APPENDIX E

Applicant's Environmental Report

Operating License Renewal Stage

Grand Gulf Nuclear Station

INTRODUCTION

System Energy Resources, Inc., South Mississippi Electric Power Association, and Entergy Operations, Inc. (hereafter referred to as "Entergy"), submit this Environmental Report (ER) in conjunction with the application to the United States Nuclear Regulatory Commission (USNRC) to renew the operating license for Grand Gulf Nuclear Station Unit 1 (hereafter referred to as GGNS or GGNS Unit 1) for twenty (20) years beyond the end of the current license term. In compliance with applicable USNRC requirements, this ER analyzes potential environmental impacts associated with renewal of the GGNS Operating License (OL). This ER is designed to assist the USNRC staff with the preparation of the GGNS specific Supplemental Environmental Impact Statement (SEIS) required for license renewal.

The GGNS ER is provided in accordance with 10 CFR 54.23, which requires license renewal applicants to submit a supplement to the ER that complies with the requirements of Subpart A of 10 CFR Part 51. This report also addresses the more detailed requirements of NRC environmental regulations in 10 CFR 51.45 and 10 CFR 51.53(c), as well as the intent of the National Environmental Policy Act (NEPA), 42 USC 4321 et seq. For major federal actions, NEPA requires federal agencies to prepare a detailed statement that evaluates environmental impacts, alternatives to the proposed action, and irreversible and irretrievable commitments of resources associated with implementation of the proposed action.

Entergy used Supplement 1 to Regulatory Guide 4.2, "Preparation of Supplemental Environmental Reports for Applications to Renew Nuclear Power Plant Operating Licenses," as guidance on the format and content of this ER. In addition, Entergy utilized the *Generic Environmental Impact Statement (GEIS) for License Renewal of Nuclear Plants* (NUREG-1437) and Appendix B to 10 CFR Part 51 in preparation of this report. The level of information provided on the various topics and issues in this ER are commensurate with the environmental significance of the particular topic or issue.

Based upon the evaluations discussed in this ER, Entergy concludes that the environmental impacts associated with renewal of the GGNS OL are SMALL. No plant refurbishment activities have been identified as necessary to support the continued operation of GGNS beyond the end of the existing operating license term. Ongoing plant operational and maintenance activities will be performed during the license renewal period, but no significant environmental impacts associated with such activities are expected since established programs and procedures are in place to ensure that proper environmental monitoring continues to be conducted throughout the renewal term as discussed in Chapter 9.

ACRONYMS AND ABBREVIATIONS

UNITS OF MEASURE	
~	approximately
$	dollars
º	degrees
"	inches
'	feet
%	percent
>	is greater than
<	is less than
≤	is less than or equal to
Btu	British thermal units
ºC	degrees Centigrade
Ceq/kWh	carbon equivalents per kilowatt hour
cfs	cubic feet per second
cm	centimeter
cm/sec	centimeters per second
cm^2	square centimeters
dBA	decibels, A scale
ºF	degrees Fahrenheit
ft	feet
ft^2	square feet
ft^3	cubic feet
gpm	gallons per minute
g	grams
gpd	gallons per day
gpd/ft	gallons per day per foot

ACRONYMS AND ABBREVIATIONS (CONTINUED)

GW	gigawatt
hr	hour
kv	kilovolts
kW	kilowatt
kWh	kilowatt-hour
kWh/m^2	kilowatt hour per square meter
lb	pound
m	meter
m^2	square meter
m^3	cubic meter
m^3/s	cubic meters per second
µ	microns
µm	micrometer
µmho/cm	micromhos per centimeter
mA	milliAmp
mgd	million gallons per day
mg/l	milligrams per liter
mGy	milli-Gray
mi	miles
mi^2	square miles
ml	milliliter
MMBtu	million British thermal units
mrad	millirad
mrem	millirem
m/s	meters per second
MSL	mean sea level

ACRONYMS AND ABBREVIATIONS (CONTINUED)

mSv	milli-Sievert
MW	megawatts
MWd/MTU	megawatt-days per metric tonne
MWe	megawatts, electric
MWh	megawatt-hours
MWt	megawatts, thermal
pCi/l	picocuries per liter
RM	river mile
sec	second
SU	standard units
tpy	tons per year
watt-hr/m^2/day	watt-hour per meter squared per day
yr	year
ACRONYMS/ABBREVIATIONS	
ALARA	as low as reasonably achievable
ARCS	Advanced Resin Cleaning Subsystem
ASU	Alcorn State University
BWR	Boiling Water Reactor
CAA	Clean Air Act
CAES	compressed air energy storage
CaO	calcium oxide
$CaSO_4*2H_2O$	calcium sulfate dehydrate
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CET	containment event tree

ACRONYMS AND ABBREVIATIONS (CONTINUED)

CDF	core damage frequency
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
COL	Combined Operating License
COLA	Combined Operating License Application
CST	Condensate Storage Tank
CWA	Clean Water Act
CWS	Circulating Water System
DSM	demand side management
EAB	Exclusion Area Boundary
ECCS	emergency core cooling systems
EEI	Edison Electric Institute
EHV	extra high voltage
EIA	Energy Information Administration
EMI	Entergy Mississippi, Inc.
EN	Entergy Nuclear
ENE	east-northeast
EOI	Entergy Operations Inc.
EPRI	Electric Power Research Institute
EPCRA	Emergency Planning and Community Right-to-Know Act
EPU	Extended Power Uprate
ER	Environmental Report
ESA	Endangered Species Act
ESE	east-southeast

ACRONYMS AND ABBREVIATIONS (CONTINUED)

ESP	Early Site Permit
ESRI	Environmental Systems Research Institute
EV	environmental
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FER	Final Environmental Report
FES	Final Environmental Statement
FIVE	Fire Induced Vulnerability Evaluation
FPC&CU	Fuel Pool Cooling and Cleanup
GEIS	Generic Environmental Impact Statement
GGMP	Grand Gulf Military Park
GGNS	Grand Gulf Nuclear Station
GHG	greenhouse gas
GIS	Geographic Information System
GPI	Groundwater Protection Initiative
HAP	hazardous air pollutants
HEPA	high efficiency particulate air
HFC	hydrofluorocarbon
HMA	Habitat Management Area
IAAO	International Association of Assessing Officers
IPE	Individual Plant Examination
IPEEE	Individual Plant Examination of External Events
ISFSI	Independent Spent Fuel Storage Installation
ISO	International Standards Organization
LA	Louisiana
LMR	Lower Mississippi River

ACRONYMS AND ABBREVIATIONS (CONTINUED)

LNHP	Louisiana Natural Heritage Program
LOCA	loss of coolant accident
LOS	Level of Service
LPCI	low pressure coolant injection
LPCS	low pressure core spray
MACCS2	MELCOR Accident Consequence Code System 2
MAWPCC	Mississippi Air and Water Pollution Control Commission
MDAH	Mississippi Department of Archives and History
MDEQ	Mississippi Department of Environmental Quality
MDH	Mississippi Department of Health
MDOT	Mississippi Department of Transportation
MDWFP	Mississippi Department of Wildlife, Fisheries and Parks
MEMA	Mississippi Emergency Management Agency
MNHP	Mississippi Natural Heritage Program
MP&L	Mississippi Power & Light
MS	Mississippi
N	north
N_2O	Nitrous oxide
NA	not applicable
NASS	National Agricultural Statistics Service
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NES	Norton Energy Storage
NESC	National Electrical Safety Code
NHPA	National Historic Preservation Act
NNE	north-northeast

ACRONYMS AND ABBREVIATIONS (CONTINUED)

NNW	north-northwest
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NRR	Nuclear Reactor Regulation
NSPS	New Source Performance Standard
NUREG	U.S. Nuclear Regulatory Commission Document
NW	northwest
ODCM	Offsite Dose Calculation Manual
OL	Operating License
OTEC	ocean thermal energy conversion
PCB	polychlorinated biphenyl
PFC	perfluorocarbon
PM	particulate matter
PM_{10}	particulates having diameter less than 10 microns
PM_f	total filterable particulates
PRA	Probabilistic Risk Assessment
PSA	Probabilistic Safety Assessment
PSW	Plant Service Water
PWEP	Pacific Wind Energy Project
RBS	River Bend Station
RCRA	Resource Conservation and Recovery Act
REMP	Radiological Environmental Monitoring Program
RHR	Residual Heat Removal
RHRSSW	Residual Heat Removal Standby Service Water

ACRONYMS AND ABBREVIATIONS (CONTINUED)

ROI	Region of Interest
ROW	right-of-way
RWCU	Reactor Water Cleanup
S	sulfur; south
SAFSTOR	safe storage
SAMA	Severe Accident Mitigation Alternative
SCR	selective catalytic reduction
SE	southeast
SEIS	Supplemental Environmental Impact Statement
SERC	Southeast Electric Reliability Corporation
SERI	System Energy Resources, Inc.
SF_6	sulfur hexafluoride
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SMEPA	South Mississippi Electric Power Association
SO_2	sulfur dioxide
SO_x	oxides of sulfur
SPCC	Spill Prevention, Control, and Countermeasure
SQUG	Seismic Qualification Utility Group
SR	State Road
SSE	south-southeast
SSW	Standby Service Water; south-southwest
SW	southwest
TDEC	Tennessee Department of Environment and Conservation
THPO	Tribal Historic Preservation Officer
UCA	Upland Complex Alluvium

ACRONYMS AND ABBREVIATIONS (CONTINUED)

UCOA	Upland Complex Old Alluvium
UDEQ	Utah Department of Environmental Quality
UFSAR	Updated Final Safety Analysis Report
U.S.	United States
U.S. 61	United States Highway 61
U.S. 65	United States Highway 65
USACE	United States Army Corps of Engineers
USC	United States Code
USCB	United States Census Bureau
USDA	United States Department of Agriculture
USDOE	United States Department of Energy
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Service
USNRC	United States Nuclear Regulatory Commission
USWAG	Utility Solid Waste Activities Group
VOC	volatile organic compound
W	west
WNW	west-northwest
WSW	west-southwest
WQC	water quality certification
YMCA	Young Men's Christian Association

TABLE OF CONTENTS

LIST OF ATTACHMENTS

Attachment A: Threatened and Endangered Species Correspondence

Attachment B: Historic and Archaeological Properties Correspondence

Attachment C: Clean Water Act Documentation

Attachment D: Not used

Attachment E: Severe Accident Mitigation Alternatives Analysis

LIST OF TABLES

LIST OF FIGURES

1.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

For license renewal the USNRC has adopted the following definition of purpose and need, stated in Section 1.3 of NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants*: "The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than USNRC) decision makers."

Nuclear power plants are initially licensed by the USNRC to operate up to 40 years, and the licenses may be subsequently renewed [10 CFR 50.51] for periods up to 20 years. 10 CFR 54.17(c) states, "[a]n application for a renewed license may not be submitted to the Commission earlier than 20 years before the expiration of the operating license currently in effect."

The proposed action is to renew the GGNS OL, which would preserve the option for Entergy to continue to operate GGNS to provide base-load power throughout the 20-year license renewal period. For GGNS (Facility OL NPF-29), the requested renewal would extend the existing license expiration date from midnight November 1, 2024, to midnight November 1, 2044.

