover.

The relatively large area of the site that is restricted from public access protects the bear from legal or illegal hunting, and the low traffic volume on roads in and around the GGNS site protects bears from collisions with cars.

Black bear populations throughout the Lower Mississippi River Valley are reportedly increasing. In addition, black bears are highly adaptable and survive in a variety of situations where protected from over-hunting and other negative interactions with humans. Because bears coexist easily with humans when provided areas in which they can avoid contacts, the possibility that resident black bears still inhabit the site is high.

2.4.1.2.2 Florida Panther

The historic range of the panther or puma was from eastern Texas and the Lower Mississippi River Valley east through most of the southeastern United States. Thus, its range once included the GGNS site.

The FER reported a cougar sighting on site in June 1973, and other periodic sightings from southeastern Mississippi with the qualification that "there are no authenticated records of cougar occurring in Mississippi during this century" (Reference 15). Similarly, the USFWS commented on numerous sightings "throughout its historic range" while stating that no viable populations of the Florida panther now occur outside of Florida.

Florida panther habitat usually consists of large tracts of forest (both upland and bottomland) with adequate prey and little human disturbance. Accordingly, the GGNS site and adjacent areas appear to offer acceptable habitat and a readily available prey base of wild hogs and white-tailed deer. However, observations on site in the 1970s as well as those documented more recently by USFWS elsewhere are probably those of individual young cougars dispersing outward from its now restricted core range. Additionally, the range of the species has probably contracted further since the early 1970s.

The Florida panther is federally listed as endangered throughout its range. Mississippi lists the species as one that historically occurred throughout the state. However, correspondence from the USFWS and LDWF failed to comment on the panther, indicating that neither agency considers the species a possible resident in the area. Thus, there is little likelihood that cougars now actually inhabit the site or occur there regularly as transients.

2.4.1.2.3 Bald Eagle

Once considered a federally endangered species, the status of the bald eagle was downgraded to threatened. It is also listed by Louisiana as endangered and as a rare and local breeder. While known to nest in the Lower Mississippi River Valley, MDWFP (Reference 8) did not include the eagle in correspondence identifying species of special interest in the GGNS site area.

The FER comments on the bald eagle as a species which “could occur” on site and mentions known nesting in bottomlands north of the Big Black River prior to 1960. Eagles construct large, conical nests near the top of tall pines, cypress, and other mature, but sturdy, trees. The same nest is often used by a pair of eagles from year to year or by another pair if abandoned until the nest tree dies or is felled by a storm. Nest sites usually have a clear view of open water. Accordingly, eagle nests are highly visible, especially during aerial reconnaissance conducted during winter, when deciduous trees are largely devoid of leaves.

Since the abrupt decline of eagle populations during the 1950s and 1960s due largely to DDT contamination, bald eagle populations in the southeast have dramatically increased. Eagles nesting on site would be largely protected from shooting, development and habitat alteration, and other human disturbance that usually accounts for mortality and reduced breeding success elsewhere.

Nesting on the GGNS site is possible, though unlikely due to the absence of suitable mature trees in the bottomland adjacent to the river. Additionally, the location of a bald eagle nest site provided by LDWF is about six miles west of GGNS on a large oxbow lake called Lake St. Joseph. Therefore, presence of bald eagles during the nesting season should be considered possible in the absence of an aerial and ground survey designed specifically to confirm or deny the presence of nest trees.

2.4.1.2.4 Interior Least Tern

The Least tern is one of the smallest terns with respect to body size. Its North American population consists of an interior segment, nesting in the GGNS site area and elsewhere along river sandbars, and a coastal segment. The interior segment is Federally-listed as endangered and listed by LDWF as “critically imperiled”. The coastal segment is not listed. Decline of the interior population is usually attributed to elimination of breeding habitat, modification of rivers and artificial control of river flow, and recreational use of river sandbars during the breeding season.

The Least tern is not discussed in the FER. In addition, sandbar nesting habitat isn’t available on or in the immediate area of the GGNS site on the east bank of the Mississippi River. However, field observation suggests that such habitat is abundant on the west bank of the river near the site and on Middle Ground Island, immediately adjacent to the northwest corner of the site. Since these terns apparently favor island nesting areas, its presence on site is unlikely but is possible on Middle Ground Island and elsewhere near the site.

There are three locations for Least tern nesting on the Mississippi River, as documented by LDWF (Reference 9): two about 9 and 17 miles northwest and northeast of the site, respectively, and one about 15 miles southwest of the site.

2.4.1.2.5 White Ibis

The white ibis is listed as a rare and local breeder or non-breeding transient by MDWFP. Its occurrence at Hamilton and/or Gin Lakes during the summer was documented in the FER. The USFWS and LDWF did not list the species in correspondence concerning potential occurrence of special interest species in the area. The bird is very common throughout most of the year in southern Louisiana and coastal Texas, and probably is common in Mississippi during the same periods in proper habitat.

While white ibis sometimes nest on the ground, preferred breeding habitat consists of shrub, cypress, and marsh vegetation, typically on barrier islands and other inland islands. Like Wood storks, white ibis breed colonially, often in mixed species colonies. Like storks, ibis colonies are usually highly observable.

White ibis are waders. Their preferred food consists primarily of aquatic invertebrates and fish. Crayfish dominate their diet in freshwater habitats. Thus, like the wood storks observed at Hamilton and/or Gin Lakes in the 1970s, white ibis in this area are probably transient, summer residents who opportunistically feed in the shallow waters around the periphery of the lakes.

2.4.1.2.6 Wood Stork

The wood stork is a transient, non-breeding species in the GGNS site area according to MDWFP (Reference 8). The USFWS (Reference 5) and LDWF (Reference 9) did not list the species in their correspondence.

The occurrence of the stork (incorrectly termed the “wood ibis”) at Hamilton and/or Gin Lakes during the summer is documented in the FER. Results of the annual Breeding Bird Census (Reference 10) now show low counts of the species in west-central Mississippi. The seasonal status of the species is documented by the National Audubon Society’s 103rd annual Christmas Bird Count. This report recorded no observations in the area but high concentrations in central and south Florida (Reference 11).

The birds typically construct very large nests in relatively large colonies in flooded, mature cypress or mangrove swamps very high above the ground. They are also the largest wading birds that breed in North America. Thus, their presence as breeders is usually highly observable. Although storks elsewhere are known to utilize other species when cypress and mangrove habitat is unavailable, the lack of mature specimens of these trees at GGNS decreases the likelihood that storks nest on or near the site. Thus, the storks documented in the FER were probably opportunistically feeding in the shallow water at the edge of the lake(s).

Storks are also wading birds that frequent areas in which receding water levels concentrate their preferred prey species, such as small fish, as occurs in the onsite lakes during summer and fall. The species should be considered a probable transient at GGNS during the summer.

In correspondence concerning special interest species, LDWF (Reference 9) commented on the presence of a water bird nesting colony near Somerset, Louisiana, about 15 miles northwest of the site. This is presumably the closest known colonial water bird nesting site to GGNS. LDWF provided no information on its composition as a single species or mixed species breeding site.

2.4.1.2.7 Mississippi Map Turtle

This turtle is not included on area lists provided by USFWS or LDWF. However, MDWFP (Reference 8) considers it a possibly secure species locally. Additionally, the FER comments on the species then being common in the area.

While in the field at the site in November 2002, several turtle shells were found in the bottomlands. The shells were bleached of color patterns and in otherwise poor condition. Additionally, identification of turtles to species is sometimes impossible without examining a live or freshly killed specimen because color patterns on the shell and skin are sometimes important in positive identification. In the case of the Mississippi map turtle, for example, distinctive characteristics include a yellow crescent on the head behind the eye and the appearance of the iris of the eye as a pure white unbroken ring surrounding a black pupil.

Despite these limitations on positive identification, one of the shells we observed was consistent in general size and shape with that of a map turtle, probably of the genus *Graptemys,* the same genus as the Mississippi map turtle. Accordingly, their presence as a resident of the GGNS site should be assumed.

2.4.1.2.8 Webster's Salamander

Webster's salamander is considered rare and local in distribution by MDWFP but is not listed as a species of special interest by either the USFWS or LDWF. It is known primarily from east-central Alabama and west-central Georgia with disjunctive populations in south-central Mississippi, the Tunica Hills of Louisiana, and elsewhere.

No specimens of this species or any other salamander during field investigations on the site were documented in the FER although numerous salamanders probably occur there. Optimal habitat for Webster's salamander is described as mesic (or wet), mixed hardwood forests on north-facing slopes with rock outcrops on or near the surface. Such stands are commonly located adjacent to perennial streams. However, a closed canopy also provides the necessary moisture regime when located over moist debris, decaying logs, and a well-developed humus layer in which the animals actually live.

GGNS does not fall within the known (or suspected) range of the species. However, areas on the site probably offer suitable habitat. Its presence should be considered unlikely.

2.4.1.2.9 Square-Stemmed (or Allegheny) Monkeyflower

The monkeyflower is an upright perennial member of the snapdragon family with smooth and nearly square stems that grow to 1-3 feet tall. Flowers are blue to purple and look something like a monkey face. The shape of the stem and the appearance of the flower obviously provide its common name. Preferred habitat consists of wet meadows, stream banks, and damp ditches so it may be considered a wetlands indicator.

The monkeyflower is of widespread distribution, occurring everywhere throughout the United States except in the Rocky Mountains and the Florida Everglades. LDWF (Reference 9) reports the species at a location along the west bank of the Mississippi River northeast of St Joseph, Louisiana. This location is about 11 miles southwest of the plant. While not discussed in the FER, the monkeyflower is widely distributed and suitable habitat apparently exists on site, therefore, its presence at GGNS should be assumed.

2.4.1.3 Critical Terrestrial Habitat

None of the resource agencies contacted (see Appendix 2.4A) commented on the occurrence of any critical terrestrial habitat on or near the GGNS site. Similarly, there are no wildlife sanctuaries, refuges, or preserves on the GGNS site or in the immediate area.

2.4.2 Aquatic Ecology

The FER reported that the Mississippi River, the Big Black River (a tributary to the Mississippi), and two oxbow lakes, Hamilton and Gin, are the major features of the aquatic environment on and near GGNS. In addition, they document five small stock ponds (under two acres) and two perennial streams. They describe the latter as having “normally negligible flow”.

The FER also documented systematic sampling of fish, benthic macroinvertebrates, and plankton in the two rivers and the oxbow lakes and fish sampling in two of the upland ponds and one of the streams. In addition, they characterized the periphyton and macrophyton assemblages of the lakes and documented sport and commercial fishing in the area.

2.4.2.1 Aquatic Habitats

For purposes of sampling and description in the FER, the two oxbow lakes were treated as a single macrohabitat. The Mississippi River system, however, was divided into backwater, river bank, main channel, and tributary macrohabitats. The GGNS site does not front on the Big Black River to the north nor Bayou Pierre River to the south. Thus, aquatic habitat at GGNS is limited to the Mississippi River, the oxbow lakes, the flooded borrow pit, upland ponds, Streams “A” and “B”, and ephemeral drainages.

The FER documented the occurrence of 86 species of fish, more than 100 plankton taxa, and over 50 benthic macroinvertebrate taxa in these habitats. The common fish documented in the FER are presented in Table 2.4-7.

2.4.2.1.1 Mississippi River

Backwater habitats in the Mississippi River are located in the slow moving, quiet waters on the inside of large bends, in coves on the leeside of sandbars and islands, in the lower reaches of sluggish tributaries, and in other similar areas. These backwaters are characterized by zero to low velocity current, relatively shallow waters, and loosely consolidated silty clay sediments of low plasticity. The FER documents an abundant and productive biologic community of fishes, benthos, and plankton in the backwaters. This biological assemblage is probably present now.

In areas of moderate to swift current, banks of the Mississippi River are usually steep and generally composed of consolidated, highly plastic clay. Clay bank stability varies greatly, depending on local soil geology, the amount and type of terrestrial vegetation, and the degree of scouring currents. In areas of stable clay outcroppings, large populations of burrowing mayflies and other invertebrate taxa become established. Where the bank is constantly eroding, however, benthic organisms are unable to establish a stable population.

Because of the large area it encompasses, the river channel is the dominant aquatic habitat at GGNS. This habitat is characterized by deep water, strong (and turbulent) currents, and coarse-grained substrate, typically consisting of gravelly sand sediments. The severity of this habitat imposes restrictions on living organisms. As documented in the FER, the bottom was found to be virtually non-productive of benthic organisms, and the water column was found to contain fewer fish than other habitats. Other than the installation of additional revetments along the east bank, no significant changes to the river channel or banks which would be expected to alter the ecological characteristics of this riparian habitat have occurred. Therefore, a similar diversity and distribution of species should currently be present.

According to the Mississippi State University Extension Service (Reference 12), commercial fishing persists in the Mississippi River near GGNS. There are apparently a small number of local fish markets that harvest big and small mouth buffalo fish from this reach of the river for sale.

There is limited commercial fishing within the study area. Most of this occurs on the Mississippi River, the Big Black River and the Bayou Pierre River, with catfish being the most abundant catch. There are approximately 12 commercial fishermen who fish within the area. (Reference 13)

2.4.2.1.2 Gin and Hamilton Lakes and Flooded Borrow Pit

Gin Lake and Hamilton Lake are natural oxbow lakes formed when the Mississippi River abandoned a former channel. A flooded man-made borrow pit now exists north of the barge slip at GGNS. This pit was formed by excavating fill material during the construction of Unit 1, thus it was not present in the 1970s (Figures 2.4-1 and 2.4-2). Like the borrow pit, the oxbow lakes are lacustrine, littoral, unconsolidated bottom wetlands. The lakes are probably not deep enough to be classified as limnetic (greater than 2 meters in depth), although the borrow pit probably exceeds this depth.

Neither lake nor the borrow pit supports emergent vegetation, except on the shorelines. Shorelines are classified independently as wetland (Section 2.4.1.1.2). The lakes retain water when floods recede from the bottomlands to the current channel of the Mississippi River. Hamilton Lake also receives water from Streams “A” and “B” which carry storm water from the existing plant area.

Hamilton and Gin Lake are connected through a culvert beneath Heavy Haul Road. The borrow pit appears to not be hydrologically connected to either of the lakes except during high water when all are subsumed by the river.

The size of Gin and Hamilton lakes is estimated to be approximately 55 acres and 64 acres, respectively, based on an aerial photograph of the site taken in December 2001 (Figure 2.4-2). The FER reports Hamilton and Gin Lakes to be relatively small and shallow. These lakes were once the channel of the Mississippi River and had an average depth of approximately 8 to 10 feet according to Reference 2. The borrow pit includes an area of about 16 acres based on the photo of Figure 2.4-2. Depth of this (borrow pit) lake is not known.

As discussed in the FER, oxbow lakes are similar to river backwater in physical characteristics, with shallow depth, no current, and loosely consolidated, highly plastic clay sediments. They generally support productive biotic assemblages.

Access to the lakes by road is provided for local recreational fishermen who use small boats and catch bluegill, catfish, and other species. After September 11, 2001, fishing access was denied, however, this denial was lifted in 2002.

During the November 2002 reconnaissance visit, trotlines were observed suspended in trees near these lakes. The trotlines were fixed to tree trunks far above the normal water level in the lakes at a height consistent with spring floods. A trotline consists of a horizontally deployed, relatively heavy gauge line normally tied between two posts, in this case trees, or between buoys. Vertical drop lines tied to the horizontal member at short intervals end with baited fishing hooks. The hooks then suspend below the surface of the water.

The current species diversity in Hamilton and Gin Lakes most likely does not differ significantly from that reported in the FER. While the borrow pit lake appears to be deeper than Hamilton and Gin Lakes, in the absence of sampling studies, there is no reason to assume that the species composition of the aquatic fauna differs significantly from that of the other lakes.

Water-dependent bird species observed in 1973 on Hamilton and/or Gin Lakes are presented in Table 2.4-4 (Section 2.4.1.1). During the 2002 reconnaissance visit to GGNS a small flock of white pelicans (*Pelecanus erythrorhynchos*) was observed feeding at the borrow pit. Additional reconnaissance revealed the presence of a narrow peninsula extending into the lake from its western edge that was being used by the pelicans as a loafing area.

The FER did not list the white pelican as an inhabitant of the site in the early 1970s, although, it documents use of the area by numerous other water bird and waterfowl. However, pelican populations have expanded throughout their range since then. Other than not being listed earlier, the occurrence of pelicans on the property is not unusual since the oxbow lakes provide good feeding habitat.

2.4.2.1.3 Upland Stock Ponds

The upland ponds, probably constructed to water cattle and other livestock, are small (0.25 to 0.50 acre each) and unproductive. The FER concluded that previous owners apparently stocked the ponds with bluegill and channel catfish. Two of the five ponds present in 1973 were filled in during construction.

2.4.2.1.4 Streams “A” and “B”

Stream “A" extends west from the GGNS sanitary waste water treatment facility and supports a palustrine, emergent, permanently flooded wetland. The FER stated that the stream then had negligible flow and characterized the habitat as “unproductive”. Currently, this drainage receives continual flow from plant storm water and process discharge from the waste treatment plant. A sedimentation basin backs water up at the head of the draw and is marked "Outfall 13." (Figure 2.3-12)

At this location, willow, rattlebrush (*Sesbani spp*.), and cattail (*Typha spp*.) flourish and appear to be persistent. Below "Outfall 13," the drainage is steeply banked with a rocky channel. It does not appear to retain water for any length of time. As this drainage nears the physiographic change from bluffs to bottomland, it widens and becomes part of the bottomland forest.

A very similar situation exists along Stream “B", which extends west from the cooling towers on the south side of the Heavy Haul Road. A sedimentation basin has been constructed there as well (Figure 2.3-12). Outfall “14” then releases water into the drainage channel. However, very little emergent vegetation exists along the shores of this pond owing to steep banks.

Flow into the drainage channel derives from storm water runoff. Flow appears to be relatively steady, but does not slow down and support hydrophytic vegetation until farther west where it eventually widens out toward Hamilton Lake.

Soils in both streambeds are Adler silt loam (Reference 4). Adler soils are not considered hydric. However, the soil is likely functioning now as a hydric soil due to the relative permanence of the inundation. At the time the soil was mapped, the area was an ephemeral drainage channel, with flow occurring sporadically only after rain storms.

When sampled in 1972-73, these streams contained fish and other species, many of which entered the streams during spring floods. These biota were then confined to isolated pools during dry weather. Water control structures placed in the streams during construction now provide more or less permanent pools.

Like the floodplain oxbow lakes, there is no reason to believe that the diversity of fish and other aquatic organisms in the streams now differs significantly from that reported in the FER. In addition to unidentified minnows or small fish, both streams support small numbers of unidentified bivalves and snails as evidenced by observation of shells along the banks of the streams. Therefore, the streams should be expected to support the same basic biotic assemblage of minnows and sunfish now that they did when sampled in the 1970s.

2.4.2.1.5 Ephemeral Drainages

In addition to aquatic habitats characterized as wetland, numerous ephemeral drainage channels occur on the upland bluffs on the eastern portion of the GGNS site. Topographic maps and field surveys suggest that approximately 24,140 linear feet of ephemeral drainage channels exist across the entire GGNS site (Figure 2.4-3).

Several support non-persistent palustrine, emergent, seasonally flooded wetlands of very small size (Figure 2.4-3). Immediately east of the existing cooling tower is an example of such a wetland. Vegetated with Pepper smartweed (*Polygonum hydropiperoides*) in the herb layer and Black willow in the overstory, this area appears to remain saturated or inundated with only a few inches of water for much of the year.

2.4.2.2 Aquatic Species of Special Interest

Resource agencies reported (Section 2.4.1.2) the possible occurrence of eight aquatic species of special interest at or near GGNS (Table 2.4-8). The relevant agencies and appropriate references regarding consultation are discussed below.

Three of these species (Pallid sturgeon: Federally-listed as endangered and state-listed as “critically imperiled”; Chestnut lamprey: rare and of limited local distribution in Mississippi; and Paddlefish: also rare and local in both states) were collected in the 1970s at the site as documented in FER.

2.4.2.2.1 Paddlefish

The paddlefish is now classified as rare or uncommon in Mississippi. However, the FER documented “large numbers” of juvenile paddlefish in both Hamilton and Gin Lakes during July, 1973. Additionally, LDWFs (Reference 9) reported record of a paddlefish on May 6, 1988 was about eight miles northwest of the site in Yucatan Lake, a large oxbow lake. Based on the fact that paddlefish have inhabited both lakes in the past, they are assumed to be present in both lakes today.

While the paddlefish is apparently uncommon in the lower Mississippi River, populations elsewhere in its range are subject to recreational fishing. Paddlefish meat is typically described as highly edible and the roe is sold commercially as a substitute for caviar.

2.4.2.2.2 Pallid Sturgeon

The pallid sturgeon is Federally-listed as endangered and state-listed as critically imperiled or endangered in Louisiana.

The pallid sturgeon report of LDWF (Reference 9) dated December 13, 1972, could be the fish collected and reported by MP&L (1973). According to Reference 9, the specimen was forwarded to the University of Michigan for addition to its permanent collection.

The U.S. Fish and Wildlife Service, Mississippi Museum of Natural Science, and Lower Mississippi River Conservation Committee, initiated trawl surveys for pallid sturgeon in the Mississippi River on September 5, 2001 (Reference 14). The collection effort was focused in the vicinity of Vicksburg, MS, from Delta Point (approximately river mile 436) to Marshall Cutoff (approximately river mile 452). This area is approximately 38 miles upriver from the GGNS site and contains a variety of channel habitat types, including islands, dikes, a closed secondary channel, a partially closed secondary channel, point bars, buckshot bank, revetted bank, deep bends, and a shallow crossover. A total of 9 adult pallid sturgeon and 7 intermediates that were tentatively identified as pallid sturgeon were caught. The captures were associated with moderate to strong currents, sand and sand/gravel substrates, 20-40 ft. depths, and usually some type of “structure” such as “reefs”, dropoffs, or secondary channels.

Therefore, the pallid sturgeon should be considered a possible, but unlikely, resident of the area.

2.4.2.2.3 Chestnut Lamprey

There are no recent records of the chestnut lamprey in the GGNS site area. Therefore, the lamprey, a rare and uncommon species in Mississippi, should also be considered a possible, but unlikely, resident of the area.

2.4.2.2.4 Gulf Sturgeon

There are no confirmed reports of the gulf sturgeon, Federally-listed as endangered, from the mainstream of the Mississippi River. The only record from the Mississippi drainage is from the Big Sunflower River. Other Mississippi populations of this fish apparently occur in the Pascagoula and Pearl River systems (Reference 16).

As an anadromous species, this sturgeon spends most of its life cycle in the ocean (or Gulf of Mexico), only returning to freshwater streams to breed. Accordingly, it is, at best, a seasonal migrant or transient in the Mississippi River at GGNS.

2.4.2.2.5 Bayou Darter

The Bayou darter is endemic to Mississippi but occurs exclusively in the Bayou Pierre River, south of the site, and its larger tributaries. It has not been shown to occur at GGNS.

2.4.2.2.6 Blue Sucker

The FER reported the collection of fifteen blue suckers, a rare or uncommon species in Mississippi, in the Big Black River north of the site. The species was not found in onsite drainages then, nor is it now likely to occur there due to the absence of suitable habitat.

2.4.2.2.7 Black Buffalo Fish

The black buffalo is a rare or uncommon species in Mississippi. Like the Bayou darter and blue sucker, also rare to uncommon in the Mississippi River and other large, interior North American rivers, preferred habitat for this species seems to include moderate to swiftly-flowing, non-turbid streams with clean sand, rock, or gravel substrates.

This type of habitat is not available in the streams on site, although the black buffalo may inhabit the Mississippi River adjacent to the site where other species of buffalo fish are caught commercially.

2.4.2.2.8 Crystal Darter

The crystal darter, considered to be critically imperiled in Mississippi, also prefers clean and unpolluted streams with water depth of about three feet. Like other species discussed above, suitable darter habitat does not occur on site or in the Mississippi River.

2.4.2.3 Critical Aquatic Habitat

None of the resource agencies contacted (see Appendix 2.4A) commented on the occurrence of any critical aquatic habitat on or near the GGNS site.

2.4.2.4 Waters of the United States

As discussed above, waters of the U.S. are broadly defined as waters that are, were, or could be used in interstate or foreign commerce. They include all waters which are subject to the ebb and flow of the tide, the territorial sea, interstate waters and wetlands, and all other waters (such as intrastate lakes, rivers, streams and wetlands) if their use, degradation or destruction could affect intrastate or foreign commerce. Also included are tributaries to waters or wetlands identified above, and wetlands adjacent to these waters.

The Mississippi River is obviously used in interstate and foreign commerce. Streams “A” and “B” as well as the ephemeral drainages at GGNS have the ability to carry large amounts of water during rainstorms. Accordingly, all are classified as waters of the United States according to the above definition and are, therefore, under the regulatory jurisdiction of the USACE. Sediment retention basins A & B are considered modifications of Streams A & B, so Streams A & B and the sediment retention basins A & B are considered waters of the State (Reference 17).

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2.5 Socioeconomics

2.5.1 Demography

The population data presented in this section are primarily based on the 2000 U.S. Census (Reference 1). When economic, employment, or population trends were analyzed over time, comparisons were made between data from the 1990 U.S. Census (Reference 2) and the 2000 U.S. Census. The LandView 5[1] software was used to develop demographic data presented in this section of the report. The census data was augmented by information from other agencies and public organizations from the states of Mississippi and Louisiana (References 3 and 4). The area encompassed by a 50-mile radius from the center of the proposed power block location, includes all or a portion of the following 25 counties and parishes in Mississippi and Louisiana.

Mississippi Counties		Louisiana Parishes	
Adams	Madison	Caldwell	Franklin
Amite	Rankin	Catahoula	Madison
Claiborne	Sharkey	Concordia	Richland
Copiah	Simpson	East Carroll	Tensas
Franklin	Warren		West Carroll
Hinds	Wilkinson		
Issaquena	Yazoo		
Jefferson			
Lincoln			

Figure 2.5-1 shows a map of the area within 10 miles of the GGNS site. On this map, the proposed location of the power block for the new facility is located in the center with concentric circles surrounding the GGNS ESP Site at distances of 1, 2, 3, 4, 5 and 10 miles. The circles are divided into 22.5-degree segments with each segment centered on one of the 16 cardinal compass points (e.g., north, north-northeast, etc.). Within each area defined by the concentric circles and radial lines, the resident population for 2002 is indicated. The estimated population for 2002, and the projected population for 2030 (the projected first year of operation), and for each decade for five decades through the year 2070 (the projected end of the initial plant license period) are estimated based on the 2000 census, and are given in Table 2.5-1. The

[1] LandView® reflects the collaborative efforts of the U.S. Environmental Protection Agency (EPA), the U.S. Census Bureau, the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Geological Survey (USGS) to provide the public readily accessible published federal spatial and demographic data. It is composed of two software programs: the LandView® database manager and the MARPLOT® map viewer. These two programs work in tandem to create a simple computer mapping system that displays individual map layers and the demographic and spatial information associated with them.

population data for the areas within ten miles of the site was based on census block points from the LandView 5 software.

The projected populations for the years 2030 through 2070 for each segment are based on averages of the population growth projections obtained from the Louisiana State University and the Mississippi Center of Policy Research and Planning for the Louisiana parishes and Mississippi counties, respectively. (References 3 and 4) Discussion regarding the population projection methodology used by the states of Mississippi and Louisiana is provided in SSAR Section 2.1.3.1.

There are no residences within the exclusion area boundary (Figure 2.2-1) as defined for the proposed location of a new facility.

Population characteristics for the low population zone[2] (LPZ), the plume exposure emergency planning zone[3] (EPZ), and the region[4] surrounding the GGNS site are listed in Table 2.5-2 and Table 2.5-3. Population percentages for age, race, and sex are listed in Tables 2.5-2 and 2.5-3. Income distributions for the LPZ, the EPZ, and the region are listed in Table 2.5-4. Regional median household income data obtained from the 2000 U.S. Census are included in Table 2.5-5.