1.1 Environmental Report

USNRC regulation 10 CFR 51.53(c) requires that an applicant for license renewal submit with its application a separate document entitled, "Applicant's Environmental Report—Operating License Renewal Stage." This appendix to the GGNS license renewal application fulfills that requirement.

Entergy has prepared Table 1.1-1 to document, in checklist form, that the 10 CFR Part 51 requirements for information to be provided in an ER in support of a license renewal application have been met. The requirements regarding information to be included in an ER are codified at 10 CFR 51.45 and 51.53(c). Table 1.1-1 provides the 10 CFR Part 51 regulatory language and regulatory citation, along with the ER section(s) that satisfy the 10 CFR Part 51 requirements.

Although not yet regulatory requirements, Entergy has also included in this ER, for purposes of completeness but not in order to satisfy governing regulatory requirements, those Category 2 issues, either new or with expanded scope, that are currently in the proposed amendment to 10 CFR Part 51 [74 FR 38117]. Table 1.1-2 lists these Category 2 issues, along with the ER section(s) that provide a discussion of the issue.

Table 1.1-1
Environmental Report Responses to License Renewal
Environmental Regulatory Requirements

Description	Requirement	ER Section(s)
Environmental Reports—General Requirements [10 CFR 51.45]		
Environmental report contains a description of the proposed action.	10 CFR 51.45(b)	3.0
Environmental report contains a statement of the purposes of the proposed action.	10 CFR 51.45(b)	1.0
Environmental report contains a description of the environment affected.	10 CFR 51.45(b)	2.0
Environmental report discusses the impact of the proposed action on the environment.	10 CFR 51.45(b)(1)	4.0
Environmental report discusses any adverse environmental effects which cannot be avoided should the proposal be implemented.	10 CFR 51.45(b)(2)	6.3
Environmental report discusses alternatives to the proposed action.	10 CFR 51.45(b)(3)	7.0 and 8.0
Environmental report discusses the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity.	10 CFR 51.45(b)(4)	6.5
Environmental report discusses any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.	10 CFR 51.45(b)(5)	6.4
Environmental report includes an analysis that considers and balances the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and alternatives available for reducing or avoiding adverse environmental effects.	10 CFR 51.45(c)	4.0, 7.0, and 8.0
Environmental report lists all Federal permits, licenses, approvals and other entitlements which must be obtained in connection with the proposed action and describes the status of compliance with these requirements.	10 CFR 51.45(d)	9.1

Table 1.1-1 (Continued)
Environmental Report Responses to License Renewal
Environmental Regulatory Requirements

Description	Requirement	ER Section(s)
Environmental Reports—General Requirements [10 CFR 51.45]		
Environmental report includes a discussion of the status of compliance with applicable environmental quality standards and requirements which have been imposed by Federal, State, regional, and local agencies having responsibility for environmental protection, including, but not limited to, applicable zoning and land-use regulations, and thermal and other water pollution limitations or requirements.	10 CFR 51.45(d)	9.1
The discussion of alternatives in the report includes a discussion of whether the alternatives will comply with such applicable environmental quality standards and requirements.	10 CFR 51.45(d)	9.2
The information submitted pursuant to 10 CFR 51.45(b) through (d) should not be confined to information supporting the proposed action but should also include adverse information.	10 CFR 51.45(e)	4.0 and 6.3
Operating License Renewal Stage [10 CFR 51.53(c)]		
Environmental report contains description of the proposed action including the applicant's plans to modify the facility or its administrative control procedures as described in accordance with §54.21. The report must describe in detail the modifications directly affecting the environment or affecting plant effluents that affect the environment.	10 CFR 51.53(c)(2)	3.0, 3.3 and 3.4
The environmental report must contain analyses of the environmental impacts of the proposed action, including the impacts of refurbishment activities, if any, associated with license renewal and the impacts of operation during the renewal term, for applicable Category 2 issues, as discussed below.	10 CFR 51.53(c)(3)(ii)	4.0
Plant utilizes cooling towers or cooling ponds and withdraws make-up water from a river whose annual flow rate is less than 3.15 x 10^{12} ft^3/year (9 x 10^{10} m^3/year)		
Environmental report contains an assessment of the impact of the proposed action on the flow of the river.	10 CFR 51.53(c)(3)(ii)(A)	4.1 and 4.6

Table 1.1-1 (Continued)
Environmental Report Responses to License Renewal
Environmental Regulatory Requirements

Description	Requirement	ER Section(s)
Related impacts on in-stream and riparian ecological communities are provided.	10 CFR 51.53(c)(3)(ii)(A)	4.1 and 4.6
Environmental report contains an assessment of the impacts of the withdrawal of water from the river on alluvial aquifers during low flow.	10 CFR 51.53(c)(3)(ii)(A)	4.1 and 4.6
Plant utilizes once-through cooling or cooling pond heat dissipation systems		
A copy of current Clean Water Act 316(b) determinations and, if necessary, a 316(a) variance in accordance with 40 CFR Part 125, or equivalent State permits and supporting documentation are provided, **OR**	10 CFR 51.53(c)(3)(ii)(B)	4.2, 4.3, and 4.4
Environmental report contains an assessment of the impact of the proposed action on fish and shellfish resources resulting from heat shock and impingement and entrainment.	10 CFR 51.53(c)(3)(ii)(B)	4.2, 4.3, and 4.4
Plant uses Ranney wells or pumps more than 100 gallons (total onsite) of groundwater per minute		
Environmental report contains an assessment of the impact of the proposed action on groundwater use.	10 CFR 51.53(c)(3)(ii)(C)	4.5 and 4.7
Plant is located at an inland site and utilizes cooling ponds		
Environmental report contains an assessment of the impact of the proposed action on groundwater quality.	10 CFR 51.53(c)(3)(ii)(D)	4.8
All Plants		
Environmental report contains an assessment of the impact of refurbishment and other license-renewal-related construction activities on important plant and animal habitats.	10 CFR 51.53(c)(3)(ii)(E)	4.9
Environmental report contains an assessment of the impact of the proposed action on threatened or endangered species in accordance with the Endangered Species Act.	10 CFR 51.53(c)(3)(ii)(E)	4.10
Plant is located in or near a Clean Air Act non-attainment or maintenance area		
Environmental report contains an assessment of vehicle exhaust emissions anticipated at the time of peak refurbishment workforce in accordance with the Clean Air Act as amended.	10 CFR 51.53(c)(3)(ii)(F)	4.11

Table 1.1-1 (Continued)
Environmental Report Responses to License Renewal
Environmental Regulatory Requirements

Description	Requirement	ER Section(s)
Plant uses a cooling pond, lake, or canal or discharges into a river having an annual average flow rate of less than 3.15 x 10^{12} ft^3/year (9 x 10^{10} m^3/year)		
Environmental report contains an assessment of the impact of the proposed action on public health from thermophilic organisms in the affected water.	10 CFR 51.53(c)(3)(ii)(G)	4.12
Plants with transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system		
Materials demonstrating that transmission lines meet the recommendations of the National Electric Safety Code for preventing electric shock from induced currents are provided, **OR**	10 CFR 51.53(c)(3)(ii)(H)	4.13
Environmental report contains an assessment of the impact of the proposed action on the potential shock hazard from the transmission lines.	10 CFR 51.53(c)(3)(ii)(H)	4.13
All Plants		
Environmental report contains an assessment of the impact of the proposed action on housing availability.	10 CFR 51.53(c)(3)(ii)(I)	4.14
Environmental report contains an assessment of the impact of the proposed action on land-use.	10 CFR 51.53(c)(3)(ii)(I)	4.17 and 4.18
All Plants		
Environmental report contains an assessment of the impact of the proposed action on public schools (impacts from refurbishment activities only) within the vicinity of the plant.	10 CFR 51.53(c)(3)(ii)(I)	4.16
Environmental report contains an assessment of the impact of population increases attributable to the proposed project on the public water supply.	10 CFR 51.53(c)(3)(ii)(I)	4.15
Environmental report contains an assessment of the impact of the proposed project on local transportation during periods of license renewal refurbishment activities and during the term of the renewed license.	10 CFR 51.53(c)(3)(ii)(J)	4.19
Environmental report contains an assessment as to whether any historic or archaeological properties will be affected by the proposed project.	10 CFR 51.53(c)(3)(ii)(K)	4.20

Table 1.1-1 (Continued)
Environmental Report Responses to License Renewal
Environmental Regulatory Requirements

Description	Requirement	ER Section(s)
Plants for which the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environmental assessment		
Environmental report considers alternatives to mitigate severe accidents.	10 CFR 51.53(c)(3)(ii)(L)	4.21
All Plants		
Environmental report must contain a consideration of alternatives for reducing adverse impacts for all Category 2 license renewal issues.	10 CFR 51.53(c)(3)(iii)	4.0 and 6.2
Environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.	10 CFR 51.53(c)(3)(iv)	5.0

Table 1.1-2
Environmental Report Responses to Proposed New or Expanded Category 2 Issues

Category 2 Issue[a]	ER Section(s)	
Water use conflicts with terrestrial resources (plants with cooling ponds or cooling towers using make-up water from a river with low flow)[b]	2.2.1.1 4.1 4.2	4.3 4.4 4.6
Water use conflicts with aquatic resources (plants with cooling ponds or cooling towers using make-up water from a river with low flow)[b]	2.2.1.1 4.1 4.2	4.3 4.4 4.6
Groundwater and soil contamination	3.2.8.2 3.2.8.4 9.1.3.2	9.1.3.3.5 9.1.3.9.1 9.1.3.9.3
Radionuclides released to groundwater	2.3.3 2.3.3.4	3.2.6 9.1.3.8
Impacts of continued plant operations on terrestrial ecosystems	2.4.1.4 2.4.2.1 3.2.10.6 3.2.10.7	4.9 9.1.3.16 9.1.3.17 9.1.3.18
Minority and low-income populations	2.6.2 4.22	
Cumulative impacts	4.23	

a. Reference: 74 FR 38117
b. Issue not applicable to GGNS since the Mississippi River is considered a large river.

1.2 Licensee and Ownership

System Energy Resources, Inc. (SERI), a subsidiary of Entergy Corporation, and South Mississippi Electric Power Association (SMEPA) are the owners of GGNS, located in Claiborne County, Mississippi. Entergy Operations, Inc. (EOI), also a subsidiary of Entergy Corporation, is the licensed operator of GGNS. SERI, SMEPA, and EOI (hereafter referred to as "Entergy") are the holders of GGNS OL NPF-29 and for purposes of this ER are considered the applicant.

Entergy Mississippi, Inc. (EMI), a subsidiary of Entergy Corporation, owns and operates the transmission lines constructed for purposes of connecting GGNS to the electric grid.

2.0 SITE AND ENVIRONMENTAL INTERFACES

The original application for a license at GGNS (Units 1 and 2) was submitted to operate a two-unit nuclear power facility under Section 103(b) of the Atomic Energy Act of 1954, as amended, and the regulations of the USNRC set forth in Part 50 of Title 10 to the Code of Federal Regulations (10 CFR Part 50).