Figure 2.5-2 depicts the area within 10 to 50 mile radius from the site. On this map concentric circles at 10, 20, 30, 40 and 50 miles from the site are shown. The circles are divided into 22.5-degree segments with each segment centered on one of the 16 cardinal compass points (e.g., north, north-northeast, etc.). The projected resident population for 2002 is indicated on the figure. Additionally, the 2002 projected population, and the population projection for each decade for five decades from 2030 (the projected first year of plant operation) to 2070 (the projected end of the initial plant license), are given in Table 2.5-6 for each area formed by the intersection of the concentric circles with the radial lines. The basis for estimating the projected population distributions are similar to those described for the population distribution for the EPZ.

Resident and transient population, particularly within the LPZ is subject to seasonal variations (due to the Grand Gulf Military Park, hunting camps, and fishing) and daily workday variations (due to GGNS Unit 1 employment and other activities of an occasional nature). There is one forest product company, Anderson-Tully of Vicksburg MS, that owns and leases land within five to ten miles of the GGNS site and has 12 people on logging crews that occasionally work in this area (Reference 5).

Based on information obtained from the U.S. Census 2000 LandView 5 data, the 2002 resident population within the LPZ is 51 people. Age, sex, and racial distributions of people within the LPZ are listed in Table 2.5.-2 and Table 2.5-3.

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[2] The low population zone (hereafter referred to as the “LPZ”) is defined as the area located within a two-mile radius of the GGNS Unit 1 reactor containment.

[3] The plume exposure emergency planning zone (hereafter referred to as the “EPZ”) is a modified 10-mile radius area surrounding the GGNS site. Consistent with GGNS Unit 1 Emergency Plan and Part 4 of this application, the 10-mile radius is extended to an approximate 14-mile radius to the northwest, west, and southwest of the GGNS site to include the towns of Newellton and St. Joseph, LA. Figure 2.5-10 illustrates the boundary of the GGNS Unit 1 EPZ.

[4] The “region” is defined as the area located within a 50-mile radius of the GGNS site.

2.5.2 Community Characteristics

The community surrounding the GGNS site is located in a rural economically isolated region of Mississippi. Claiborne, Copiah, and Jefferson Counties in Mississippi and Tensas Parish, Louisiana are classified as persistent poverty counties (Reference 32). This designation indicates a rural non-metropolitan area in which at least 20 percent of the population lived in poverty in 1960, 1970, 1980, and 1990 (Reference 6). The poverty in this region is worse, when county poverty estimates are compared to State averages. The 2000 U.S. Census indicates the percent of individuals below the poverty level in Claiborne County is 32.4% compared to the State of Mississippi with 19.9% of individuals below the poverty level (Reference 7). Claiborne County and Tensas Parish income and poverty data obtained from the 2000 U.S. Census is provided in Table 2.5-7.

2.5.2.1 Area Economic Base

In 2001, Mississippi ranked 49 out of 50 states for the lowest median family income in the nation (Reference 8). Income data including median household income, median family income, and per capita income, were reviewed for Claiborne County and compared to income data for the state of Mississippi (Reference 7). This review indicates that individuals in Claiborne County have significantly lower incomes in comparison to the averages for Mississippi (Table 2.5-7).

Approximately 750 people work at the Grand Gulf Nuclear Station Unit 1 facility. Plant staffing is round the clock, with approximate numbers of personnel on site as indicated below for the normal day crews and night crews (Reference 30).

GGNS Unit 1 Approximate Staffing Levels

Time Period	Normal Week Day	Normal Weekend Day	Outage Week Day*	Outage Weekend Day
Day	660	70	800*	210
Night	90	60	170*	140

* Outage weekday estimated based on difference between outage weekend day and normal weekend plus normal week day staff. This assumes outage weekday and weekend day staffing is constant (no specific data was provided for outage weekday staff levels).

The annual average wage for the year 2000 in Claiborne County and contiguous Mississippi counties are listed in Table 2.5-8. Pay rates include management personnel.

Table 2.5-9 presents regional labor force employment statistics according to the major industry categories for the years 1990 and 2000. The data indicates the majority of the work force, in Claiborne County and adjacent counties, is employed in educational and health services. The largest employers in the manufacturing sector in the region include lumber, electronic component manufacturers, food processing, apparel producers and transportation equipment manufacturers (Table 2.5-10).

Comparisons between the 1990 and 2000 area employment statistics by industry type (Table 2.5-9) indicates that the total number of jobs for Claiborne County and the four adjacent counties decreased by 9 percent. Several industries experienced severe job decline between 1990 and 2000, including: agriculture, forestry and fishing jobs (down 38.5 percent); professional, scientific, and management jobs (down 34.5 percent); and retail trade (down 29.8%). In contrast, employment in transportation and warehousing increased by 20 percent and educational and health services employment increased by 10.7 percent. A study conducted by the Rural Health Works in Mississippi, estimates that employment in the health care sector represents 5.3 percent of the total workforce within Claiborne County. The study also concludes that the impact of local health care services typically represents a much larger sector of rural economies than for urban communities (Reference 12).

The December 2002 area labor force data (Table 2.5-11) shows Claiborne County had a higher unemployment rate of 12.4 percent as compared to the surrounding area, composed of the four contiguous counties (i.e. Copiah County, Hinds County, Jefferson County, and Warren County), and Tensas Parish, LA. The surrounding area had an average unemployment rate of 8.3 percent, and the State of Mississippi had an unemployment rate of 6.1 percent. (References 9 and 10) A comparison of 1990 U.S. Census data to the 2000 U.S. Census data reveals that two of the four adjacent counties (Hinds County and Warren County), and Tensas Parish, exhibited increases in employment rates ranging from 3.1 percent to 22.9 percent. Copiah and Jefferson Counties experienced small declines in employment rates of 1.1 percent and 3.0 percent, respectively. In contrast, Claiborne County experienced a 14.3 percent drop in employment rates from 1990 to 2000. The area employment trends for Claiborne and the adjacent counties, and for Tensas Parish, LA, for the years 1990 and 2000 are listed in Table 2.5-12.

2.5.2.2 Area Political Structure and Nuclear Facility Taxation

Claiborne County is a political jurisdiction of the State of Mississippi. An elected five-member Board of Supervisors governs the county. Other elected county officials include: Chancery Clerk, County Circuit Clerk, County Assessor/Collector and County Sheriff. Mississippi Code Title 27 addresses taxation of nuclear generating plants and the distribution of tax revenues from nuclear plants (Reference 11). This code states that any nuclear generating plant located in the state, which is owned or operated by a public utility is exempt from county, municipal and district ad valorem taxes. In lieu of the payment of county, municipal and district ad valorem taxes, the nuclear power plant pays the State Tax Commission a sum based on the assessed value of the nuclear generating plant.

The Grand Gulf Nuclear Station is taxed a sum equal to 2% of the assessed value, but not be less than twenty million dollars ($20,000,000), annually. Of this amount, $3,040,000 is allocated to Claiborne County, provided that Claiborne County upholds its commitment to the Grand Gulf Nuclear Station offsite emergency plan.

The State Tax Commission transfers $160,000 annually to the City of Port Gibson provided that the City maintains its commitment to the Grand Gulf Nuclear Station offsite emergency plan.

Ten (10) percent of the remainder of the payments are transferred from the Mississippi Tax Commission to the General Fund of the state. The balance of the tax revenue from GGNS is transferred to the counties and municipalities in the state of Mississippi where electric service is provided. The tax revenues are distributed in proportion to the amount of electric energy consumed by the retail customers in each county with no county receiving an excess of twenty percent of the funds. (Reference 11) This distribution based on energy consumed also includes Claiborne County.

Depending on the type of plant (merchant plant which would be unregulated, or a regulated – by the Public Service Commissions (PSC) of Mississippi and Louisiana - plant) the tax structure may be similar to the above for GGNS Unit 1 (for a regulated plant), or be some mutually agreeable amount for an unregulated merchant plant.

2.5.2.3 Demographic Information

Port Gibson, located approximately 6 miles to the southeast, is the closest town to the GGNS site, and has a population of 1,840 based on the 2000 U.S. Census. The majority of the population in this area is African American. Four towns with higher population densities are located within the 50-mile radius of the GGNS site. Vicksburg, Mississippi, located 25 miles to the north-northeast, had a 2000 U.S. Census population of 26,407. Clinton, Mississippi located to the northeast and Natchez, Mississippi, located to the southwest had 2000 U.S. Census populations of 23,347 and 18,464, respectively. Jackson, Mississippi, the largest nearby metropolitan area, located about 55 miles northeast of the site had a 2000 U.S. Census population of 184,256. Projected population information for the area surrounding the GGNS site is discussed in Section 2.5.1.

The cumulative resident population for 2000 was calculated using the data from LandView 5 software provided by the U.S. Census Bureau. The population density for Claiborne County is 24.3 persons per sq. mile; for the state of Mississippi, it is 60.6 persons per sq. mile. (Reference 1)

2.5.2.4 Social Structure Information

Population data for the areas surrounding GGNS indicate low population densities and a rural setting. The larger population centers to the north, northeast, and southwest provide employment, services, and entertainment for the region. Rural communities, similar to Port Gibson are located throughout the outlying areas, and provide limited services.

2.5.2.5 Housing Information

Regionally, 301,747 occupied housing units were reported in the 2000 U.S. Census (Table 2.5-13). Table 2.5-13 presents information on regional occupied housing stability characteristics by county. Table 2.5-14 provides regional housing information by county. Examination of this data indicates 18.2 % of families have lived in the same housing unit for at least one year. Long-term statistics demonstrate housing stability in the region. For example, 22.5% of the population have lived in the same housing unit since 1979. U.S. Census Data for 2000 indicates 567 vacant housing units are located within Claiborne County, representing 13% of the total housing in the county. Regionally, 31,967 housing units were reported as vacant for the 2000 U.S. Census. Based upon the vacancy numbers, no housing shortage appears to exist in the region.

2.5.2.6 Educational System

Ten undergraduate schools and one university are located within the EPZ for the GGNS site. In total, 6,277 students attended these institutions in the 2001/2002 school year (Reference 13). The student and faculty/teacher populations for each of these schools are listed in Table 2.5-15. Claiborne County, the four adjacent counties and Tensas Parish, LA, contain 116 primary and secondary schools with a student population of 60,281 (Table 2.5-16). In addition, 14 schools of higher education with a student population of 22,535 were identified within the counties listed in Table 2.5-16 (Reference 13).

2.5.2.7 Public and Private Recreational Facilities

The Grand Gulf Military Park is located approximately 1-1/2 miles north of the proposed location of the power block of the new facility and is contiguous to the GGNS site property. The park is open daily from 8:00 a.m. to 5:00 p.m. and had over 88,000 visitors in 2001. School groups, Boy Scouts, YMCA groups and other community groups use Grand Gulf Military Park for field trips, historical and nature studies. The highest volume of guests visit the park on Sundays while Saturday is typically the second largest attendance day. The park is most heavily populated during the months of June and July, when 250 to 300 persons visit the site per day depending on the weather conditions. (Reference 15)

The Warner-Tully YMCA Camp consists of 108 acres of land located approximately 3-1/2 miles north from the site. Approximately 800 campers use the Warner-Tully camp facilities each year. The YMCA camp is open from late May to the end of August. (Reference 16)

Lake Claiborne is a private development of residential and recreational facilities. It is located approximately 3-1/2 miles east of the site. Lake Claiborne, Inc. has a total of about 450 members who have access to the lake and picnic area. There are 51 permanent residents in the development. A maximum of 200 people use these facilities on a summer weekend. (References 22 and 31)

Lake Bruin State Park consists of 53 acres located on the shore of Lake Bruin, Louisiana, approximately 9.5 miles southwest of the site. From July 2001 to June 2002, the park had approximately 36,000 visitors. (Reference 18)

There are approximately 150 hunting camps within Claiborne County. These camps are primarily used for deer hunting and other types of hunting, as well as sport fishing. The camps are too numerous to get an accurate number of hunters who use them. Each camp, depending on the size of the camp, could have up to 20-30 hunters on a weekend day during hunting season. (References 17 and 19)

There are several hunting clubs located across the Mississippi River from the GGNS site in Tensas Parish, Louisiana. Approximately 400 hunters are members of these clubs, primarily deer and duck hunters. (Reference 20)

Deer season in Mississippi traditionally opens early in October for archery and late November for guns. The season continues through early January. The greatest number of hunters, approximately 500 to 600, is invariably present on the first day of gun season. After the opening weekend, approximately 70% of the hunting population utilize the camps until the end of the season in early January. (References 17 and 19) Louisiana deer season is similar in duration to that of Mississippi, beginning in early October and ending in late January (Reference 33).

Sport fishing in the area occurs in the months of April through September with Saturday the busiest day of the week. As many as 200-250 fishermen may be within the vicinity on weekends during the months noted above. The number of fishermen may drop to less than 150 during the week, and depending on the weather conditions. (Reference 19)

The Delta Queen Steamboat Company operates three paddle wheel tour boats on the Mississippi River, The Delta Queen, The Mississippi Queen and the American Queen. The Delta Queen is scheduled to pass the GGNS site a minimum of five times during the 2003 season with a full compliment of 174 passengers and 75 crew. The Mississippi Queen is scheduled to pass the GGNS site a minimum of 8 times during the 2003 season with a full complement of 416 passengers and 156 crew. The American Queen is scheduled to pass the

GGNS site a minimum 13 times during the 2003 season with a full complement of 436 passengers and crew of 161. (Reference 21)

2.5.2.8 Local Land Use Planning and Zoning

Claiborne County has no local Planning or Zoning Department. Instead, the county belongs to a statewide Planning and Zoning Development District comprised of eight (8) separate districts. Claiborne County is located within District 6, which includes Adams, Claiborne, Franklin, Jefferson, Lawrence, Walthall, and Wilkerson Counties. The Mississippi Development Authority assists communities with planning and zoning issues and business development. (Reference 22)

Due to the low projected population grown and population density surrounding the GGNS site, no local land use or zoning changes are planned within the LPZ of the site. The land immediately adjacent to the site is predominantly agricultural and forested.

2.5.2.9 Social Services and Public Facilities

Port Gibson Water Works supplies Port Gibson with municipal water and sewer services. Approximately 95% of Port Gibson's population is connected to the municipal water and sewer system, which is presently at 90 percent capacity. Operational averages for the water and sewer services provided by Port Gibson Water Works are provided below.