In December of 1979, construction of GGNS Unit 2 (USNRC Docket Number 50-417) was deferred in order to concentrate resources on the completion of GGNS Unit 1. After GGNS Unit 1 received its Commercial Operating License on November 1, 1984, EOI formally requested the USNRC to terminate the Construction Permit and officially cancel the second unit at GGNS. The Construction Permit for GGNS Unit 2 was formally cancelled by the USNRC in August 1991. [GGNS 2010a, Section 1.1.3]

SERI submitted an application for an early site permit (ESP) for the Grand Gulf site on October 16, 2003, and the USNRC issued the Grand Gulf ESP on April 5, 2007. EOI submitted a combined operating license application (COLA) for an Economic Simplified Boiling Water Reactor, designated as GGNS Unit 3, on February 27, 2008. On January 9, 2009, Entergy informed the USNRC that it was considering alternate reactor design technologies and requested the USNRC suspend its review effort until further notice. Entergy also submitted an extended power uprate (EPU) application on September 8, 2010, to increase the licensed thermal power level from 3,898 MWt to 4,408 MWt.

In addition to the original licensing documents for GGNS, this ER cites portions of application documents related to regional, vicinity, and site characteristics previously submitted to the USNRC for the ESP, COLA, and EPU. The ER also cites USNRC's NUREG-1817, *Environmental Impact Statement for an Early Site Permit (ESP) at the Grand Gulf ESP Site*, and NUREG-1840, *Safety Evaluation of Early Site Permit Application in the Matter of System Energy Resources, Inc., a Subsidiary of Entergy Corporation, for the Grand Gulf Early Site Permit Site*.

2.1 Location and Features

GGNS is located in Claiborne County, Mississippi, on the east bank of the Mississippi River at river mile (RM) 406, approximately 25 miles south-southwest of Vicksburg, Mississippi, and 37 miles north-northeast of Natchez, Mississippi. EOI maintains control of entrances and exits from the GGNS site property. [USNRC 2006a, Sections 2.0 and 2.2.1] The property boundary shown in Figure 2.1-3 encompasses approximately 2,100 acres of property that make up the GGNS site. The property is now approximately 2,015 acres in size as a result of the loss of approximately 85 acres due to historical erosion by the Mississippi River [SERI 2008b, Section 2.4.1].

2.1.1 Vicinity and Regional Features

The site is bounded by the Mississippi River on the west and by land not owned by GGNS on the north, east, and south. The Grand Gulf Military Park (GGMP), a Mississippi state park, borders a portion of the north side of the property. The vicinity of the GGNS site is defined as a six-mile

radius from the center of the power block location (Figure 2.1-1). The vicinity includes a portion of Claiborne County in Mississippi and Tensas Parish in Louisiana. The nearest incorporated community is the Town of Port Gibson about five miles southeast of the site. The small community of Grand Gulf lies about 1.6 miles north of GGNS. [USNRC 2006a, Section 2.2.1]

Approximately 11 miles of the Mississippi River courses through the GGNS six-mile vicinity. The river provides a critical inland shipping route from the Gulf Coast to the interior of the South and Midwest. There is direct access to the GGNS site from the Mississippi River along the entire western edge of the site. The Port of Claiborne has constructed a small shipping port on the river at RM 404.8 in Claiborne County. The mean depth of channel and berth at Port Claiborne is 14 feet. Services provided at this port include mooring assistance, stevedore, dryage, and deep-water berths. Port cargo includes forest products, pulpwood, feed grains, and agricultural products. [USNRC 2006a, Section 2.2.1]

The GGNS site is accessible by both river and road. Public transportation routes are limited within the site vicinity. The major highway in the vicinity of the site is U.S. Highway 61 (U.S. 61), which passes by the site on the east-southeast. U.S. 61 parallels the Mississippi River from New Orleans, Louisiana, to St. Louis, Missouri, and is approximately 4.5 miles from the GGNS site at the closest point. From Port Gibson, the highway goes north to Vicksburg, Mississippi, and south-southwest to Natchez, Mississippi. A section of the Natchez Trace Parkway passes approximately six miles southeast of the site running southwest toward Natchez and to the northeast to Jackson. State Highway 18 runs east from Port Gibson to Jackson. A number of county and rural roads are located in the vicinity of the site. [USNRC 2006a, Section 2.2.1]

Connecting Vicksburg and Jackson, Mississippi, with towns to the east and west, Interstate 20 passes approximately 20 miles north of GGNS. Connecting Jackson, Mississippi, and New Orleans, Louisiana, Interstate 55 passes approximately 36 miles east of GGNS. U.S. Highway 65 (U.S. 65) runs north and south in Louisiana and lies approximately 11 miles to the west of the site. U.S. Highway 84 runs east and west, connecting U.S. 65 and Interstate 55, and passes within about 31 miles to the south of the site. Figure 2.1-2 shows the locations of Federal highways and railroads in the site region. The Mississippi River, which borders GGNS on the west, provides another route for transportation. The nearest river port facility is Port Claiborne at RM 404.8. A larger river port facility, which is also a U.S. Customs port of entry, lies north of the site near RM 437 in Vicksburg. [USNRC 2006a, Section 2.2.3]

The 50-mile region from the center of the GGNS Unit 1 containment encompasses significant portions of the following counties in Mississippi and parishes in Louisiana:

- Mississippi:
  Adams, Claiborne, Copiah, Franklin, Hinds, Issaquena, Jefferson, Lincoln, and Warren; and minor portions of Amite, Madison, Rankin, Sharkey, Simpson, Wilkinson, and Yazoo.

- Louisiana:
  Catahoula, Concordia, East Carroll, Franklin, Madison, Richland, and Tensas; and minor portions of Caldwell and West Carroll.

As shown in Table 2.6-1, 2010 census data show all of the counties and parishes in the region have declined in population since the 2000 census, with the exception of four counties in Mississippi and one parish in Louisiana. The nearest population center, Port Gibson, Mississippi, located approximately five miles to the southeast, had a 2000 population of 1,840 and a 2010 population of 1,567. Four larger towns are located within 50 miles of the GGNS site. Vicksburg, Mississippi, located 25 miles to the north-northeast, had a 2000 population of 26,407 and a 2010 population of 23,856. Clinton, Mississippi, located to the east-northeast, and Natchez, Mississippi, located to the southwest, had 2000 populations of 23,347 and 18,464, respectively. Populations for Clinton and Natchez in 2010 were 25,216 and 15,792, respectively. Jackson, Mississippi, the largest nearby metropolitan area, located approximately 55 miles east-northeast of the site, had a 2000 population of 184,256 and a 2010 population of 173,514. 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, as described in Sections 2.6 and 2.10. [USCB 2010b; USCB 2011a; USNRC 2006a, Section 2.8.1]

The region consists mainly of forest and agricultural lands. No known local or regional land use plans or other regional development plans affect the GGNS site. About 70 miles of the Natchez Trace Parkway, designated as a National Scenic Byway and All American Road, traverses the region. Because of the topography of the region, agriculture thrives as an industry on the Louisiana side of the Mississippi River. The Louisiana side is typically a flat alluvial plain, while the Mississippi side is typically upland and rolling, forested hill country. On the Mississippi side, farms are generally smaller than on the Louisiana side. [USNRC 2006a, Section 2.2.3]

According to information from the Claiborne County Agricultural Extension office, there are approximately 300 to 400 head of cattle and no commercial dairy milk cows reported within a six-mile radius of the GGNS site. Most of the cattle are located southwest of the site. [USNRC 2006a, Section 2.2.3]

There are no known missile sites or airports within a 10-mile radius of GGNS. Outside the 10-mile radius, the nearest airport is located near St. Joseph, about 11 miles west-southwest of the site; it is a small public airstrip with a 4,000-foot hard-surfaced runway. The airport at Newellton, about 12 miles west-northwest of the site, has a 2,700-foot hard-surfaced runway. Commercial airport facilities are available at Jackson, Mississippi, 55 miles northeast of the site; at Natchez, Mississippi, 30 miles southwest; and Vicksburg, Mississippi, 25 miles north-northeast of the site. [GGNS 2010a, Section 2.2.1]

2.1.2 Station Features

The principal structures at GGNS consist of the containment structure, turbine building, auxiliary building, control building, diesel generator building, standby service water cooling towers and basins, enclosure building, radwaste building, independent spent fuel storage installation (ISFSI), radial collector well system, auxiliary cooling tower, and the natural draft cooling tower. Figure 2.1-3 shows the general features of the GGNS site. Section 3.2 describes key features of

the station, including reactor and containment systems, cooling and auxiliary water systems, radwaste systems, and transmission facilities.

The Protected Area is completely enclosed by a security fence, with access to the area controlled at a security gate. A plant security system monitors the Protected Area, as well as the buildings within the station. Access to the site is by paved entrance roads built across the site from Grand Gulf Road, located on the north side of the property, and Bald Hill Road located on the east side of the property. The exclusion area, as defined by 10 CFR 100.3, surrounds the site, as shown in Figure 2.1-3. The nearest occupied residence lies 0.83 miles beyond the site boundary to the east [GGNS 2010g, Section 2.8].

Physically, the site is about equally divided between the floodplain adjacent to the river and loess hills (Figure 2.1-4). 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 miles. 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 floodplain in the western portion of the site. These lakes were once the channel of the Mississippi River and have an average depth of approximately eight to ten feet. Most GGNS facilities are located in the uplands portion of the site on the bluffs area. The eastern half of the plant site (in the undeveloped areas surrounding GGNS and its facilities) rises from the floodplain as rough and irregular loess bluffs, 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 MSL to more than 200 feet MSL inland. Elevations of about 400 feet MSL occur on the hilltops east and northeast of the site. Grade elevation for GGNS plant structures is 132.5 feet above MSL. [SERI 2005b, Section 2.1; GGNS 2010a, Figure 2.1-2]

There are no active railroads that traverse the site. One county road runs through the GGNS plant site property: Bald Hill Road, which cuts through the south-southeast, south, south-southwest, and southwest sectors of the plant site. Grand Gulf Road traverses the plant site property in the north, north-northwest, northwest, west-northwest, and west sectors, providing public access to the two lakes on the property. Two EMI transmission lines traverse the GGNS plant site property. There are no other industrial, commercial, or institutional structures on the site. [USNRC 2006a, Section 2.2.1] EOI allows access to parts of the plant site property outside the exclusion area for recreational purposes [SERI 2005b, Section 2.2.1.1].

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 three miles east of GGNS. The GGMP borders a portion of the north side of the property, and the community of Grand Gulf is approximately 1.8 miles to the north. [USNRC 2006a, Section 2.2.1] The Claiborne County Port Commission built a small port on the Mississippi River at RM 404.8 in Claiborne County, about 0.6 miles south of the site property boundary and approximately two 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 five miles of the site. [SERI 2005b, Section 2.8.1]

The natural draft cooling tower, the tallest structure on site, is approximately 522 feet in height [USNRC 2006a, Section 5.4.1.2]. Based on field observations by Entergy personnel, the cooling tower is visible from the Mississippi River; portions of Grand Gulf, Bald Hill, and Oil Mill Roads in Claiborne County, Mississippi; and a segment of U.S. 61 near Vicksburg, Mississippi, and U.S. 65 south of Newellton, Louisiana. Otherwise, the site is well screened by topography and forested areas surrounding it, with minimal visual resource impacts to the surrounding community.