Source	Maximum Capacity (gpd)	Average Consumption (gpd)	Peak Consumption (gpd)	Storage Capacity (gal)	Sanitary Sewer Capacity (gal)
Wells	1 million	800,000	950,000	750,000	200,000

GGNS has its own water/sewage facility. The facility currently operates at about 1/3 capacity during normal operation and 2/3 capacity during outages. The facility consumes 100,000 gpd of water and 50,000 gpd for the activated sludge system (Reference 35).

The Claiborne County Sheriff's department handles the present duties for law enforcement within the immediate 5 mile radius of GGNS site. Additional law enforcement resources from the town of Port Gibson assist when needed. GGNS maintains its own security force to handle the security within the GGNS site property boundaries. Fire capabilities are maintained by Claiborne County fire department along with the volunteer fire department from the town of Port Gibson. GGNS Unit 1 maintains an emergency response team on site, including a Fire Brigade to respond to fires within the plant buildings and structures. Emergency planning responsibilities are assigned to a number of departments and agencies. Federal, state and local officials will implement appropriate protective actions in case of an emergency. (References 23 and 24)

The Claiborne County Hospital has 32 beds. The staff consists of five doctors, ten registered nurses, six nurses' aides, and three X-ray technicians. (Reference 34) Information for hospitals located in the adjoining counties is listed below. (Reference 9)

County / Parish	Number of Hospitals	Number of Beds
Copiah	1	49
Hinds	6	2,468
Jefferson	1	30
Warren	2	354
Tensas Parish, LA	2	89

2.5.2.10 Highway and Transportation System

Transportation routes are limited within the site vicinity. The major highway within the vicinity is U.S. Highway 61 that passes by the GGNS site to the east-southeast. U. S. Highway 61 parallels the Mississippi River from New Orleans, Louisiana to St. Louis, Missouri, and is approximately 4.5 miles from the site at the closest point. From the town of Port Gibson the highway goes north to Vicksburg, MS, and runs southwest to Natchez, MS.

The Natchez Trace Parkway lies to the east and south of Port Gibson and runs southeast to Natchez and northeast to Clinton. Figures 2.5-3 and 2.5-4, show estimated traffic count with road classification, and roadway development priority, respectively (Reference 26). Bald Hill Road is scheduled for reconstruction from Grand Gulf Road to Headly Road (Figure 2.2-2) to accommodate commercial traffic to/from Port Claiborne (Reference 25).

A highway construction plan to extend the present path of Highway 18 is in the early planning stages. This proposed extension will connect Highway 18 to Grand Gulf Road, providing additional access to the GGNS site. (Reference 25) There are a number of other county and rural roads within a five mile radius of the site (Figure 2.2-2).

A Kansas City Southern freight train passes within 28 miles to the north-northeast of the site twice daily. The train runs from Vicksburg to Meridian, Mississippi, then returns to Vicksburg. The train carries a crew of five. (Reference 27)

2.5.2.11 Distinctive Characteristics

The region around GGNS is an area rich in Civil War history. The Grand Gulf Military Park lies north of the site and is listed on the National Register of Historic Places (National Register). Several civil war battle sites are identified within this region and the National Register lists several restored homes and businesses whose original construction dates back to the Civil War.

2.5.3 Historic Properties

Grand Gulf Nuclear Station is located in a richly historic section of Mississippi. Claiborne County was one of the first counties organized in the State and boasts many historic features, including antebellum homes, Civil War battlefields, and Indian relics. Grand Gulf Nuclear Station obtained its name from the Grand Gulf Military Park located immediately north of the site. There are 35 sites in Claiborne County that are listed on the National Register of Historic Places, some of which are located within a 10-mile radius of the site. The majority of these sites are historic buildings, homes, churches and or cemeteries. A list of features listed on the National Register of Historic Places is included in Table 2.5-17. Approximate locations for historic features listed on the National Register of Historic Places is listed on Figure 2.5-5.

An initial survey by the Mississippi Department of Archives and History in June 1972 disclosed only one nonexpendable archaeological resource within the Gulf Nuclear Station site and its associated transmission routes. This was a Marksville period (150 BC -- 300 AD.) Indian burial mound which lay about 1000 feet directly south of the meteorological tower. The excavation and data recovery was performed in the winter of 1972-1973 under the direction of Mr. James H. Stone, then Assistant Administrator of the Division of Historic Sites and Archaeology of the Mississippi Department of Archives and History. Upon completion of the salvage archaeological excavation, the Department deemed it unnecessary to preserve the site since the mound no longer existed.

Documentation from the FER indicated three battle areas within a five-mile radius of the GGNS site. Two of these sites - the Grand Gulf Military Park and the Port Gibson Battlefield - are listed in the National Register of Historic Places. The Port Gibson Battlefield is located approximately two miles south of the Grand Gulf Nuclear Station site. (Reference 29)

2.5.4 Environmental Justice

Executive Order 12898 (59 FR 7629) directs Federal executive agencies to consider environmental justice under the National Environmental Policy Act. This executive order ensures that minority and/or low-income groups do not bear a disproportionate share of adverse environmental consequences of a proposed project.

This environmental justice section provides an indication of the low-income and minority populations within the region surrounding the GGNS site. “Low-income” is defined as a household living at or below the national poverty level. A “minority” individual is defined as an individual who is American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or, Hispanic.

The characteristics of the population within the region, an area with a 50-mile radius around the GGNS site, were determined by examining 2000 Census data (Reference 1) as discussed in Sections 2.5.1 and 2.5.2.

A minority population is defined to exist if the percentage of minorities within a Census Block Group (CBG) exceeds the percentage of minorities in the State, in which the CBGs are located, by 20 percentage points or more, or if the percentage of minorities in the CBG is 50 percent or greater. A low-income population is defined to exist if the percentage of households within a Census Tract[5] living below the poverty level exceeds the percentage of low-income households within the state by 20 percentage points, or if the percentage of low-income households in the Census Tract is 50 percent or greater. (Reference 39)

Portions of Mississippi counties and Louisiana parishes in the region with minority populations that meet the criteria above are indicated in Figures 2.5-6 and 2.5-7, respectively. Overall, minority individuals account for approximately 46% of the population within the 50-mile radius (Table 2.5-3).

As detailed in Section 2.5.2, the region surrounding the GGNS site is generally a rural, economically isolated community, roughly split by the Mississippi River between Mississippi and Louisiana. Claiborne, Copiah, and Jefferson Counties in Mississippi, and Tensas Parish,

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[5] Because of difficulties in obtaining income data from the 2000 Census that is compatible with the LandView program used for this analysis, income data is presented per Census Tract instead of Census Block Group.

Louisiana, all within the region, are classified as persistent poverty counties (Reference 36). This designation indicates a rural non-metropolitan area in which at least 20 percent of the population lived in poverty in 1960, 1970, 1980, and 1990 (Reference 37). The poverty in this region is worse, when county or parish poverty estimates are compared to state averages. For example, regarding relevant Mississippi counties, the 2000 U.S. Census (Reference 1) indicates the percent of individuals below the poverty level in Claiborne County is 32.4% as compared to the State of Mississippi with 19.9% of individuals below the poverty level (Reference 38). Claiborne County and Tensas Parish income and poverty data obtained from the 2000 U.S. Census is provided in Table 2.5-7. The few areas of Mississippi and Louisiana, in the region surrounding the GGNS site, which meet the "low-income population" criteria defined above are indicated in Figures 2.5-8 and 2.5-9, respectively.

2.5.5 References

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2.6 Geology

A detailed description of the geological, seismological, and geophysical characteristics of the GGNS Site and the ESP Site region (200 mile radius), vicinity (25 mile radius), area (5 mile radius) and the site location (0.6 mile radius) is provided in the ESP Site Safety Analysis Report, Part 2 of the Application.

2.7 Meteorology and Air Quality

This section describes the general climate of the Grand Gulf Nuclear Station (GGNS) site and the surrounding regional meteorological conditions. This section also documents the range of meteorological conditions that would likely exist during the construction and operation of a new facility. Data presented includes a climatological summary of normal and extreme values of several meteorological parameters for the National Weather Service stations located in Jackson and Vicksburg, Mississippi.

2.7.1 General Climate

General climate data provided here is based on Climatic Atlas of the United States, (U.S. Department of Commerce, 1968 - Reference 32), "Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years" (U.S. Weather Bureau, 1961 - Reference 20), and "Two to Ten Day Precipitation for Return Periods of 2 to 100 Years in the Contiguous United States" (U.S. Weather Bureau, 1964 - Reference 21).

The climate of southwestern Mississippi is humid and subtropical with a short cold season and a relatively long warm season. The predominant air mass over the region during most of the year is maritime tropical with origins over the Gulf of Mexico. In the winter, occasional southward movements of continental polar air from Canada bring colder and drier air into Mississippi. However, cold spells seldom last more than 3 or 4 days. (Reference 4)

In summer, climate is almost wholly dominated by the westward extension of the Bermuda High, a subtropical, semi-permanent anticyclone. The prevailing southerly winds provide a generous supply of moisture and this, combined with thermal instability, produces frequent afternoon and evening showers and thundershowers. The convective thundershowers of the summer season are more numerous than frontal type thunderstorms. However, the thunderstorms associated with the occasional polar front activity in late winter and early spring are more severe and sometimes produce tornadoes. (Reference 4)

Mississippi is south of the average track of winter cyclones, but occasionally one moves across the State. In some winters, a succession of such cyclones will develop in the Gulf of Mexico or in Texas and move over or near the State. Mississippi is also occasionally in the path of tropical storms or hurricanes. (References 4 and 1).

Snowfall is not a rare event in Mississippi. During the 65 years from 1898 through 1957 and 1997 through 2001, measurable snow or sleet fell on some part of the State in all but three years. During these 65 years, snow or sleet fell in January in 40 years and, in February, in 32 years. Along the latitude of the site (approximately 32° north), snow falls in approximately 30 percent of the years. (References 1 and 3)

An ice storm (also called glaze ice) is the accretion of generally clear and smooth ice, formed on exposed objects by the freezing of a film of supercooled water deposited by rain, drizzle, or possibly condensed from supercooled water vapor. The weight of this ice is often sufficient to greatly damage telephone and electric power lines and poles. (Reference 4)

Most glaze is the result of freezing rain or drizzle falling on surfaces with temperatures between 25 °F and 32 °F. The glaze belt of the United States includes all of the area east of the Rocky Mountains. However, in the Southeast and Gulf Coast sections of the country, below freezing temperatures seldom last more than a few hours after glaze storms (References 4 and 15).

2.7.2 Regional Climatology

The description of the regional climatology at the time of licensing of GGNS Unit 1 was based primarily on climatological records for Vicksburg and Jackson, Mississippi. This description utilizes that data as appropriate and is augmented by more recent data for the Vicksburg station and the GGNS site meteorological tower.

Topographical considerations and examination of the records indicate that meteorological conditions at Vicksburg and Jackson are representative of the general climate of the region encompassing the site. Since Vicksburg is the closer of the two stations and borders the Mississippi River, the tables and figures included are based primarily on Vicksburg data when the period of record and observational procedures are considered adequate. Otherwise Jackson data are presented. (Reference 4)

Recent improvements in the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC) data systems provide easy access to local meteorological data records since the middle of 1996. GGNS site data is also available for this period. In several cases, such as the recurrence rate of rare events based on many decades of observation, the original GGNS Unit 1 data is preferable. For example, the last few years have been unusually dry in the region, so it would be more accurate and more conservative, in terms of maximizing rainfall predictions, to use the Unit 1 licensing data, rather than to draw long term rainfall conclusions on data from the last five years.

2.7.2.1 Wind

The general direction of airflow across the region is from the southerly sectors during much of the year, although the prevailing direction may be from one of the northerly sectors during some months. The net air movement can be deduced from the annual resultant wind values for the GGNS site shown in Table 2.7-1. The average windspeed at the site ranged from 3.7 miles per hour (mph) to 4.3 mph between 1996 and 2001. The average windspeed at Vicksburg between 1997 and 2001 ranged from 7.0 mph to 7.5 mph, as shown in Table 2.7-2.

2.7.2.2 Temperature

The temperature regime of the region can be described by the data shown in Table 2.7-3. From 1997 to 2001, the maximum dry bulb temperature during the summer months in Vicksburg was 99^{o}F while the winter extreme low was 16^{o}F. From 2000 to 2001, the maximum dry bulb temperature[1] during the summer at the GGNS site was 98.6^{o}F, while the winter extreme low was 17.3^{o}F.

Table 2.7-3 presents wet and dry bulb temperatures for Vicksburg and dry bulb temperature for the site. The values from Grand Gulf Updated Final Site Analysis Report (UFSAR) (Table 2.7-4) date from 1964, and represent data for Jackson, MS. The data collected at Vicksburg over a five-year period, and at Grand Gulf over a two-year period, are consistent with the GGNS UFSAR data.

2.7.2.3 Atmospheric Moisture

Climatic records of humidity in Vicksburg are shown in Table 2.7-5. These data show that relative humidity in the region is high throughout the year. Nighttime relative humidities are

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[1] Reference 2 includes temperatures and rainfall data only for a two-year period, from 2000 to 2001.

highest in summer and fall and lowest in winter. Daytime humidities are highest in winter. Seasonal variations are in the vicinity of 5 to 10 percent. Highest relative humidities occur in the early morning hours (0000 – 0600), averaging greater than 80 percent during all months. Lowest relative humidities occur during early and mid afternoon with averages ranging from approximately the mid-50s to the mid-60s for all months.

2.7.2.4 Precipitation

Mean annual precipitation in the region ranges from about 50 inches in northwestern Mississippi to 65 inches in the southeastern part of the State. During the freeze-free season, rainfall ranges from about 24 inches in the northwest to about 37 inches in the southeast, but during winter the precipitation maximum is centered in the northwest with the minimum on the coastal counties. The fall months are typically the driest of the year. (Reference 4) Yearly average precipitation at the GGNS site for 2000 and 2001 is approximately 45 inches (Table 2.7-6) and at Vicksburg for the period of 1997 to 2001 was about 50 inches (Table 2.7-7).

Local site meteorological conditions are expected to result almost entirely from synoptic-scale atmospheric processes. (Reference 4) That is, the local site does not have a unique micro-climate but rather the local meteorology is consistent with the regional meteorology. There are two exceptions caused by local effects due to the Mississippi River.

First, there is higher humidity directly adjacent to the Mississippi River, and so the Vicksburg humidity data is more appropriate for site estimates than the Jackson data.

Second, there is some evidence of channeling of extremely low level (less than 70 feet above grade) winds from the west into a trajectory along the River. This phenomenon has no effect on dispersion of effluents from the plant since the site is east of the area affected (Reference 4).

2.7.2.5 Severe Weather

This section describes severe weather phenomena in the region. Most recent data is taken from the NCDC Storm Event database that covers the period of 1950 through 2002 (Reference 5), but even longer data periods are used for some phenomena in order to document the occurrence of rare events.

2.7.2.5.1 Hurricanes

During the period 1899 to 2000 there were 117 documented cyclones that affected the Middle Gulf Coast (Louisiana, Mississippi, Florida, Texas and Alabama). Of these, 39 (33.3 percent) were Category 1, 30 (25.6 percent) were Category 2, 36 (30.8 percent) were Category 3, 10 (8.5 percent) were Category 4 and 2 (1.8 percent) were Category 5 hurricanes. Table 2.7-8 presents a monthly breakdown of the 117 cyclones and provides a definition of the storm categories.

Tropical cyclones, including hurricanes, lose strength as they move inland from the coast and the greatest concern for an inland site is possible flooding due to excessive rainfall. The extremes for rainfall presented below include possible hurricane effects. (Reference 4)

The small diameter, extremely intense Camille hurricane (1969), whose center passed less than 10 miles to the east of Jackson Municipal Airport, generated gusts at Jackson of only 67 mph. The top winds in this hurricane at points on the coast were estimated at over 170 mph (References 4 and 7).

2.7.2.5.2 Tornadoes

Tornadoes also occur in the region. A highly destructive tornado struck Vicksburg in December 1953. In addition, on April 17, 1978, a tornado struck GGNS. A detailed report of this event was submitted to the NRC (References 4 and 8). The tornadoes reported during the years 1950-2002 in the vicinity of Claiborne, Warren and Hinds Counties in Mississippi and Tensas Parish in Louisiana are shown on Table 2.7-9.

During the period 1950 to April 2002, a total of 108 tornadoes touched down in these four counties/parishes that have a combined area of 2,545 square miles (Reference 9). References 10 and 11 confirm that local tornadoes have a mean path area of 0.43 square mile. The site recurrence frequency of tornadoes can be calculated using the point probability method as follows:

Total area of tornado sightings = 2,545 sq. mi.

Average annual frequency = 108 tornadoes/52.3 years = 2.07 tornadoes/year

Annual frequency of a tornado striking a particular point P = [(0.43 mi^2) (2.07 tornadoes/year)] / 2545 sq. mi. = 0.00035

Mean recurrence interval = 1/P = 2,860 years.

2.7.2.5.3 Thunderstorms

Table 2.7-10 presents the thunderstorm data for the region from 1955 through April 2002. Approximately 62 percent of the thunderstorms in this area occur during the warm months (March-July), indicating that the majority are warm air-mass thunderstorms. From 1955 - April 2002, 421 thunderstorms are listed for this area, with Hinds County receiving approximately 40 percent, Claiborne County receiving 12 percent, Warren County receiving 32 percent, and Tensas Parish receiving 16 percent of the thunderstorms. The total of 298 storms shown in the table is less than the sum of the individual totals (421) for each of the three counties and Tensas Parish because some of the individual storms extended into more than one county.

2.7.2.5.4 Lightning

Data on lightning stroke density is extremely sparse. Analysis has shown that the density per square mile is approximately one-half of the number of storm days from the isokeraunic map. This was partially confirmed by a two-year count in a region with 27 storm days per year where the average stroke density was approximately 15 strokes per square mile per year (References 4 and 12).

The annual mean number of thunderstorm days in the site area is estimated to be 66 based on interpolation from the isokeraunic map (Reference 13); therefore it is estimated that the annual lightning stroke density in the GGNS site area is 33 strokes per square mile. (Reference 4)

2.7.2.5.5 Hail

From 1955 – April 2002, 279 hailstorms occurred in the region annually, with Hinds County receiving approximately 57 percent, Claiborne County receiving 6 percent, Warren County receiving 19 percent, and Tensas Parish receiving 18 percent of the hailstorms, as shown in Table 2.7-11. For this table, each occurrence of hail was counted as an individual event, even if two counties recorded hail simultaneously. The most probable months of occurrence of hail are March and April. Property damage occurs infrequently, with 6 recorded events in Warren

County, 14 in Hinds County, 4 in Claiborne County, and 2 in Tensas Parish in this 47-year period.

2.7.2.5.6 Severe Winter Storm Events

The occurrences and durations of recorded ice storms and heavy snow storms in the three counties and one parish in the vicinity of the GGNS site for the eight-year period 1993-2001 is shown in Table 2.7-12. From these data, conservatively including the heavy snowstorm of 1997, the frequency of ice storms in the Grand Gulf area is estimated to be 4 in 8 years, or 0.5 storms per year.

The ice storm reported from December 22, 1998 at 8:00 PM through December 25 at 5:00 AM, was the longest lasting storm with a total duration of 57 hours. Property damage was estimated at $16.6 million. It should be noted that, while the ice storm duration was 57 hours, that period was over an area of 27 counties. Vicksburg reported the following history: 2 hours of trace rain (~0.01 inches), followed by one dry hour, and then eight hours of rain for a total of 0.4 inches at the start of the storm, then a period of 15 hours with only a trace of precipitation, and then 11 hours of rain totaling 0.85 inches, followed by only a trace of precipitation for the remainder of the storm. A conservative approach would be to neglect the dry/trace precipitation periods and assume this represents a 19-hour ice storm duration. Reference 4 also discussed combining periods of ice storms in this manner and developed a 12-hour maximum based on the ten years 1954 through 1963. Based on a maximum duration of 12 hours in 10 years of data, and this maximum value of 19 hours in 18 years of data, the maximum probable duration in 100 years would be 27 hours assuming a logarithmic extrapolation, i.e.,

$27 = 12 + (19-12)*\log(100-10)/\log(18-10)$.

The total number of glaze storms reported in the broad general area surrounding the plant site during the period 1917 through 1953 inclusive, ranged from 1 to 7. It is estimated that approximately 30 percent of these caused ice coatings in excess of 0.5 inches in some portions of the area. (Reference 4) As noted above, Vicksburg received approximately 1.25 inches of precipitation during the 1998 ice storm.

Rainfall in the recent 5-year period discussed below is from a period of relatively low rainfall (Reference 18). Therefore, it is conservative to use earlier data periods to develop the probable maximum winter precipitation values. Table 2.7-13 shows that the maximum rainfalls at Vicksburg in the 5-year period 1997-2001 are well below the 5-year recurrence rate presented in the GGNS UFSAR Table 2.3-74. This UFSAR data is based on a 15-year period.

The observed maximum precipitation amounts (water equivalent) during any consecutive 48-hour period at Jackson, Mississippi for the indicated winter (November through March) seasons is given in Table 2.7-14. (Reference 17) The data were analyzed by the Gumbel-Lieblein method described by Thorn in Reference 16 with the following results: (Reference 4)

Return Period (Years)	Max. 48 Hr Winter Precip. Water Equivalent (inches)
10	4.60
25	5.50
50	6.15
100	6.80
500	8.20
1000	8.80

Thus, it is estimated that a value of 7.0 inches (water equivalent) is ultra-conservative for the 48-hour probable maximum winter precipitation at the Grand Gulf site, especially since only one of the above maximum values contained a trace of frozen precipitation. (Reference 4)

The maximum reported snow and/or ice depths at Jackson and Vicksburg, Mississippi were reviewed from three sources. The current NCDC storm event database (Reference 5) identifies that the greatest snowfall in its period of data, 1993 to September 2002, occurred on December 14, 1997. That storm deposited 8 inches of snow in certain areas in a snow event that covered Claiborne, Hinds and Warren Counties. Reference 23 records that a site in the Vicksburg area saw a total of 10.1 inches of snowfall in January 1919. Reference 19 identifies the maximum 24-hour snowfall at Jackson as 10.6 inches in January 1940. Since this data review covers at least 83 years back to 1919, it is possible to conclude with 83 percent confidence that the 100-year snowfall maximum is 10.6 inches.

In the Jackson/Grand Gulf area, snow melts and/or evaporates quickly, usually within 48 hours, and before additional snow is added. Since the plant site is subjected to a subtropical climate with mild winters, prolonged snowfalls or large accumulations of snow or ice on the ground and structures are not anticipated.

2.7.3 Regional Air Quality

Air quality in the vicinity of the GGNS ESP site is generally good, including compliance with the newly promulgated U.S. Environmental Protection Agency 8-hour ozone standard of 0.08 ppm. For example, maximum ozone concentration in Hinds County, MS in 1999 was 0.08 ppm and in Warren County, MS, the maximum ozone concentration was 0.07 ppm (Reference 33). These levels are generally a reflection of the predominantly rural character of the region. Contact with the Mississippi Department of Environmental Quality indicates that these three counties are in an air quality attainment status for all criteria pollutants, including the 8-hour ozone standard.

For Jackson, MS, the closest Standard Metropolitan Statistical Area (SMSA) to the site, the fourth highest ozone concentration in 1999 was 0.083 ppm. The 10-year trend (1990-1999) in ozone concentrations in Jackson is increasing (Reference 33). The somewhat higher ozone levels in the Jackson SMSA are likely a result of increasing population and increasing economic activity.

The Grand Gulf Unit 1 UFSAR also contains an evaluation of smog based on Jackson data over the years 1955 through 1964. Grand Gulf is well removed from Jackson metropolitan area and Vicksburg, and is, therefore, not prone to heavy smog. Table 2.7-100 shows haze records by month from Vicksburg for the period of 1997 - 2001. There were about 194 hours/yr on average of haze during this period.

2.7.4 Local Meteorology

The following sections contain information on wind, air temperature, atmospheric water vapor, precipitation, and fog in the vicinity of the ESP site.

2.7.4.1 Wind Distribution (All Meteorological Conditions)

Wind data is available from both the Vicksburg meteorological station and the Grand Gulf meteorological tower. Both sets of data are discussed here to provide a fuller description of winds in the area.

2.7.4.1.1 Vicksburg Wind Data

Tables 2.7-62 through 2.7-73 provide monthly percent joint frequency distributions for wind directions and speeds, based on a 5-year period of record from 1997 through 2001, for Vicksburg. Table 2.7-74 provides an annual summary of the data. On an annual basis, Vicksburg wind data collected in the five years 1997 through 2001 show central north is the most frequent (13.8 percent) wind direction. The wind is from the southeast through central south 30.8 percent of the time. Westerly (W-SW - W-NW) and easterly (E-NE - E-SE) winds are least frequent with frequencies of 9.1 percent and 16.2 percent, respectively. Southerly components prevail in spring, summer and winter, while northerly components prevail in the fall (Tables 2.7-62 through 2.7-73).

Winds average greater than 8.1 mph from January through April, and 7.7 mph or less from May through December. Mean annual wind speed is 7.4 mph (Table 2.7-74).

The Vicksburg meteorological station winds are presented graphically in Figures 2.7-8 through 2.7-13. These wind roses cover the period from 1997 through 2001 and represent the frequency of winds coming from a particular direction by the length of the line in that direction. Vicksburg records a usual pattern of winds coming from the north or south. At Vicksburg, winds from the west occur as infrequently as winds from the east. However, in the year 2001 most winds came from the eastern half of the compass rose (Figure 2.7-13).

2.7.4.1.2 Grand Gulf Wind Data

The same wind data assessment was applied to GGNS site data collected at the Grand Gulf meteorological tower for the period from 1996 through 2001 (Reference 2). Monthly relative frequencies of wind direction and speed for the GGNS site are shown in Tables 2.7-75 through 2.7-86, and data for all years is given in Table 2.7-87. The wind speeds are hourly averages and there are no zero speeds recorded. The minimum site recorded wind speed is 0.309 mph. Winds average greater than 4.2 mph from December through April and 3.6 mph or less from May through November. Mean annual wind speed is 3.9 mph.

Wind roses are presented for the GGNS site in Figures 2.7-1 to 2.7-7 for the 6-year period from 1996 through 2001. The normal wind pattern shows winds primarily from either the north (NW to NE) or south (SW to SE), with the highest frequency originating in the SE. In most years, few winds blew from the east, although 2001 was an exception to this pattern. In general, the wind roses from Vicksburg and Grand Gulf show the same trend toward prevailing winds from the NW to NE and SW to SE.

2.7.4.1.3 Wind Direction Persistence

Hourly weather observation records from the National Weather Service at Vicksburg, Mississippi for the years 1997 through 2001 were examined for wind direction persistence. The longest persistence periods from a single sector (22.5 degrees), three adjoining sectors (67.5 degrees), and five adjoining sectors (112.5 degrees) were determined from each sector (and calm) during each year. The results are shown in Tables 2.7-88 through 2.7-90. During the period, the single sector persistence was greatest (28 hours) for the central north direction. The average maximum persistence (17.6 hours) was also greatest for the central north direction. For the persistence in three adjoining sectors, the central south sector had the longest period of persistence (109 hours) and the largest average maximum persistence (63.8 hours), as shown in Table 2.7-89. The longest persistence period (105 hours) from five adjoining sectors occurred in the S-SE sector (Table 2.7-89). The central north sector showed the greatest average maximum persistence (57.2 hours).

Wind persistence data similar to the above are shown in Tables 2.7-91 through 2.7-93 for the Grand Gulf site. The statistics shown in these tables cover a six-year period from 1996 through 2001. Table 2.7-91 shows that the longest single sector persistence period was 27 hours from the central north sector. The central north sector also had the greatest average maximum persistence. For the persistence in three adjoining sectors, the central south sector had the longest period of persistence (109 hours) and the largest average maximum persistence (63.8 hours) as shown in Table 2.7-92. The persistence data for five adjoining sectors (Table 2.7-93) shows the central N-NE sector with the longest persistence period (181 hours) and the greatest average maximum persistence (102.8 hours).