There are no noise ordinances imposed by Claiborne County that limit allowable sound levels at GGNS. Given the industrial nature of the station, noise emissions from GGNS are generally nothing more than an intermittent minor nuisance. Although the United States Environmental Protection Agency (USEPA) uses 55 dBA level as a threshold level to protect against excess noise during outdoor activities, this threshold does "not constitute a standard, specification, or regulation," but was intended to provide a basis for State and local governments establishing noise standards. Although surveys have not been conducted since the construction of GGNS, when the greatest sources of noise would have occurred, NUREG-1817 determined that background noise levels at GGNS are expected to range from 45 to 55 dBA at the nearest site boundary. In addition, based on review of condition reports from previous years, there have been no recorded instances of noise complaints from offsite residents.

2.1.3 Mineral and Surface Rights

SERI, SMEPA, and EOI own or effectively control the mineral rights within the GGNS exclusion area. Currently, mining, exploration, drilling, and other mineral-extraction activities are not being conducted at the site. Past unsuccessful exploration activities on or near the site and the geological character of the subsurface structure in the vicinity indicate that commercial mineral production appears unlikely in the foreseeable future. [USNRC 2006a, Section 2.2.1]

SERI and SMEPA own all the surface rights at GGNS except the plant switchyard, which is owned by EMI. A number of easements over the GGNS property are in effect. With respect to easements within the exclusion area, Bald Hill Road traverses the southern corner of the exclusion area in which Claiborne County maintains an easement or road rights-of-way (ROW). In addition, EMI has two ROWs or easements for transmission line purposes on the GGNS plant site property which are 200 feet in width. However, only one of these transmission line easements is located in part within the exclusion area. Furthermore, SMEPA has a general easement within the exclusion area which was obtained from SERI at the time SMEPA obtained an ownership interest in the power block area. SMEPA's easement rights for purposes of exercising its ownership rights in connection with GGNS apply to all property located within the exclusion area owned by SERI in which SMEPA did not acquire a 10 percent undivided ownership interest. SERI and SMEPA also have an easement in and over the switchyard area. There are no other ROWs or easements within the exclusion area other than those described above. [SERI 2005b, Section 2.1.2.4]

2.1.4 Federal, Native American, State, and Local Lands

A number of recreational areas are in the vicinity of the GGNS site. The GGMP (400 acres) abuts the northern edge of the site and has its main facilities about two miles north of the site. The GGMP provides a year-round, 25-site campground and hosts many living history events and other activities for area visitors. The Warner-Tully Young Men's Christian Association (YMCA) Camp (108 acres) is a youth summer camp located approximately three miles northeast of the site. Major local, state, federal, and Native American lands within an approximate 6-mile and 50-mile radius of GGNS are shown in Figure 2.1-1 and Figure 2.1-2, respectively. Table 2.1-1 provides a list of major federal, state, and local land locations within an approximate 50-mile radius of the site. Although Entergy submitted consultation letters to the Mississippi Band of Choctaw Indians and Louisiana Tunica-Biloxi Tribal Historic Preservation Office in an effort to identify any cultural sites of significance that should be considered in conjunction with license renewal (Attachment B), there are no designated Native American or military reservations located within the 50-mile region.

Table 2.1-1
Federal, State, and Local Lands, 50-Mile Radius of GGNS

Site	Management	Direction and Distance (mi) from GGNS	Nearest City/Town	County/Parish
Louisiana				
Winter Quarters State Historic Site	State	W, 7 mi	Newellton	Tensas
Lake Bruin State Park	State	WSW, 10 mi	St. Joseph	Tensas
Division of State Lands - Patent	State	W, 12 mi	Newellton	Tensas
Buckhorn Wildlife Management Area	State	W, 20 mi	Newellton	Tensas
Division of State Lands - Patent	State	NNW, 22 mi	Richmond	Madison
Tensas River National Wildlife Refuge	Federal	NW, 23 mi	Richmond	Tensas and Madison
Big Lake Wildlife Management	State	WNW, 28 mi	Gilbert	Franklin and Madison
State Land Office - Dried Lake Bed	State	SW, 39 mi	Ridgecrest	Concordia
Division of State Lands - Patent	State	WSW, 41 mi	Sicily Island	Catahoula

Table 2.1-1 (Continued)
Federal, State, and Local Lands, 50-Mile Radius of GGNS

Site	Management	Direction and Distance (mi) from GGNS	Nearest City/Town	County/Parish
Division of State Lands - Patent	State	W, 42 mi	Wisner	Franklin
Sicily Island Hills Wildlife Management Area	State	WSW, 43 mi	Harrisonburg	Catahoula
Bayou Cocodrie National Wildlife Refuge	Federal	SW, 46 mi	Ridgecrest	Concordia
Division of State Lands - Patent	State	NNW, 48 mi	Epps	East Carroll
Poverty Point State Historical Site	State	NNW, 48 mi	Epps	West Carroll
Poverty Point National Monument	Federal	NNW, 49 mi	Epps	West Carroll
Boeuf River Wildlife Management Area[a]	State	W, 51 mi	Winnsboro	Caldwell and Catahoula
Mississippi				
Grand Gulf Military State Park and Cemetery (NRHP)	State	N, 2 mi	Port Gibson	Claiborne
Sacred Heart Roman Catholic Church (NRHP)	State	N, 2 mi	Port Gibson	Claiborne
Warner-Tully YMCA Camp	Local	ENE, 3 mi	Port Gibson	Claiborne
Old Brickyard Place (NRHP)	Local	SE, 4 mi	Port Gibson	Claiborne
Port Gibson Battlefield (NRHP)	Local	SSE, 4 mi	Port Gibson	Claiborne
Port Gibson Oil Works Mill Building (NRHP)	Local	SE, 4 mi	Port Gibson	Claiborne

Table 2.1-1 (Continued)
Federal, State, and Local Lands, 50-Mile Radius of GGNS

Site	Management	Direction and Distance (mi) from GGNS	Nearest City/Town	County/Parish
Widow's Creek Bridge (NRHP)	Local	S, 4 mi	Port Gibson	Claiborne
Building at 801 Chinquepin Street (NRHP)	Local	SE, 5 mi	Port Gibson	Claiborne
Catholic Cemetery (NRHP)	Local	SE, 5 mi	Port Gibson	Claiborne
Claremont (NRHP)	Local	SE, 5 mi	Port Gibson	Claiborne
Collina (NRHP)	Local	SE, 5 mi	Port Gibson	Claiborne
Drake Hill Historic District (NRHP)	Local	SE, 5 mi	Port Gibson	Claiborne
Golden West Cemetery (NRHP)	Local	SE, 5 mi	Port Gibson	Claiborne
Idlewild (NRHP)	Local	SE, 5 mi	Port Gibson	Claiborne
Jewish Cemetery (NRHP)	Local	SE, 5 mi	Port Gibson	Claiborne
Market Street-Suburb Ste. Mary Historic District (NRHP)	Local	SE, 5 mi	Port Gibson	Claiborne
Old Depot Restaurant and Lounge (NRHP)	Local	SE, 5 mi	Port Gibson	Claiborne
Van Dorn House (NRHP)	Local	S, 5 mi	Port Gibson	Claiborne
Chamberlain-Hunt Academy Historic District (NRHP)	Local	SE, 6 mi	Port Gibson	Claiborne
Natchez Trace Parkway and National Scenic Trail	Federal	SSW to ENE, 6 mi[b]	Port Gibson	Adams, Claiborne, Jefferson, and Hinds
Wintergreen Cemetery (NRHP)	Local	SE, 6 mi	Port Gibson	Claiborne

Table 2.1-1 (Continued)
Federal, State, and Local Lands, 50-Mile Radius of GGNS

Site	Management	Direction and Distance (mi) from GGNS	Nearest City/Town	County/Parish
Copiah County Wildlife Management Area	State	ESE, 24 mi	Hazlehurst	Copiah
Vicksburg National Military Park	Federal	NNE, 27 mi	Vicksburg	Warren
Natchez State Park	State	SSW, 30 mi	Roxie	Adams
Natchez National Historical Park	Federal	SW, 38 mi	Natchez	Adams
Mahannah Wildlife Management Area	State	NNE, 39 mi	Vicksburg	Issaquena and Warren
Homochitto National Forest	Federal	S, 42 mi	Meadville	Adama, Amite, Copiah, Franklin, Jefferson, Lincoln, and Wilkinson
Sandy Creek Wildlife Management Area	State	SSW, 42 mi	Roxie	Adams
Saint Catherine Creek National Wildlife Refuge	Federal	SW, 45 mi	Vidalia	Adams
Caston Creek Wildlife Management Area	State	S, 46 mi	Bude	Amite and Franklin
Hillman-Berry Park	Local	ENE, 48 mi	Clinton	Hinds
Robinson Park	Local	ENE, 48 mi	Clinton	Hinds
Lake Lincoln State Park	State	ESE, 48 mi	Wesson	Lincoln
Traceway Park	Local	ENE, 50 mi	Clinton	Hinds
Delta National Forest[a]	Federal	NNE, 54 mi	Vicksburg	Issaquena and Sharkey
Sunflower Wildlife Management Area[a]	State	NNE, 56 mi	Vicksburg	Sharkey

References: ESRI 2005; NA; NRHP; BTS; MARIS; SONRIS

a. Distances are approximate and based on GGNS and land centroid data. Therefore, although the distances for the Boeuf River Wildlife Management Area, Delta National Forest, and Sunflower Wildlife Management Area shown in this table are greater than 50 miles, the nearest property boundary for these lands are within 50 miles.
b. Approximate distance from GGNS to the nearest portion of the Natchez Trace Parkway.

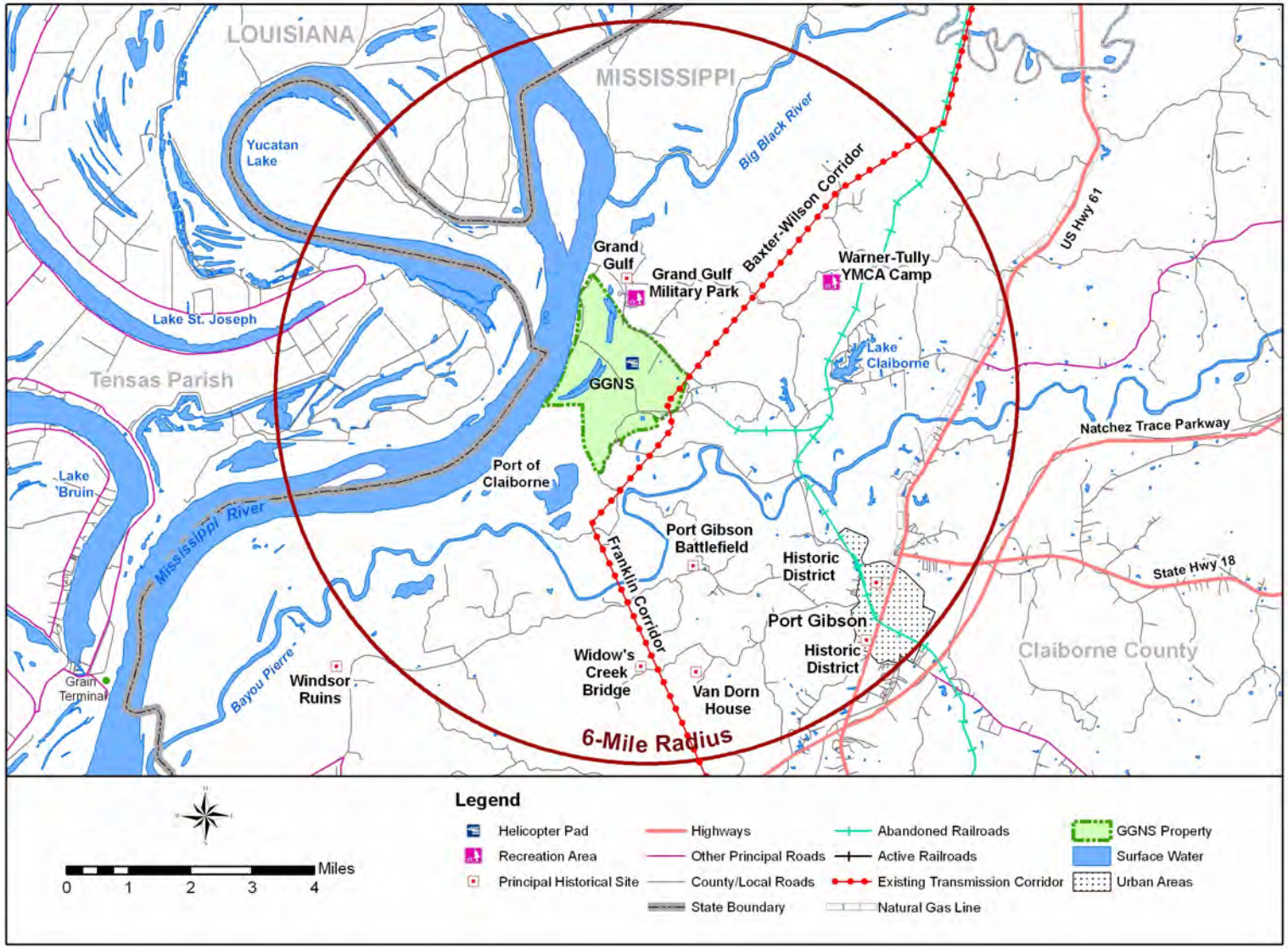


Figure 2.1-1
Location of GGNS, 6-Mile Radius

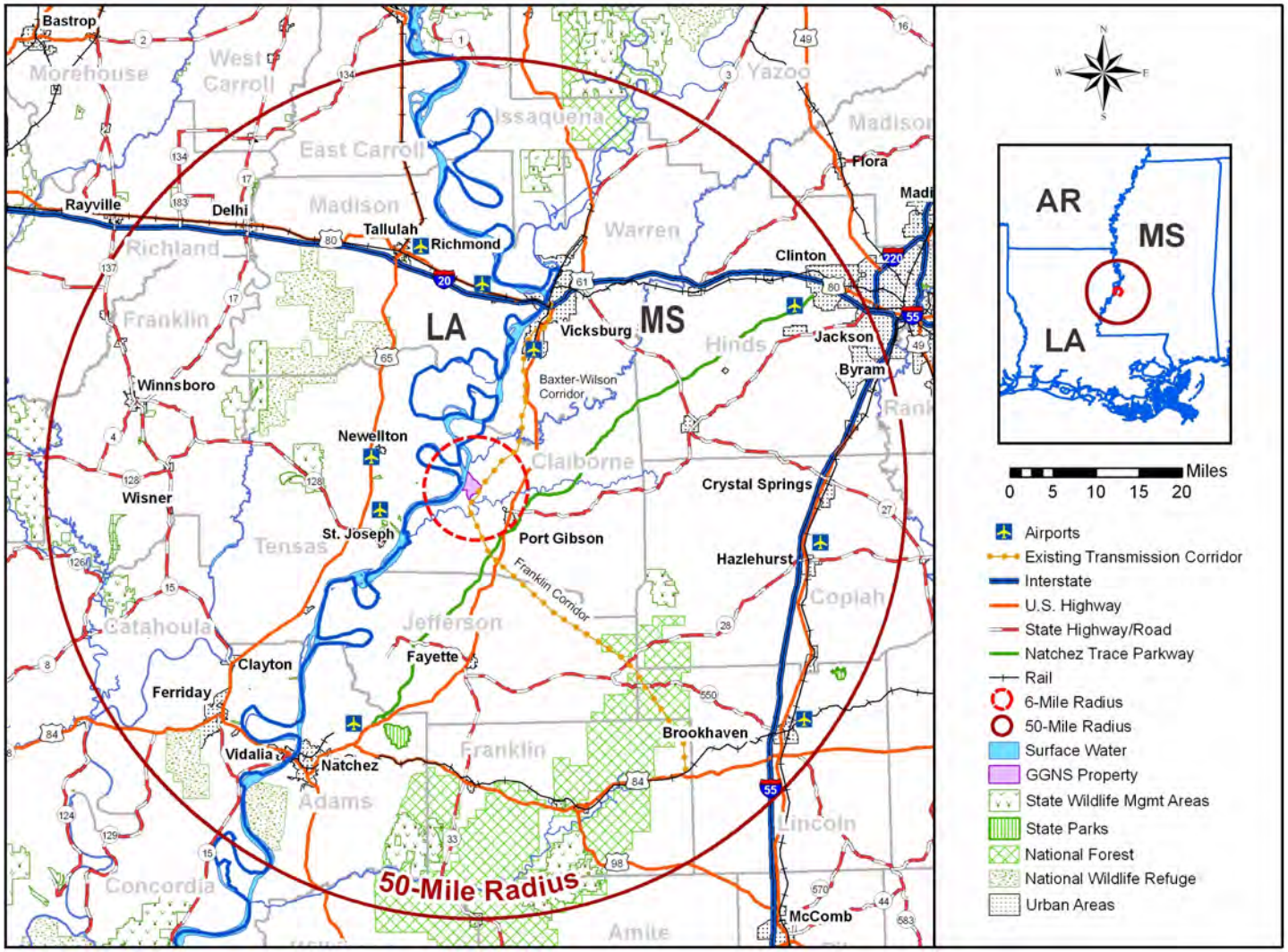


Figure 2.1-2
Location of GGNS, 50-Mile Radius

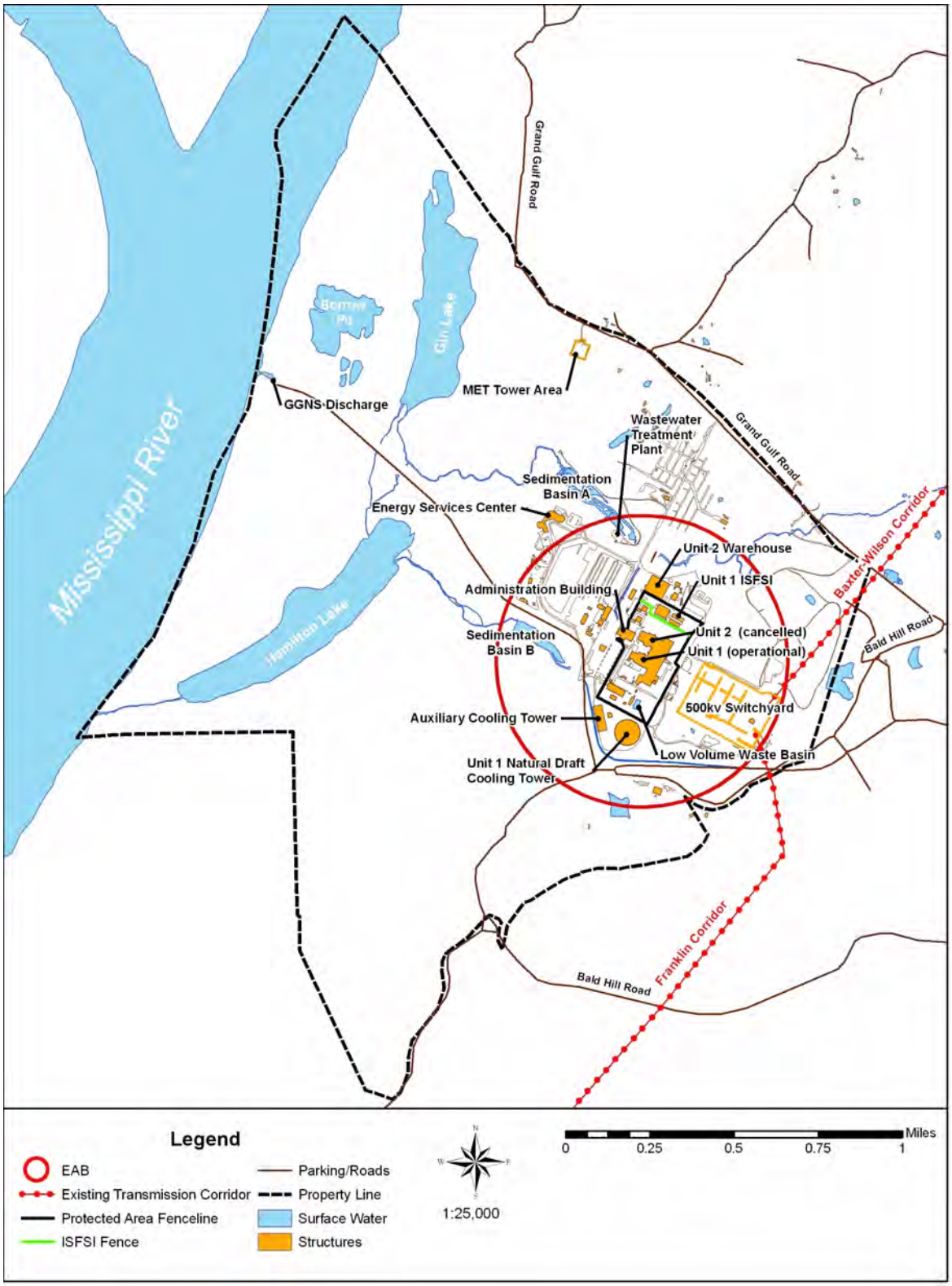


Figure 2.1-3
GGNS Exclusion Area Boundary

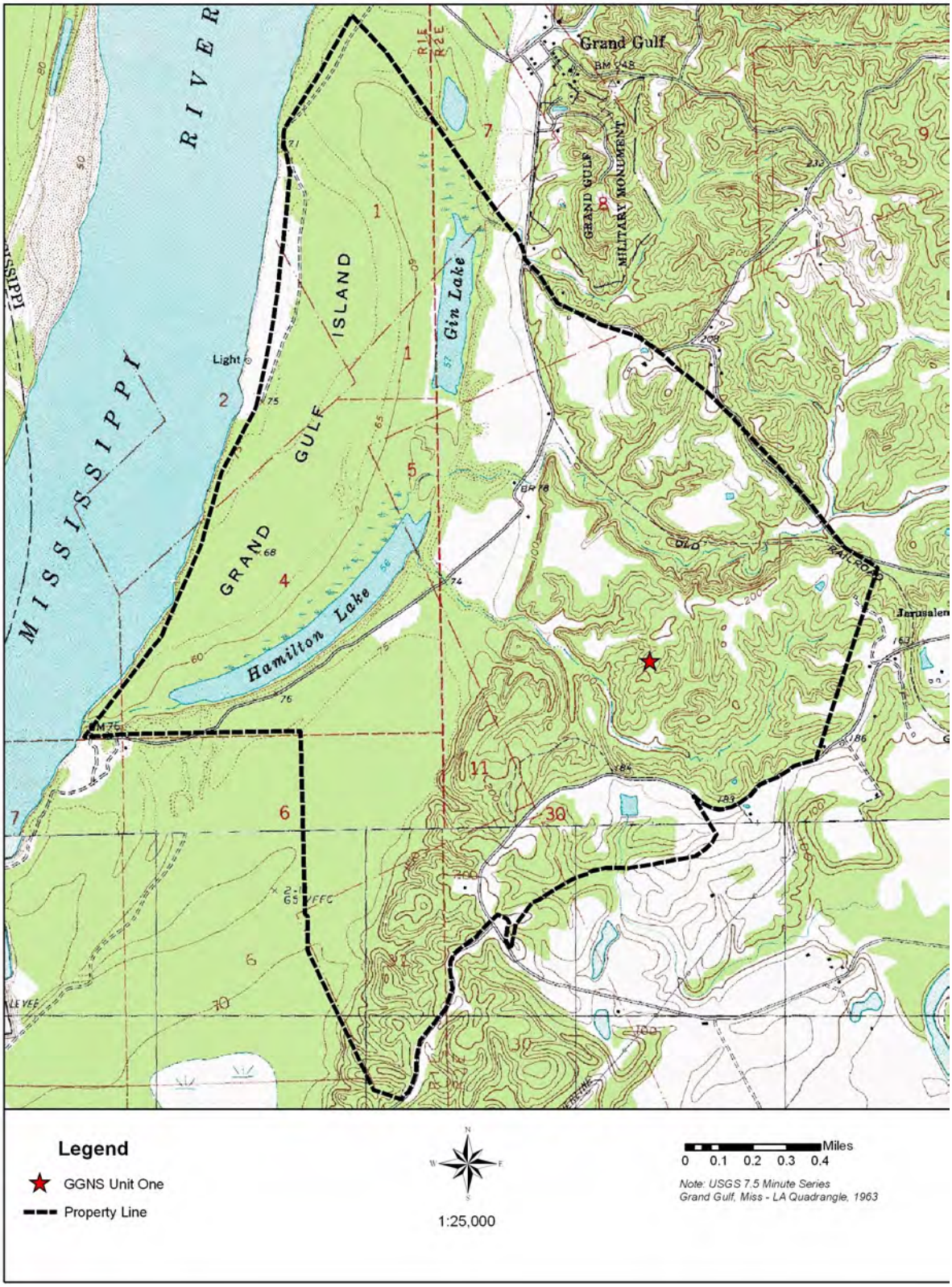


Figure 2.1-4
Topographic Map

2.2 Aquatic and Riparian Ecological Communities

GGNS is located in Claiborne County, Mississippi, on the east bank of the Mississippi River at RM 406, approximately 25 miles south of Vicksburg, Mississippi, and 37 miles north-northeast of Natchez, Mississippi. The property boundary shown in Figure 2.1-4 encompasses approximately 2,100 acres of property that make up the GGNS site. [USNRC 2006a, Sections 2.0 and 2.2.1] The property is now approximately 2,015 acres in size as a result of the loss of approximately 85 acres due to historical erosion by the Mississippi River [SERI 2008b, Section 2.4.1]. The United States Army Corps of Engineers (USACE) has since stabilized the banks of the river by constructing revetments; therefore, further erosion of the eastern bank is not anticipated. [USNRC 2006a, Section 2.7.1]

The site has three primary hydrological areas. The first is the Mississippi River, the dominant hydrological feature of the vicinity. The second is the lowlands between the bluffs and the Mississippi River. The third is the uplands area east of the bluffs. These three areas can be seen in Figure 2.1-4. Aquatic resources at the GGNS site are associated with the Mississippi River adjacent to the site, two onsite oxbow lakes (Hamilton and Gin), a flooded borrow pit in the bottomland, three small upland ponds, and two perennial streams.

2.2.1 Physical and Chemical Environment

2.2.1.1 Mississippi River

The Mississippi River and its tributaries drain a total of 1,245,000 square miles (mi^2), which is 41 percent of the 48 contiguous states of the United States (U.S.). The river basin spans 31 states and two Canadian provinces and is bounded on the west by the Rocky Mountains and on the east by the Appalachian Mountain Chain. [USACE 2004; USGS 1998] Waters from New York in the east to Montana in the west contribute flows into the Mississippi. [USACE 2004]

Beginning in Minnesota, the headwaters of the Mississippi flow southward for approximately 2,470 miles into the Gulf of Mexico [USGS 1998]. Because the river is so vast, it has been broken into three segments, which contain a variety of habitat conditions and fisheries. The upper 512 miles from Lake Itasca to St. Anthony Falls, Minnesota, is considered the headwaters of the Mississippi. This portion of the Mississippi flows alternately through forests and wetlands. Dams have been built to form 11 small reservoirs and modify the elevation and discharge of several natural river lakes. These dams variously function for flood control, electricity generation, water supply, or recreation. [Schramm]

The Upper Mississippi River reach stretches 668 miles from St. Anthony Falls to Alton, Illinois, a few miles above the confluence with the Missouri River. The Upper Mississippi River is impounded by 28 locks and dams built for commercial navigation and one dam (Keokuk, Iowa) built for commercial navigation and hydropower generation. These dams are operated to maintain minimum navigation channel depth (9 feet); thus, the dams have little effect on the river stage and discharge during spring floods. [Schramm]

Downstream from the confluence of the Missouri River near West Alton, Missouri, north of St. Louis, the Mississippi flows un-dammed to Head of Passes in Louisiana where it branches into several distributaries that carry water to the Gulf of Mexico. The 195 miles reach from the mouth of the Missouri River to the mouth of the Ohio River is referred to as the Middle Mississippi River by management agencies. At the Missouri River confluence, water volumes in the Mississippi River almost double. The 976 miles reach from the Ohio River to Head of Passes is referred to as the Lower Mississippi River (LMR). Water from the Ohio River increases Mississippi River discharge 150 percent. Although discharge and channel size differ between the two reaches, they share similar hydrologic conditions, methods and levels of channelization, and loss of connectivity with the historic floodplain. [Schramm]

With an average discharge of 593,000 cubic feet per second (cfs), the Mississippi River is the largest river in the U.S. The western boundary of the GGNS site is defined by the Mississippi River's eastern bank. At the site, the Mississippi River is about 0.5 miles wide at low flow and about 1.4 miles during a typical annual high flow period. The depth of the thalweg (deepest portion of the channel) of the Mississippi River at the site is about 16 feet below MSL. Historically, the Mississippi River near the site has been very active with frequent changes in the channel alignment and thalweg. [USNRC 2006a, Section 2.6.1.1]

The Mississippi River is now subject to the management and control of the USACE. Through an aggressive and ongoing program of dredging, installation of river bank revetments and armor, levee construction and maintenance, and upstream reservoir regulation, the USACE has stabilized the historical movement of the river into a relatively stable channel alignment. The bluffs at the GGNS site represent a natural levee and have confined the river, even during pre-channelization times, to stay to the west of the GGNS site. [USNRC 2006a, Section 2.6.1.1]