Table 2.7-94 presents a comparison of the maximum persistence period for the GGNS site in hours with historic data from Jackson and Table 2.7-95 presents a comparison of the maximum persistence periods for Vicksburg and GGNS. While there are differences in the preferred sectors, the data demonstrate that it is not likely that any single wind direction would persist for a substantial period of time.

2.7.4.2 Air Temperature

Table 2.7-96 indicates that temperature extremes for Vicksburg have ranged from 107 ^{o}F (August and September 2000) to 16 ^{o}F (January 2001) (Reference 3). Table 2.7-97 also indicates that temperature extremes for GGNS have ranged from 104.2 ^{o}F (August 2000) to 17.3 ^{o}F (January 2000) (Reference 2). The data shows good agreement between the two locations.

Figures 2.7-14 and 2.7-15 present the site hourly temperatures for the years 2000 and 2001 (Reference 2). A comparison of the two years is made in Figure 2.7-16, where the maximum and minimum temperatures measured in 96-hour intervals are plotted against the start date of the interval.

2.7.4.3 Atmospheric Moisture

Mean relative humidities for four time periods per day at Vicksburg are shown in Table 2.7-5 (Reference 3).

All of Mississippi experiences high humidity during much of the year. At Vicksburg humidities of 90 percent or higher have occurred at any hour of the day. They are most frequent in the early morning hours. In the summer, at times there develops a combination of high temperatures together with high humidities; this usually builds up progressively for several days and becomes oppressive for one or more days. Humidities of less than 50 percent occur on some days each month, usually in the early afternoon hours. Humidities drop under 30 percent on about one-quarter of the October and November days; the number of days with such low humidities diminishes in the other months. In July and August there may be none (References 4 and 19).

Table 2.7-3 shows temperature data for the GGNS site and Vicksburg. Maximum one percent exceedance dry bulb of 99 °F and the one percent exceedance maximum wet bulb temperature of 82 °F are shown for Vicksburg. These values are slightly greater than the Grand Gulf Unit 1 maximum temperatures of 98 and 79, respectively, that were based on a 1964 data source (Table 2.7-4).

2.7.4.4 Precipitation

2.7.4.4.1 Rain

Average monthly precipitation at the GGNS site follows a seasonal trend, reaching a maximum mean in March (10.02 inches) and a minimum mean in November (0.02 inches). Maximum annual mean precipitation has been 46.85 inches. For Vicksburg, the maximum mean precipitation is in December (9.94 inches) and a minimum mean in May (0.38 inch). The maximum annual precipitation in Vicksburg is 59.76 inches.

The GGNS site rainfall data covers the time period from 2000-2001 and the Vicksburg data covers the time period from 1997-2001 (References 2 and 3). Monthly and annual mean and extreme precipitation amounts for the GGNS site and Vicksburg, Mississippi (References 2 and 3) are presented in Tables 2.7-6 and 2.7-7, respectively. Tables 2.7-98 and 2.7-99 provide monthly frequency distribution of rainfall rates at the Grand Gulf site and Vicksburg, respectively.

In general, the Vicksburg data appears to be representative of the GGNS site area. The variations between the two locations from month to month, particularly during the summer months, are likely reflective of the occurrence of heavy shower and thunderstorm activity common in the area.

The maximum short period precipitation was determined for the GGNS Unit 1 UFSAR (Reference 4). As discussed previously, that data is still valid and conservative as compared to recent experience. The maximum point precipitation values are given in Table 2.7-13. These were interpolated from the maps of USWB Technical Papers 40 and 49 (References 4, 20, and 21). For comparison purposes, the recent 5-year maximum short period precipitations are listed in the table for Vicksburg, Mississippi.

Table 2.7-100 was obtained from Reference 22. It presents maximum observed short period precipitation data for Vicksburg. A comparison of the two tables suggests that 100-year frequency precipitation events may have occurred during the period of record (1893-1961) for periods of 3, 6, 12 and 24-hour durations. (Reference 4)

A comparison of the more recent data record, the five years from 1997 through 2001, shows that the more recent period has had fewer heavy rainfall events than would be expected for a random 5-year period.

2.7.4.4.2 Snow

Annual average snowfall in the Grand Gulf area is estimated to be 1 to 2 inches. This estimate is based on 36 years of record (1930-1966) at Vicksburg (Reference 23) and 39 years of record (1936-1975) at Jackson (References 4 and 19). This data is assumed to be more representative of the long term site meteorology due to the relatively dry recent years, although, during 1997 through 2001, the Vicksburg meteorology station reported snow conditions for several hours in November through March as presented in Table 2.7-101.

The maximum monthly amount in Vicksburg was 10.0 inches in February 1960 and this total fell within a 24-hour period. The maximum annual amount was also 10.0 inches. At another site in the Vicksburg area, a total of 10.1 inches of snow fell in January 1919 (References 4 and 23). The maximum recorded in the current NCDC storm event database is 8 inches on December 14, 1997 (Reference 5). This database includes snowstorms for the period 1993 through September 2002.

The maximum monthly amount at Jackson was 10.6 inches in January 1940 during a 24-hour period. The maximum annual amount was 11.6 inches and occurred in the 1939-1940 season (References 4 and 19).

2.7.4.5 Fog

Fog is an aggregate of minute water droplets suspended in the atmosphere near the surface of the earth. According to international definition, fog reduces visibility to less than 0.62 miles.

Table 2.7-102 indicates that, over the period 1997 to 2001, Vicksburg has averaged approximately 92 hours/year of fog, with October through January having the greatest frequency of fog. Vicksburg records are considered representative of the Grand Gulf site due to its proximity and to its similar location relative to the east bank of the Mississippi River.

Note that the GGNS Unit 1 UFSAR (Reference 4) estimated that moderate fog will occur approximately 1 percent (88 hours) of the time at Grand Gulf, and heavy fog will occur approximately 0.6 percent (53 hours) of the time, which is consistent with the Table 2.7-102 data.

2.7.4.6 Atmospheric Stability

Atmospheric stability data for the GGNS site were generated as part of a plume behavior study. This stability data was generated in Reference 24, based on five years of surface observations at the GGNS site and the Vicksburg NCDC meteorology station. Hourly observation data were converted into stability classes and frequency by season using the SACTI software code (Reference 25). The resulting stability classes for Grand Gulf are presented by season and wind direction in Tables 2.7-16 through 2.7-19, and annual frequency data is presented in Table 2.7-15.

The frequency and strength of inversion layers are also investigated with nine years of weather balloon data collected at the Jackson Airport. Weather balloons are released twice daily at 6:00 a.m. and 6:00 p.m. to collect temperatures at increasing elevations. The monthly data are provided in Tables 2.7-20 through 2.7-31 in terms of percentages of mornings and afternoons containing inversions, average inversion layer elevation, and the maximum strength of the inversions. Table 2.7-32 provides annual average data for the period. An inversion is defined as any three elevation readings showing temperatures increasing with elevation. The inversion layer height is the point (found by interpolation between readings) at which temperature again starts to decrease with elevation. The maximum inversion strength is the maximum temperature rise divided by elevation difference within the inversion layer (Reference 14).

The weather balloon data does not address how long inversion layers may persist. For this purpose, the GGNS UFSAR data, based on the period 1955 through 1964, is used in Tables 2.7-33 through 2.7-44. The tables show the number of discrete periods when inversion conditions existed one hour, or two or more consecutive hours. Short periods contained within a longer period are not considered as discrete occurrences. These tables show the data for each of the 10 years in order to show the variations from year to year. They also show the monthly mean distribution calculated from the 10 years. (Reference 4)

The monthly means are summarized in Tables 2.7-45 and 2.7-46. They have been summed to provide an annual mean.

Tables 2.7-47 through 2.7-60 show similar inversion data for the Grand Gulf site. These inversion occurrences were determined from E, F or G stability classifications resulting from onsite delta-temperature measurements. The period covered by the data is from August 1972 through July 1974 and January 1976 through December 1976. (Reference 4)

2.7.4.7 Mixing Heights

Monthly mixing heights for Jackson, Mississippi are shown in Table 2.7-61. These were obtained from the NCDC and are based on the ten-year period 1992 through 2001 (Reference 4), which are based on a four-year record at Jackson. The average mixing heights in the mornings are lowest during the fall, and the average mixing heights in the afternoon are lowest in the winter.

2.7.4.8 Topographical Description of the Surrounding Area

The proposed location for a new facility is approximately 6,300 feet east of the Mississippi River. The Town of Port Gibson, Mississippi is located approximately six miles to the southeast; the Town of St. Joseph, Louisiana is approximately 13 miles to the southwest, and the Big Black River discharges into the Mississippi River approximately three miles to the north.

The surrounding terrain is generally hilly and wooded to the south and east, with several hilltops over 350 feet above mean sea level (MSL) to the south. To the north and west, the terrain is generally flat and wooded, with an elevation less than 100 feet above mean sea level. Numerous lakes of various sizes and isolated marshes dot the landscape. There is a rather abrupt (irregular) 100 to 200 foot rise in terrain approximately one mile east of the river bank. Figures 2.7-17 through 2.7-19 present topographic cross sections and a site area map. (Reference 4)

According to Regulatory Guide 1.3, credit for elevated release of contaminants is allowed only if the release point is at a height of at least 2.5 times the height of the tallest nearby structure that could affect dispersion. Since discussion of effects of topography on diffusion estimates is required only for elevated releases, and the diffusion analyses for a new facility at the Grand Gulf site assume a ground level release, these effects have not been estimated.

2.7.5 Onsite Meteorological Measurements Program

The onsite meteorological measurements program has been designed to meet requirements at least as stringent as those required by Regulatory Guide 1.23.

The onsite meteorological measurement program has evolved over the years from temporary monitoring towers installed prior to construction to a state-of-the-art system installed in late 2000 and early 2001. In March of 1972 two temporary towers were installed, one on the bluff and one in flood plane, near the Mississippi River Bank. A permanent tower was installed in August 1972 approximately 5000 ft N-NW of the center of the Unit 1 reactor, adjacent to the temporary tower. Both temporary towers were removed in March of 1973.

The permanent tower was 162 ft high and supported instrumentation for wind speed and direction and temperature at 33 ft and 162 ft. The instrumentation on this tower was upgraded in 1983 to meet the requirements of NUREG-0654 as part of the initial licensing conditions for

GGNS Unit 1. A back-up tower was also installed to provide data on wind speed and direction and sigma-theta.

Data collection since the startup of the system (August 1972) has met Regulatory Guide 1.23 (Rev. 0) requirements except the relative humidity data as discussed in Section 2.7.5.1. A new relative humidity sensor was installed in December 2000 as indicated in Section 2.7.5.2.

2.7.5.1 Onsite Meteorological Measurements Program – Pre-2000 Modifications

The following describes the GGNS site meteorological tower and instrumentation as of 1983 and prior to modifications in year 2000 (text in Section 2.7.5.1 is taken from a previous revision of Reference 4, GGNS UFSAR).

The permanent tower is 162 feet high and has the following equipment installed at each of the indicated levels (all heights above grade):

Surface	Tipping bucket rain gauge Delta temperature translator (utilizes 33- and 162-foot temperature sensors)
33 feet	Wind speed sensor, Wind direction sensor, Temperature sensor, Dew point sensor
162 feet	Wind speed sensor, Wind direction sensor, Temperature sensor

Table 2.7-103 shows the specifications of the meteorological equipment at Grand Gulf. All data collected since the starting date of August 2, 1972, have met Regulatory Guide 1.23 requirements except the relative humidity data. Maintenance and operational difficulties were experienced with the relative humidity sensors. The sensors were replaced by two Tech-Ecology Met Set 5-T Dewpoint systems in December 1976.

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All parameters are measured by duplicate sensors at each level.

Meteorological data from the permanent tower will be supplemented with information from the backup meteorological system. This system will monitor wind speed, wind direction, and sigma theta. The information from the backup system will be supplied to the control room via a telemetry system. This information will be utilized to ensure data availability should a temporary loss of information from the permanent tower occur. Table 2.7-103 outlines the specifications for the backup meteorological equipment.

All information recorded by the meteorological instruments on the permanent tower are stored both in digital and analog forms. The analog traces serve as backup to the digital system. Data from the temporary tower instrumentation were recorded by analog trace only.

The permanent (main) tower serves as a representative observation station (i.e., meteorological conditions at that location are considered to be representative of the site). The 162-foot meteorological tower with base elevation of 156 feet (MSL) is located approximately 5,300 feet northwest of the control building of the station as shown in Figure 2.1-1. The nearest bluffs are 362 feet to the west of the meteorological tower. There are trees 35 feet high along these bluffs.

Approximately 50 feet below the bluffs the flood plain extends 4,500 feet to the west to meet the Mississippi River at an elevation of 65 feet (MSL). To the south and to the east, the nearest trees are 689 feet and 396 feet from the tower, respectively. Tree heights in these directions are between 50 to 60 feet. A country road passes the meteorological tower 400 feet to the north. The meteorological tower is surrounded by a fence which is 7 feet high and 70 feet away from the base of the tower. An instrument shack about 8 feet high is installed near the base of the tower. The immediate vicinity of the tower is covered by Bermuda grass which is mowed as necessary. The soil beneath the grass is loess. ….

The percentage of data recovery during the first annual cycle … for [the] combination of sensor systems used in preparation of joint frequency distributions … and used in diffusion analyses …. [50/10 meters (162/33 feet) T, 10 meters (33 feet) wind direction and speed], [was] 98.73 percent of all possible sets of hourly values from August 1, 1972 through July 31, 1973 …. Data recovery from each of the other sensing systems exceeded 90 percent for the year.

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2.7.5.1.1 Meteorological Data Processing

2.7.5.1.1.1 Introduction

The data processing procedure for Grand Gulf meteorological data involves three basic steps:

a. Data collection

b. Data editing and consolidation

c. Data analysis

Computer software has been developed to process the collected data according to steps b. and c. above. This section includes a summary of the data collection methods and description of the processing and analysis of the data.

2.7.5.1.1.2 Data Collection

The onsite meteorological data are recorded in both analog and digital form.