The Mississippi River flow varies considerably throughout the year and between years. Based on stream flow data from Vicksburg, Mississippi, from 1929 through 1983, the 7-day, 10-year low flow and 100-year flood have been estimated at 120,000 cfs and 2,203,000 cfs, respectively. February, March, April, and May are the months with the highest mean monthly discharges and as such are the periods that the river would most likely rise over its normal banks, inundating the adjacent lowland floodplain. [USNRC 2006a, Section 2.6.1.1] The Mississippi River floods in April and May 2011 were among the largest and most damaging recorded along the U.S. waterway in the past century. In April 2011, two major storm systems deposited record levels of rainfall on the Mississippi River watershed. Rising from springtime snowmelt, the river and many of its tributaries began to swell to record levels by the beginning of May. Specifically, the flood of 2011 likely set a new maximum peak streamflow record at Vicksburg during the month of May as shown in Table 5.1-1 based on USGS provisional data.

The habitat of the Mississippi River has the following features: backwater, river bank, and main channel. The backwater habitat is associated with the large bend in the river at the site, which creates slow moving, relatively shallow, quiet water. The substrate in the backwaters is loosely consolidated, silty clay sediment of low plasticity. The river bank habitat is steep with swift current, consolidated, high-plastic clay substrate, and eroding slopes. In 1979, the river bank downstream of the discharge structure and barge slip was stabilized with articulated concrete

mats. The main channel is deep with strong, turbulent currents and coarse grained substrate. [USNRC 2006a, Section 2.7.2]

2.2.1.2 Lowland Plain

The lowland plain of the GGNS site is the area between the Mississippi River and the bluffs. With an elevation of about 70 feet above MSL, the lacustrine or palustrine wetlands of the lowlands are subject to nearly annual inundation by the Mississippi River. In periods when the Mississippi is not inundating the lowlands, movement of water through the lowlands is primarily associated with the stream flow of small tributaries that drain the uplands into Hamilton Lake before joining the Mississippi River. Both Gin Lake and Hamilton Lake, within the lowlands, show the characteristics of shallow oxbow lakes formed by the historic migration of the Mississippi River. Construction of a haul road from the GGNS site to the Mississippi River divided the lowlands. Buried pipelines that carry cooling make-up water to the plant and discharge cooling tower blowdown to a small embayment along the Mississippi River follow the path of the haul road. [USNRC 2006a, Section 2.6.1.1]

2.2.1.3 Hamilton and Gin Lakes and the Flooded Borrow Pit

Hamilton and Gin Lakes are oxbow lakes on the GGNS site. These lakes are what remain of the former river channel after the Mississippi River moved to the west. Hamilton and Gin Lakes are relatively small and shallow with characteristics similar to the backwater habitat. The surface area of these lakes has decreased since 1973, and the last estimates made in 2001 indicate the surface area of Hamilton Lake is 64 acres and Gin Lake is 55 acres. The average depth of these lakes is approximately eight to ten feet. However, during high-water events, the Mississippi River submerges these lakes. Hamilton Lake receives site runoff via the two perennial streams onsite. Gin Lake is connected to Hamilton Lake via a culvert beneath the Heavy Haul Road. [USNRC 2006a, Section 2.7.2]

A flooded borrow pit north of the barge slip was created in the 1970s when fill was excavated for use in the construction of GGNS. The depth of the pit is not known. The surface area in 2001 was estimated to be 16 acres in size. The pit does not appear to be hydrologically connected to the lakes except during high water of the river. [USNRC 2006a, Section 2.7.2].

2.2.1.4 Wetlands

Wetlands and other waters of the U.S. fall within the jurisdictional control of the USACE, which regulates any activity resulting in the discharge of dredge or fill materials to such waters. Wetlands, as defined by the United States Fish and Wildlife Service (USFWS) Wetland Delineation Manual, 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. [SERI 2005b, Section 2.4] Based on previous reconnaissance visits to GGNS to assess wetlands and other ecological resources, the oxbow lakes, borrow pit, upland ponds, and stream channels all support associated wetlands. [SERI 2005b, Section 2.3.1.1.4]

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. [USNRC 2006a, Section 2.7.1.1]

Emergent wetlands are located near the periphery of Gin and Hamilton Lakes and occupy approximately 30 acres along the shorelines. Scrub-shrub wetlands occur in two distinct areas. One of these wetland areas occurs 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. Streams A and B (Figures 2.3-4 and 2.4-1) 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. [SERI 2005b, Section 2.3.1.1.4]

Although no disturbance to wetlands is planned for purposes of license renewal, wetlands are under the regulatory jurisdiction of the USACE; therefore, appropriately conditioned permits would have to be obtained prior to any disturbance of onsite wetland areas.

2.2.1.5 Uplands

The uplands at GGNS are drained by two upland watersheds (A and B) and their associated stream channels. Watershed A lies to the north of Watershed B. The estimated areas of Watershed A and Watershed B are 2.94 mi^2 and 0.68 mi^2, respectively. [USNRC 2006a, Section 2.6.1.1 and Figure 2-2]

The watersheds are very distinct in nature. Whereas Watershed A is mostly covered with a dense canopy of trees and brush, the majority of Watershed B has been cleared of vegetation. The stream channel in Watershed A follows its natural course, whereas the course of the stream channel in Watershed B has been altered and the channel lined to provide stormwater runoff drainage for the GGNS site. The alterations to Watershed B have resulted in it behaving more like an urban watershed with flashy responses to rainfall with little or no baseflow, whereas Watershed A responds like a forested watershed with a more attenuated response to rainfall and continuous baseflow. [USNRC 2006a, Section 2.6.1.1]

Sedimentation basins were constructed on both stream channels downstream from the GGNS site. However, because of the greater flow and higher sediment load, the sediment basin on Stream A has been filled with sediment and now represents more of a constructed wetland than a basin to trap sediment. Because of the lower flow and lower sediment yield, the sediment basin in Watershed B remains a viable trap for sediment. [USNRC 2006a, Section 2.6.1.1]

The local precipitation is relatively uniform throughout the year. With an average annual precipitation of 53 inches, eight months have average monthly precipitation of four to six inches and four months have average monthly precipitation of two to four inches. March and October are the months with both the highest and lowest monthly average precipitation and runoff, respectively. Because of the relatively warm winters, the region experiences little precipitation as snow. [USNRC 2006a, Section 2.6.1.1]

There are no aquatic populations of recreational or commercial value in the onsite streams, nor is there any critical habitat associated with the onsite streams. The perennial Streams A and B as well as the ephemeral drainages at GGNS are classified as "waters of the U.S." Sediment retention basins A and B are associated with Streams A and B and are considered modifications of Streams A and B. Waters of the U.S. are under the regulatory jurisdiction of the USACE, who would issue appropriately conditioned permits for work involving these streams. [SERI 2005b, Section 4.3.2.4]

Before the development of the GGNS site, three small ponds were constructed onsite to provide water for cattle stock. At the time of construction of GGNS, five small ponds existed, each under two acres in size. Since 1973, two of the ponds have been filled and no longer exist. [USNRC 2006a, Section 2.7.2] The three remaining ponds have very small populations of recreational and commercially important fish, represent no significant recreational fishing opportunity, and have no important fish habitat associated with them. [SERI 2005b, Sections 4.3.2.3 and 4.3.2.4]

2.2.1.6 Water Use

Although surface water is not directly used at the existing GGNS site, the facility withdraws groundwater that is hydraulically connected to the river, as described in Section 2.3. Total surface water withdrawals in Claiborne County are predominantly for agricultural use, with no surface water usage reported for public supply, domestic self-supplied systems, mining, hydroelectric power, thermoelectric power, industrial, or commercial uses. [USNRC 2006a, Section 2.6.2.1]

Water in the vicinity satisfies a variety of purposes including domestic, industrial, and agricultural uses with groundwater withdrawn from the various aquifers and surface water withdrawn from the Mississippi River. NUREG-1817 determined that the total estimated water use in Claiborne County was 34.3 mgd based on United States Geological Services (USGS) data from 2000. Groundwater comprises that entire total except for 0.4 mgd of surface water. [USNRC 2006a, Section 2.6.2]

The nearest downstream user of Mississippi River water is Southeast Wood Fiber located at the Claiborne County Port facility, 0.8 miles downstream of the GGNS site. The maximum intake requirement for this facility is less than 0.9 mgd for industrial purposes; however, none of this intake is used as potable water. 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. There are also no downstream or upstream intakes in Mississippi within 100 miles of the GGNS site that use the Mississippi River as a potable water supply. [USNRC 2006a, Section 2.6.2.1]

2.2.1.7 Water Quality

The Mississippi River is classified for fish and wildlife use. As such, the river is to be suitable for the propagation of fish, aquatic life and wildlife; and for fishing, fish consumption, and secondary contact recreation. Secondary contact recreation is defined as incidental contact with the water during activities such as wading, fishing, and boating, that are not likely to result in full body

immersion. Based on the Mississippi Department of Environmental Quality's (MDEQ) 2010 Section 303(d) list of impaired waterbodies, the segment of the Mississippi River located within Claiborne County is not impaired [MDEQ 2011c].

The massive nature of the Mississippi River makes the discharges from the GGNS facility undetectable within the overall flow regime, and any changes in the quality are small and localized compared to the overall width of the river. [USNRC 2006a, Section 2.6.3.1] Effluent limitations and monitoring requirements for plant discharges to the Mississippi River are an integral part of National Pollutant Discharge Elimination System (NPDES) Permit MS0029521 to ensure that state water quality standards are maintained.

Based on previous operational experience and routine observations conducted by site personnel, there have been no instances of "fish kill" events due to heat or cold shock as a result of the heated effluent from GGNS.

2.2.2 Plankton Communities

Plankton in the Mississippi River were characterized as zooplankton and phytoplankton. The density of zooplankton ranged over two orders of magnitude during the study period. A total of 46 taxa were identified, and the dominant taxa changed over time. A stalked protozoan (*Carchesium* sp.), various cladocerans, and a colonial rotifer were the dominant zooplankton. Fall and spring blooms of phytoplankton were observed. A total of 49 phytoplankton genera were identified, with centric diatoms being the most dominant. [USNRC 2006a, Section 2.7.2.1]

The composition and abundance of plankton in Hamilton and Gin lakes varied based on the frequency and duration of flooding by the river. When the lakes were not flooded, they developed distinct plankton populations. However, during flood events, the populations more closely resembled those characterized in the river. [USNRC 2006a, Section 2.7.2.1]

2.2.3 Macroinvertebrate Communities

The LMR habitat near the GGNS site has the following features: backwater, river bank, and main channel. 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. The bottom of the river channel was found to be virtually non-productive of benthic organisms, and the water column was found to contain fewer fish than other habitats. [SERI 2005b, Sections 2.4.2.1 and 2.4.2.1.1]

Backwater habitat is associated with the large bend in the river at the site, which creates slow moving, relatively shallow, quiet water. The substrate in the backwaters is loosely consolidated, silty clay sediment of low plasticity. The river bank habitat is steep with swift current, consolidated, high-plastic clay substrate, and eroding slopes. [USNRC 2006a, Section 2.7.2]

Benthic macroinvertebrate populations are most common in the backwaters of the riverine environment. Dipteran larvae (aquatic true fly larvae), tube-forming worms, and bivalves

(mussels and clams) represented the dominant groups of macroinvertebrates. Where the river banks are stable (consolidated silt and clay), mayflies are the most common macroinvertebrate. The 1973 GGNS Final Environmental Report (FER) stated that macroinvertebrates were found in areas where the river bank is stable, but few or no macroinvertebrates were found where the river bank was constantly eroding. Nevertheless, in 1981, macroinvertebrates would not colonize areas where the banks were stabilized with articulated concrete mats. Macroinvertebrates were also absent in the main channel of the river, probably because of strong currents and coarse sand-gravel sediment. [USNRC 2006a, Section 2.7.2.1]

Drifting benthic macroinvertebrates were also collected in the river and adjacent backwaters. The majority of the drifting macroinvertebrates was composed of dipteran pupae and larvae, predominantly of the genus *Chaoborus*. A total of 96 macroinvertebrate taxa were collected in drift samples. [USNRC 2006a, Section 2.7.2.1]

Another predominant invertebrate was the river shrimp (*Macrobrachium ohione*). These shrimp were caught mainly along the river banks with their numbers peaking in October and dropping from November to April, when water temperatures were coldest. [USNRC 2006a, Section 2.7.2.1]

The possible occurrence of the fat pocketbook mussel in the Mississippi River at the GGNS site was investigated by performing a mussel survey at the intake and discharge location on November 20, 2006. The survey found no native mussels of any species or live mussels of any exotic species. Dead zebra mussel (*Dreissena polymorpha*) and asiatic clam (*Corbicula fluminea*) shells occurred on the river bank. Both are introduced species common to the Mississippi River. Because the shells represented dead specimens, their origin is unknown except to note that they probably originated somewhere upriver and were carried to the site by river currents. [SERI 2008b, Section 2.4.2]

Benthic macroinvertebrates in Hamilton and Gin lakes more closely resemble the populations collected in the backwaters of the river. Chironomids, tubificid worms, and bivalves were the most dominant taxa. The composition and abundance of plankton in Hamilton and Gin lakes varied based on the frequency and duration of flooding by the river. When the lakes were not flooded, they developed distinct plankton populations. However, during flood events, the populations more closely resemble those characterized in the river. [USNRC 2006a, Section 2.7.2.1]

2.2.4 Vascular Aquatic Plants

Hamilton and Gin lakes did not support vascular aquatic plants in the preconstruction studies. The only aquatic plant recorded in the lakes was the big duckweed, *Spirodela* spp. In the reconnaissance visit completed in 2002, no emergent vegetation was found in the lakes except along the periphery [USNRC 2006a, Section 2.7.2.1]. Palustrine, emergent, seasonally flooded wetlands are located near the periphery of both Gin and Hamilton Lakes. These wetlands are limited in aerial extent and dominated by grasses and sedges (*Panicum rigidulum* and *Carex spp*.). [SERI 2005b, Section 2.4.1.1.2.1]

2.2.5 Fish Communities

GGNS does not have an intake structure that withdraws surface water directly from the Mississippi River. Circulating cooling water is provided from radial wells as discussed in Sections 2.3 and 3.2.2, and although the radial wells withdraw groundwater that is hydraulically connected to the river, impacts that might be associated with operations of a power plant, such as entrainment or impingement of organisms, do not occur. Additionally, GGNS utilizes a closed-cycle cooling system with cooling towers and does not have cooling ponds or lagoons. As a result, the information on fish and shellfish communities provided below is relevant to the potential impacts associated with water quality and thermal discharge impacts.

Commonly found fish in the vicinity of GGNS are listed in Table 2.2-1, while Table 2.2-2 lists the recreational and commercially important fish species in the vicinity of GGNS.

2.2.5.1 Mississippi River

The LMR is distinguished by its extraordinary species richness, particularly in fish. The entire Mississippi basin has served as a center for fish distribution as well as a glacial refugium, and as such is home to many of the species found in surrounding drainages. As a result, it is the second richest ecoregion in North America, after the Tennessee. The ecoregion is noted for its assemblages of large river fish, which include lamprey species (*F. Petromyzontidae*), sturgeon (*F. Acipenseridae*), the only North American paddlefish (*Polyodon spathula*), gar (*Lepisosteus* spp.), and the bowfin (*Amia calva*). Many of these large river fish exhibit adaptations for the constantly turbid character of the Mississippi. Additionally, numerous marine species have been commonly recorded in the Mississippi's lower reaches. [FEOW]

Although primary productivity in the LMR is low, it is distinguished by extraordinary species richness with regard to fish. [FEOW] Plentiful habitat exist for fishes that thrive in swiftly flowing water, but few species can tolerate the high current velocities of the upper and middle water column of the channel. Species less tolerant of high current velocities likely inhabit areas near the banks and channel bottom where the current is less severe [LP&L, Section 2.2.2.5.2].