2.7.5.1.1.2.1 Analog Data

The analog traces are recorded on strip charts which act mainly as a backup and verification for the digital data. The data are recorded continuously on six chart rolls, one for each of the following sets of parameters:

1. 50-meter (162 foot) wind speed and direction (sensor A)
2. 50-meter (162 foot) wind speed and direction (sensor B)
3. 10-meter (33 foot) wind speed and direction (sensor A)
4. 10-meter (33 foot) wind speed and direction (sensor B)
5. 10-meter (33 foot) temperature and 50-meter (162 foot)/ 10-meter (33 foot) T, surface precipitation, and 10-meter (33 foot) dew point temperature (sensor A)
6. 10-meter (33 foot) temperature and 50-meter (162 foot)/ 10-meter (33 foot) T, surface precipitation, and 10-meter (33 foot) dew point temperature (sensor B)

All wind speeds are recorded in miles per hour. Wind directions are recorded on a 0-[360 degree] scale. Temperatures are recorded in F (degrees Fahrenheit). The precipitation is a step trace, each step representing 0.01 inches.

2.7.5.1.1.2.2 Digital Data

The digital data is received by the plant data computer at a rate of one reading per second. It is recorded each time the value varies by a specified deadband. Each piece of data is checked to assure it is between the minimum and maximum instrument limits. This quality indication and the time is recorded with each value.

An average is calculated each hour from the one second readings. The quality of the samples is reflected in the quality of the average. This quality indication and the time the average was calculated is recorded with each hourly value.

The meteorological data are available to the main control room and personnel via the plant computer. A one second reading and an hourly average is available for each of the following parameters:

1. Wind speed - 10-meter (33 foot) and 50-meter (162 foot) elevations
2. Wind direction - 10-meter (33 foot) and 50-meter (162 foot) elevations
3. Temperature - 10-meter (33 foot) elevation
4. Differential temperature (T) - 10-meter (33 foot) and 50-meter (162 foot) elevations
5. Dew point - 10-meter (33 foot) elevation
6. Precipitation - ground level

2.7.5.1.1.2.3 Data Processing

The meteorological data is gathered from the plant data computer recordings on request. The quality of the hourly averages is used to determine the data reliability. The data is then available for correction or change and reliability is evaluated again.

The hourly readings are used to calculate joint frequency distributions from wind speeds and wind direction data for the 10 meter and 50 meter levels. These frequency distributions are summarized on request for each Pasquill Stability Class.

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2.7.5.1.2 Meteorological Instrumentation Inspection and Maintenance

GGNS has established procedures for the inspection and maintenance of the onsite meteorological instrumentation. This responsibility is shared between the Operations and Maintenance Departments.

Routine inspections are made to ensure proper operation of equipment and that no damage to the tower, shack, or any other structure or equipment has occurred. The recording medium are checked for proper operation and changed biweekly. The standby generator is tested for auto start on a routine basis.

Semiannual visual inspections of the tower and equipment are made to determine the conditions of sensors, cabinets, wiring, structures, and individual components. Semi-annual checks for proper instrumentation readings are made at various points. A check for the "As-Found" and "Final" data condition are made to verify proper operation of the equipment. A check on the battery bank and battery charger is made along with the proper operation of the standby generator and its inverter. The tower cables are adjusted for proper tension, and the following instrumentation is calibrated:

1. 2 - Differential temperature sensor, El. 33'-162' (10-50 meters)
2. 2 - Dew point - El. 33' (10 meters)
3. 2 - Wind speed - El. 33', 162' (10 meters, 50 meters)
4. 2 - Wind direction - El. 33', 162' (10 meters, 50 meters)
5. Rain gauge – Surface

2.7.5.2 Onsite Meteorological Measurements Program – Post-2000 Modifications

Both the main 162 ft (50-meter) tower and backup 33 ft (10-meter) tower were replaced around December of 2000, due to obsolescence and increased maintenance costs. The 162 ft (50-meter) tower has the following equipment installed at each of the indicated levels (all heights above grade):

The following describes the GGNS site meteorological tower and instrumentation as of implementation of modifications in year 2000 (text in this Section 2.7.5.2 is taken from Reference 4, GGNS UFSAR).

Surface	Tipping bucket rain gauge
	Delta temperature (utilizes 33- and 162-foot temperature sensors)
33 feet	Wind speed sensor
	Wind direction sensor
	Relative humidity sensor
162 feet	Wind speed sensor
	Wind direction sensor
	Temperature sensor

The specifications for the new instrumentation are provided in Table 2.7-104.

The main tower serves as a representative observation station (i.e., meteorological conditions at that location are considered to be representative of the site). The 162-foot meteorological tower with base elevation of 156 feet (MSL) is located approximately 5,300 feet northwest of the control building of the station as shown in Figure 2.1-1. The nearest bluffs are 362 feet to the west of the meteorological tower. There are trees approximately 50 feet high along these bluffs. Approximately 50 feet below the bluffs, the flood plain extends 4,500 feet to the west to meet the Mississippi River at an elevation of 65 feet (MSL). To the south and to the east, the nearest trees are approximately 489 feet and 396 feet from the tower, respectively. Tree heights in these directions are between 50 to 60 feet. A country road passes the meteorological tower 600 feet to the north. The meteorological tower is surrounded by a fence which is 8 feet high. An instrument shack about 8 feet high is installed approximately 400 feet north of the tower. ….

Data recovery from the new meteorological tower instrumentation, based on evaluation of data from March 2001 to March 2002, was 98 percent.

2.7.5.2.1 Meteorological Data Processing

The data processing procedure for Grand Gulf meteorological data involves three basic steps:

a. Data collection

b. Data editing and consolidation

c. Data analysis

Computer software has been developed to process the collected data according to steps b. and c. above. This section includes a summary of the data collection methods and description of the processing and analysis of the data.

2.7.5.2.1.1 Data Collection

The onsite meteorological data are recorded in digital form.

All wind speeds are recorded in miles per hour. Wind directions are recorded on a 0-360° scale. Temperatures are recorded in F (degrees Fahrenheit). The precipitation is a step trace, each step representing 0.01 inches. Relative humidity is recorded on a 0 100% scale. Sigma Theta is calculated and recorded in degrees.

The digital data package is received by the plant data computer every ≤ ten seconds. It is recorded each time the value varies by a specified deadband. Each piece of data is checked to assure it is between the minimum and maximum instrument limits. This quality indication and the time is recorded with each value.

An average is calculated every fifteen minutes and each hour from the readings. The quality of the samples is reflected in the quality of the average. This quality indication and the time the average was calculated is recorded with each value.

The meteorological data are available to the main control room and personnel via the plant computer. A ≤ ten second reading, a fifteen minute average, and an hourly average is available for each of the following parameters:

1. Wind speed – 10-meter (33 foot) and 50-meter (162 foot) elevations
2. Wind direction – 10-meter (33 foot) and 50-meter (162 foot) elevations
3. Temperature – 10-meter (33 foot) and 50-meter (162 foot) elevations
4. Differential temperature (T) – 10-meter (33 foot) and 50-meter (162 foot) elevations
5. Relative Humidity – 10-meter (33 foot) elevation (ten second and hourly only)
6. Precipitation – ground level
7. Sigma Theta – 10-meter (33 foot) and 50-meter (162 foot) elevations (fifteen minute and hourly only)
8. Aspirator flow – 10-meter (33 foot) and 50-meter (162 foot) elevations (fifteen minute and hourly only)

2.7.5.2.1.2 Data Processing

The meteorological data is gathered from the plant data computer recordings on request. The data can also be acquired from data storage modules in the meteorological monitoring tower shack. The quality of the hourly averages is used to determine the data reliability. The data is then available for correction or change and reliability is evaluated again.

The hourly readings are used to calculate joint frequency distributions from wind speeds and wind direction data for the 10 meter and 50 meter levels. These frequency distributions are summarized on request for each Pasquill Stability Class.

2.7.5.2.2 Meteorological Instrumentation Inspection and Maintenance

GGNS has established procedures for the inspection and maintenance of the onsite meteorological instrumentation. This responsibility is shared between the Operations and Maintenance Departments.

Routine inspections are made to ensure proper operation of equipment and that no damage to the tower, shack or any other structure or equipment has occurred.

Semiannual visual inspections of the tower and equipment are made to determine the conditions of sensors, cabinets, wiring, and individual components. Semi-annual checks for proper instrumentation readings are made at various points. A check for the “As-Found” and “Final” data condition are made to verify proper operation of the equipment. A check on the batteries and battery charger is made. The tower cables are adjusted for proper tension, and the following instrumentation calibrated on the primary tower:

1. 2-Temperature sensor, El. 33’-162’ (10-50 meters)
2. 1-Relative Humidity– El, 33’ (10 meters)
3. 1-Wind speed – El, 33’, 162’ (10 meters, 50 meters)
4. 1-Wind direction – El, 33’, 162’ (10 meters, 50 meters)
5. Rain gauge – Surface near primary tower

The following instruments are calibrated on the back-up tower:

1. 1 – Temperature sensor, El. 33’ (10 meters)
2. 1 – Wind speed, El. 33’ (10 meters)
3. 1 – Wind direction, El. 33’ (10 meters)

For this ESP application, calculations to determine diffusion estimates for both short- and long-term conditions were completed using data from the meteorological instrumentation in service prior to the most recent replacement in December 2000, as described in Section 2.7.5.1. Data recovery for the period evaluated in the calculations (Sections 2.7.6 and 2.7.7) is indicated in Table 2.7-105.

2.7.6 Short-Term Diffusion Estimates

2.7.6.1 General

The consequence of a design basis accident in terms of personnel exposure is a function of the atmospheric dispersion conditions at the site of the potential release. Atmospheric dispersion consists of two components: 1) atmospheric transport due to organized or mean airflow within the atmosphere and 2) atmospheric diffusion due to disorganized or random air motions.

Atmospheric diffusion conditions are represented by relative air concentration (*X*/Q) values (Reference 28).

The efficiency of diffusion is primarily dependent on winds (speed and direction) and atmospheric stability characteristics. Dispersion is rapid within Stability Classes A through D and much slower for Classes E through G. That is, atmospheric dispersion capabilities decrease with progression Classes A to G, with an abrupt reduction from Classes D to E. (Reference 4)

Relative concentrations of released gases, *X*/Q values, as a function of direction for various time periods at the exclusion area boundary (EAB) and the outer boundary of the low population (LPZ), were determined by the use of the computer code PAVAN (Reference 26). This code implements the guidance provided in Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," August 1979. (Reference 4) The *X*/Q calculations are based on the theory that material released to the atmosphere will be normally distributed (Gaussian) about the plume centerline. A straight-line trajectory is assumed between the point of release and all distances for which *X*/Q values are calculated (References 26 and 28).

Using joint frequency distributions of wind direction and wind speed by atmospheric stability, PAVAN provides the *X*/Q values as functions of direction for various time periods at the exclusion area boundary (EAB) and the low population zone (LPZ). The meteorological data needed for this calculation included wind speed, wind direction, and atmospheric stability. (Reference 4) The meteorological data used for this analysis was collected from the onsite monitoring equipment from January 1996 through December 2000. These five years were averaged and are reported in Tables 2.7-106 through 2.7-112. Other plant specific data included tower height at which wind speed was measured (10.0 m) and distances to the EAB (841 m) and LPZ (3219 m).

The following text is taken from the GGNS UFSAR, Reference 4.

Within the ground release category, two sets of meteorological conditions are treated differently. During neutral (D) or stable (E, F, or G) atmospheric stability conditions when the wind speed at the 10-meter level is less than 6 meters per second (m/s), horizontal plume meander is considered. *X*/Q values are determined through the selective use of the following set of equations for ground-level relative concentrations at the plume centerline:

$$X/\mathrm{Q} = \frac{1}{\mathrm{U}_{10}\left(\pi u_{\mathrm{y}} u_{\mathrm{z}} + \mathrm{A}/2\right)} \qquad \text{Equation 1}$$

$$X/\mathrm{Q} = \frac{1}{\mathrm{U}_{10}\left(3\pi u_{\mathrm{y}} u_{\mathrm{z}}\right)} \qquad \text{Equation 2}$$

$$X/\mathrm{Q} = \frac{1}{\mathrm{U}_{10}\pi S_{\mathrm{y}} u_{\mathrm{z}}} \qquad \text{Equation 3}$$

where:

X/Q is relative concentration, in sec/m³,

U_{10} is wind speed at 10 meters above plant grade, in m/sec

u_y is lateral plume spread, in meters, a function of atmospheric stability and distance

u_z is vertical plume spread, in meters, a function of atmospheric stability and distance

S_y is lateral plume spread with meander and building wake effects, in meters, a function of atmospheric stability, wind speed, and distance

A is the smallest vertical-plane cross-sectional area of the reactor building, in square meters

PAVAN calculates X/Q values using Equations 1, 2, and 3. The values from Equations 1 and 2 are compared and the higher value is selected. This value is then compared with the value from Equation 3, and the lower value of these two is selected as the appropriate X/Q value.

During all other meteorological conditions, unstable (A, B, or C) atmospheric stability and/or 10-meter level wind speeds of 6 m/s or more, plume meander is not considered. The higher value calculated from equation 1 or 2 is used as the appropriate X/Q value.

From here, PAVAN constructs a cumulative probability distribution of X/Q values for each of the 16 directional sectors. This distributions is the probability of the given X/Q values being exceeded in that sector during the total time. The sector X/Q values and the maximum sector X/Q value are determined by effectively "plotting" the X/Q versus probability of being exceeded and selecting the X/Q value that is exceeded 0.5% of the total time. This same method is used to determine the 5% overall site X/Q value.

The X/Q value for the EAB or LPZ boundary evaluations will be the maximum sector X/Q or the 5% overall site X/Q, whichever is greater (Reference 28). All direction-dependent sector values are also calculated.

2.7.6.2 Calculations and Results

Reference 28 divides release configurations into two modes, ground release and stack release. A ground level release includes all release points that are effectively lower than two and one-half times the height of the adjacent solid structures. Since specific building arrangement details (i.e., building height and area) are unknown until a specific plant type is selected, the building area and height were not used in the calculation. This is conservative since the building wake effect will tend to reduce the calculated X/Q. Also, since the release point, or stack height, is unknown until a specific plant type is selected, the release mode was classified as a ground release.

PAVAN requires the meteorological data in the form of joint frequency distributions of wind direction and wind speed by atmospheric stability class. The meteorological data used was obtained from the GGNS site meteorological data collected from 1996 through 2000.

The stability classes were based on the classification system given in Table 2 of Regulatory Guide 1.23 (Safety Guide 23), as follows:

Classification of Atmospheric Stability
(Reference 31, Table 2)

Stability Classification	Pasquill Categories	σ_θ*	Temperature change with height (°C/100m)
Extremely unstable	A	25.0°	<-1.9
Moderately unstable	B	20.0°	-1.9 to -1.7
Slightly unstable	C	15.0°	-1.7 to -1.5
Neutral	D	10.0°	-1.5 to -0.5
Slightly stable	E	5.0°	-0.5 to 1.5
Moderately stable	F	2.5°	1.5 to 4.0
Extremely stable	G	1.7°	> 4.0

* Standard deviation of horizontal wind direction fluctuation over a period of 15 minutes to 1 hour.

Joint frequency distribution tables were developed from the meteorological data with the assumption that if data required as input to the PAVAN program (i.e., lower level wind direction, lower wind speed, and temperature differential) was missing from the hourly data record, all data for that hour was discarded. Also, the data in the joint frequency distribution tables was rounded for input into the PAVAN code.

Building area is defined as the smallest vertical-plane cross-sectional area of the reactor building, in square meters. As stated above, this parameter was not used and the building area was entered as zero.

Building height is the height above plant grade of the containment structure used in the building-wake term for the annual-average calculations. As stated above, this parameter was not used and the building height was entered as zero.

The tower height is the height at which the wind speed was measured. Based on the lower measurement location, the tower height used was 10 meters.

A ground level release includes all release points that are effectively lower than two and one-half times the height of adjacent solid structures (Reference 28). Therefore, as stated above, a ground-release analysis was assumed.

The cumulative frequency of X/Q at the EAB (841 m) can be found in Table 2.7-113. Table 2.7-114 presents the cumulative frequency at the LPZ (3219 m). A summary of results is provided below. Median (50 percent) values may be used in making realistic estimates of the environmental effects of potential radiological accidents; conservative estimates may be based on calculated 5 percent values.

ESP X/Q VALUES (sec/m^3)
(Based on 1996-2000 Meteorological Data)

	0 – 2 Hrs	0 – 8 Hrs	8 – 24 Hrs	24 – 96 Hrs	96 – 720 Hrs
EAB (841 m, SW)	5.13E-04				
LPZ (3219 m, SW)		7.65E-05	5.35E-05	2.46E-05	8.04E-06

Tables 2.7-115 and 2.7-116 report the directional-dependent sector *X*/Q values at the EAB and LPZ respectively.

2.7.6.3 Relative Concentration Estimates at the Control Room Emergency Intake

A specific plant design has not yet been selected for construction at the GGNS ESP Site, therefore, determination of dispersion and diffusion coefficients at the Control Room emergency intake has not been completed.

2.7.6.4 Ingress/Egress Diffusion Estimates

A specific plant design has not yet been selected for construction at the GGNS ESP Site for this Early Site Permit Application; therefore, determination of diffusion estimates for site ingress/egress has not been done.

2.7.7 Long Term Diffusion Estimates

2.7.7.1 General

For a routine release, the concentration of radioactive material in the surrounding region depends on the amount of effluent released, the height of the release, the momentum and buoyancy of the emitted plume, the wind speed, atmospheric stability, airflow patterns of the site, and various effluents removal mechanisms. Annual average relative concentration, *X*/Q, and annual average relative deposition, D/Q, for gaseous effluent routine releases were, therefore, calculated.

2.7.7.2 Calculation Methodology and Assumptions

The XOQDOQ Computer Program (Reference 27) which implements the assumptions outlined in Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Release from Light-Water-Cooled Reactors" (Reference 30) developed by the USNRC, was used to generate the annual average relative concentration, *X*/Q, and annual average relative deposition, D/Q. Values of *X*/Q and D/Q were determined at points of maximum potential concentration outside the site boundary, at points of maximum individual exposure and at points within a radial grid of sixteen 22 1/2^{o} sectors and extending to a distance of 50 miles. Radioactive decay and dry deposition were considered.

Meteorological data for the period from 1996 through 2000 was used, and receptor locations were determined from the locations given in the GGNS 2001 Land Use Census. Hourly meteorological data was used in the development of joint frequency distributions, in hours, of wind direction and wind speed by atmospheric stability class. The wind speed categories used were consistent with the GGNS site short-term (accident) diffusion *X*/Q calculation discussed above, and the GGNS Offsite Dose Calculation Manual (ODCM) meteorological evaluation (Reference 29). Calms were distributed as the first wind speed class.

Joint frequency distribution tables were developed from the hourly meteorological data with the assumption that if data required as input to the XOQDOQ program (i.e., lower level wind direction and wind speed, and temperature differential as opposed to upper level wind direction and wind speed) was missing from the hourly data record, all data for that hour would be discarded. This assumption maximizes the data being included in the calculation of the *X*/Q and D/Q values.

The analysis assumed a combined vent located at the center of the proposed facility location. At ground level locations beyond several miles from the plant, the annual average concentration of effluents are essentially independent of release mode; however, for ground level concentrations within a few miles, the release mode is very important. Gaseous effluents released from tall stacks generally produce peak ground-level air concentrations near or beyond the site boundary. Near ground level releases usually produce concentrations that decrease from the release point to all locations downwind. Guidance for selection of the release mode is provided in Regulatory Guide 1.111 (Reference 30). In general, in order for an elevated release to be assumed, either the release height must be at least twice the height of adjacent buildings or detailed information must be known about the wind speed at the height of the release. For this analysis, a new facility's routine releases were conservatively modeled as ground level releases.

Building cross-sectional area and building height are used in calculation of building wake effects. Regulatory Guide 1.111 (Reference 30) identifies the tallest adjacent building, in many cases the reactor building, as appropriate for use. Several plant types were evaluated for the GGNS early site permit and building dimensions vary; therefore, for conservatism, building wake effects were not considered.

Consistent with Regulatory Guide 1.111 (Reference 30) guidance regarding radiological impact evaluations, radioactive decay and deposition were considered. For conservative estimates of radioactive decay, an overall half-life of 2.26 days is acceptable for short-lived noble gases and a half-life of 8 days for all iodines released to the atmosphere. At sites where there is not a well-defined rainy season associated with a local grazing season, wet deposition does not have a significant impact. In addition, the dry deposition rate of noble gases is so slow that the depletion is negligible within 50 miles. Therefore, in this analysis only the effects of dry deposition of iodines were considered. The calculation results with and without consideration of dry deposition are identified in the output as "depleted" and "undepleted".

No terrain recirculation factor was applied. This is consistent with the GGNS position on Regulatory Guide 1.111 (Reference 30) as stated in the UFSAR (Section 3A). This regulatory position states that, since the meteorological data does not show any conclusive or systematic up and down or cross valley flow, it would be inappropriate to apply recirculation factors as indicated in Regulatory Guide 1.111 (Reference 30).

Receptor locations for the Grand Gulf site were evaluated as specified in NUREG-1555 which states: "*X*/Q and/or D/Q at points of potential maximum concentration outside the site boundary, at points of maximum individual exposure, and at points within a radial grid of sixteen 22½ degree sectors (centered on true north, north-northeast, northeast, etc.) and extending to a distance of 80 km (50 mi.) from the station. A set of data points should be located within each sector at increments of 0.4 km (0.25 mi.) to a distance of 1.6 km (1 mi.) from the plant, at increments of 0.8 km (0.5 mi.) from a distance of 1.6 km (1 mi.) to 8 km (5 mi.), at increments of

4 km (2.5 mi.) from a distance of 8 km (5 mi.) to 16 km(10 mi.), and at increments of 8 km (5 mi.) thereafter to a distance of 80 km (50 mi.). Estimates of *X*/Q (undecayed and undepleted; depleted for radioiodines) and D/Q radioiodines and particulates should be provided at each of these grid points."

2.7.7.3 Results

Results of the analysis, based on 5 years of data collected on site, are presented in Tables 2.7-117 through 2.7-120.

2.7.8 References

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24. Calculation ENTO002-CALC-003, Plume Characteristics Of Proposed New Cooling Towers At Grand Gulf, Rev. 1.

25. User's Manual: Cooling-Tower-Plume Prediction Code, EPRI CS-3403-CCM, April 1984.

26. NUREG/CR-2858, PNL-4413, PAVAN: An Atmospheric Dispersion Program for Evaluating Design Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations, November 1982.

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31. U.S. Nuclear Regulatory Commission Regulatory Guide 1.23 (Safety Guide 23), Onsite Meteorological Programs, 2/17/72.

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2.8 Noise

2.8.1 Ambient Background Noise Survey

The GGNS site is located in a remote area that consists primarily of woodlands and farms. Due to the remoteness of the site, there are few human activities within a 5-mile radius. A two-acre residential property (totally surrounded by the plant site property boundary in the southwest sector of the site) is privately owned. Lake Claiborne, a private development of residential and recreational facilities, is located approximately 3-1/2 miles east of the site. The Grand Gulf Military Park borders a portion of the north side of the property, and the community of Grand Gulf is approximately 1-1/2 miles to the north. The Claiborne County Port Commission built a small port on the Mississippi River at river mile 404.8 in Claiborne County, about 0.6 miles south of the site property boundary and 2.1 miles south-southwest of the plant site. There are no other public or private schools, hospitals, commercial plants, sports facilities, or residential development parks within 5 miles of the site.

The following noise surveys were conducted in 1973 during the construction of Units 1 and 2[1] and the results were presented in the GGNS Final Environmental Report. Test locations are shown in Figure 2.8-1.

<u>Ambient Background Noise Survey (July 27-28, 1973)</u>

*Ambient background noise levels were measured at eight accessible, representative locations on and near the property line of the site and in nearby populated areas (*Figure 2.8-1*). Point 8, not shown on* Figure 2.8-1*, was located at the entrance to Addison Junior High School*[2] *on the northwestern edge of Port Gibson, Mississippi, about 7 miles southeast of the site. Each location was monitored four times a day during diurnal and nocturnal hours on one weekday and one weekend day. Measurements were typically made in the morning (0830 hours), noon (1200 hours), afternoon (1800 hours), and night (2230 hours). These time periods were considered adequate and sufficient to cover differences due to human activities and insect and animal behaviors, and to obtain representative data for a typical summer day.*

<u>Equipment</u>

A General Radio Model 1933 Sound Analysis System, equipped with a 1-inch electric-condenser microphone and its windscreen, and a Simpson Model 2745 Graphic Level Recorder were used during the ambient and construction noise surveys to measure and record noise levels. The measuring and recording equipment were calibrated as a unit with a General Radio Type 1562-A external calibrator. Calibration was performed prior to each monitoring period.

Measurements at each monitoring location during the four monitoring periods each day consisted of a 5-minute reading on the A-weighted scale and an octave band analysis. The A-weighted scale was designed to duplicate the human ear in its response to sound. The octave band analysis, performed immediately following each 5-minute dB(A) measurement, consists of a 20-second reading on each of the 10 octave bands comprising the human audio spectrum.

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[1] While the construction of GGNS Unit 2 was eventually terminated, a substantial portion of the power block structures were built.

[2] Addison Junior High School is no longer in use. It was replaced by Port Gibson Middle School which is located on the south side of Port Gibson, MS.

The diel variation of ambient background noise levels (solid line) at each monitoring location was compared with the average noise level (dashed line) of all seven locations on and near the property line in Figure 2.8-2. *At all locations, ambient noise levels were greater at night than during the day. These increased nocturnal noise levels can be attributed almost entirely to the crickets that were most active at night.*

Noise levels at near-site populated or recreational areas (points 1, 2, and 3) were generally somewhat higher than the mean noise level from all seven near-site locations. At point 3, located approximately 100 yards from the Shady Rest Grocery, the only local restaurant in the area at the time, ambient noise levels were louder on Friday during both the day and night than on Saturday afternoon, primarily because of increased human activity at the restaurant.

On the bank of the Mississippi River, point 7 was noticeably quieter than the mean site noise level because there was little traffic or human activity nearby. However, riverboats pass by frequently on the Mississippi; the noise level of one typical boat was measured at a steady 67 dB(A) for the few minutes it took to pass the monitoring point.

Measured ambient noise levels at all other monitoring locations were very similar to the mean site levels. The overall average noise level for the Grand Gulf site during the survey was 50.2 dB(A).

Ambient Background Noise Survey Conclusions

Since typical summer weather prevailed during the sampling periods (the weather was clear and hot with slight breezes both days, with the exception of a very short rain shower on Saturday afternoon), it can be assumed that normal agricultural, commercial, and recreational activities were conducted during the ambient background noise survey. The amount of human activity appeared to be similar on both days. The slight differences in noise levels between Friday and Saturday were probably due to random sampling error over the short time period monitored.

Insects had a greater influence on the overall site noise level than did the people in the area.

Given that the environs surrounding the site have not changed significantly since the noise surveys above were done, the results of the ambient background noise survey are deemed to be applicable to the current site and its surroundings.

Discussion of the impacts of construction and operation of the existing GGNS plant on the noise levels surrounding the site are presented in Sections 4.1, 4.4, 5.1, and 5.8 of this report. Impacts of new facility construction and operation with regards to noise are discussed in Sections 4.1, 5.3, and 5.8.

2.8.2 References

1. Mississippi Power and Light Company, Grand Gulf Nuclear Station Units 1 and 2, Final Environmental Report (FER), as amended through Amendment No. 8.

2.9 Related Federal Project Activities

The purpose of this section is to identify federal activities directly related to the proposed project in order to: (1) determine the need for other federal agencies (i.e., cooperating agencies) to participate in the preparation of the environmental impact statement; and (2) assess the interrelationship and cumulative environmental impacts of the proposed project and related federal activities.

In accordance with NUREG-1555 (Reference 1), the scope of this review is limited to federal actions that are directly related to the proposed project. Therefore, actions related only to granting of licenses, permits, or approvals by other federal agencies were not included in the scope of this review.

No directly related federal activities or relevant cooperating agencies that affect plant siting or water supply were identified at this time.

2.9.1 References

1. U.S Nuclear Regulatory Commission, 1999, Environmental Standard Review Plan (NUREG-1555), October.