Only 4 percent of fish species are endemic to the LMR and these are found in tributary drainages rather than in the Mississippi mainstem. These endemics include a shiner (*Notropis rafinesquei*), catfish (*Noturus hildebrandi*), killifish (*Fundulus euryzonus*), and a number of darters (*Percina aurora*, *Etheostoma chienense*, *Etheostoma pyrrhogaster*, *Etheostoma raneyi*, *Etheostoma rubrum*, *Etheostoma cervus*, and *Etheostoma lynceum*). [FEOW]

The dominant species in the LMR based on numbers and weight are gizzard shad (*Dorosoma cepedianum*), freshwater drum (*Aplodinotus grunniens*), blue catfish (*Ictalurus furcatus*), and flathead catfish (*Pylodictis olivaris*). The numbers vary within the particular habitats of the river. In the backwater habitat, the dominant species are gizzard shad, blue catfish, river carpsucker (*Carpiodes carpio*), freshwater drum, and shovelnose sturgeon (*Scaphirhynchus platorynchus*). In the river bank, the dominant fish are gizzard shad, freshwater drum, silver chub (*Macrhybopsis storeriana*), flathead catfish, and blue catfish. [USNRC 2006a, Section 2.7.2.1]

2.2.5.2 Hamilton and Gin Lakes

Based on preconstruction studies (1972–1973), Hamilton Lake had 46 fish species, and Gin Lake had 36 species. Several of the fish species in Hamilton and Gin lakes are thought to be from the Mississippi River. When the river floods the lakes, fish are brought into the area and then are trapped in the lakes when the flood waters recede. The difference in fish diversity between the two lakes was attributed to the connection of Hamilton Lake to the river during periods when the river is not at flood stage. While more species were present in Hamilton Lake based on the study, the dominant fish were the same in both lakes. The top 80% of the population was made up of gizzard shad, bluegill (*Lepomis macrochirus*), threadfin shad (*Dorosoma petenense*), and largemouth bass (*Micropterus salmoides*). Several stragglers (fish that normally inhabit the river) were also found in Hamilton and Gin lakes. [USNRC 2006a, Section 2.7.2.1]

Table 2.2-1
Common Fish Species in the Vicinity of GGNS

Common Name	Scientific Name
Black crappie	*Pomoxis nigromaculatus*
Blue catfish	*Ictalarus furcatus*
Bluegill sunfish	*Lepomis macrochirus*
Bluntnose minnow	*Pimephales notatus*
Channel catfish	*Ictalurus punctatus*
Emerald shiner	*Notropis atherinoides*
Flathead catfish	*Pylodictis olivaris*
Freshwater drum	*Aplodinotus grunniens*
Gizzard shad	*Dorosoma cepedianum*
Green sunfish	*Lepomis cyanellus*
Largemouth bass	*Micropterus salmoides*
Longear sunfish	*Lepomis megalotis*
Mississippi silverside	*Menidia audens*
Mosquitofish	*Gambusia affinis*
Paddlefish	*Polyodon spathula*
River carpsucker	*Carpiodes carpio*
River shiner	*Notropis blennius*
Shortnose gar	*Lepisosteus platostomus*
Shovelnose sturgeon	*Scaphirhynchus platorynchus*
Silver chub	*Hybopsis storeriana*
Silvery minnow	*Hybognathus nuchalis*
Skipjack herring	*Alosa chrysochloris*
Smallmouth buffalo	*Ictalurus bubalus*
Threadfin shad	*Dorosoma petenense*
Warmouth	*Lepomis gulosus*
White bass	*Morone chrysops*
White crappie	*Pomoxis annularis*
Reference: SERI 2005b, Table 2.4-7	

2.2.5.3 Commercial and Recreational Fish Species

Commercial harvest of fishes in the LMR is difficult to assess because of inconsistencies in methods of gathering and reporting data. The limited information available indicates commercial harvest is increasing. [ENSR 2007, Section 3.3.1.1] Valuable commercial catches from the LMR include buffalo fish (*Ictiobus* spp.), freshwater catfish (*Ictalurus* spp.), gar (*Lepisosteus* spp.), and freshwater drum (*Aplodinotus gunniens*) [LP&L, Section 2.2.2.4.1]. Commercial fishing is limited in the area with most occurring on the Mississippi River near the GGNS site and on the Big Black and Bayou Pierre Rivers. Approximately twelve commercial fishing operations are in the area. They catch predominately catfish, but also harvest bigmouth (*Ictiobus cyprinellu*s) and smallmouth buffalo fish (*Ictiobus bubalus*). [USNRC 2006a, Section 2.7.2.1]

Recreational species targeted most often in freshwater portions of the LMR include black bass (*Micropterus* spp.), catfish, crappie (*Pomoxi* spp.), gar, and carp (*Cyprinus* spp.). [ENSR 2005, Section 3.3]

Table 2.2-2
Recreational and Commercially Important Fish Species

Common Name	Scientific Name
Recreational Species	
Black bass	*Micropterus* spp.
Carp	*Cyprinus* spp.
Catfish	*Ictalurus* spp.
Crappie	*Pomoxi* spp.
Gar	*Lepisosteus* spp.
Commercial Species	
Bigmouth buffalo fish	*Ictiobus cyprinellus*
Catfish	*Ictalurus* spp.
Freshwater drum	*Aplodinotus grunniens*
Gar	*Lepisosteus* spp.
Smallmouth buffalo fish	*Ictiobus bubalus*
References: LP&L, Section 2.2.2.1; USNRC 2006a, Section 2.7.2.1; ENSR 2005, Section 3.3	

2.2.6 Federal- and State-Listed Aquatic and Riparian Species

2.2.6.1 Federally Listed Aquatic and Riparian Species

Aquatic and terrestrial (riparian) species currently protected under the Endangered Species Act (ESA), including candidate species, that may potentially be present in the vicinity of the site include two mammals, three birds, two fish, and two macroinvertebrates (Table 2.5-1).

These species collectively include the Louisiana black bear (*Ursus americanus luteolus*), American black bear (*Ursus americanus*), interior least tern (*Sterna antillarum athalassos*), red-cockaded woodpecker (*Picoides borealis*), wood stork (*Mycteria americana*), pallid sturgeon (*Scaphirhynchus albus*), bayou darter (*Etheostoma rubrum*), fat pocketbook mussel (*Potamilus capax*), and rabbitsfoot mussel (*Quadrula cylindrica*). A more detailed discussion of federally-listed threatened and endangered species for aquatic and terrestrial species is provided in Section 2.5.

2.2.6.2 State-Listed Aquatic and Riparian Species

Aquatic and terrestrial (riparian) species designated as endangered or of special concern by the Mississippi Natural Heritage Program (MNHP), and as threatened or endangered by the Louisiana Natural Heritage Program (LNHP), that could potentially be present in the vicinity of GGNS includes two mammals, five birds, one amphibian, eight fish, one macroinvertebrate, one insect, and one plant species (Table 2.5-1).

These MNHP and LNHP threatened or endangered species collectively include the Louisiana black bear, American black bear, bald eagle (*Haliaeetus leucocephalus*), wood stork, interior least tern, red-cockaded woodpecker, pallid sturgeon, bayou darter, crystal darter (*Crystallaria asprella*), and fat pocketbook mussel. The MNHP species of special concern include the white ibis (*Eudocimus albus*), Webster's salamander (*Plethodon webster*), sicklefin chub (*Macrhybopsis meeki*), chestnut lamprey (*Ichthyomyzon castaneus*), black buffalo (*Ictiobus niger*), paddlefish (*Polyodon spathula*), blue sucker (*Cycleptus elongates*), and robust baskettail (*Epitheca spinosa*). [GGNS 2010h, Attachment 4 - Table 5.4-2] A more detailed discussion of state-listed threatened and endangered species for aquatic and terrestrial species is provided in Section 2.5.

2.3 Groundwater Resources

The GGNS site is located on approximately 2,100 acres on the east bank of the Mississippi River at RM 406, approximately 25 miles south of Vicksburg, Mississippi, and 37 miles north-northeast of Natchez, Mississippi. [USNRC 2006a, Sections 2.0 and 2.2.1] This portion of the LMR is referred to on USACE charts as the Yucatan Cut-Off. [USACE 1998]

The GGNS site consists primarily of woodlands and former farms, as well as two lakes, Hamilton Lake and Gin Lake. These lakes were once in the channel of the Mississippi River and have an average depth of eight to ten feet. The western half of the site is floodplain in the Mississippi Alluvial Valley, consisting of materials deposited by the Mississippi River and extending eastward

from the river about 0.8 miles. The floodplain area is generally at elevations of 55 to 75 feet above MSL. The eastern half of the site is rough and irregular with steep slopes and deeply cut stream valleys and drainage courses. Ground elevations in the upland portion of the GGNS site range from 80 feet above MSL to more than 200 feet above MSL inland. Elevations of about 400 feet above MSL occur on the hilltops east and northeast of the site. Grade elevation for the existing GGNS facility structures is 132.5 feet above MSL. [USNRC 2006a, Section 2.1]

2.3.1 Geology

2.3.1.1 Regional Geology

Regional and site geology has been extensively evaluated for various USNRC licensing activities at the GGNS site - i.e., construction and operating licenses for GGNS Units 1 and 2, an ESP and COLA [MP&L; SERI 2005a; SERI 2008a]. The geological stratigraphy of the region can be illustrated by the geologic units that underlie Claiborne, Hinds, Copiah, Jefferson, and Warren Counties in Mississippi. Table 2.3-1 lists the formations in order from most recent to oldest, with a brief description of each formation and the occurrence of groundwater. [SERI 2005a, Table 2.4-20] It should be noted that some formations may not be present in all areas of the region. For example and as noted below, the Pleistocene Terrace Deposits (Upland Complex by local nomenclature) unconformably overlie the Catahoula Formation due to the absence of the Citronelle, Pascagoula, and Hattiesburg Formations. In order to present geologic information relevant to the description of groundwater resources at GGNS, the emphasis of the description below is on those formations potentially affected by GGNS operations and license renewal. The important groundwater stratigraphic units encountered at the site are the Mississippi River Alluvium, Loess, Upland Complex (terrace deposits), and the Catahoula Formation.

The geological formations underlying the region record a long history of tectonic stability and deposition. The formations include both marine and terrestrial sediments that reflect distinct changes in depositional environments, climatic conditions, and glacial-eustatic cycles over the past 36 million years. Deposits of at least Oligocene and younger age dip very gently southward and are laterally continuous across the site region. These deposits are not deformed and thus document long term tectonic stability. The Oligocene and younger deposits demonstrate a long period of tectonic stability and the absence of tectonic deformation in the region. There are no faults or folds in the region. [SERI 2005a, Section 2.5.1.2.2]

The Oligocene depositional environment in the region was dominated by shallow marine seas, in which the Glendon Limestone and Byram Marl formations of the Vicksburg Group were deposited. These deposits primarily consist of limestone and marl with interbedded calcareous sands and clays. The Byram Marl was overlain by the late Oligocene Bucatunna Clay Formation, possibly representing a transition to a deep water or estuarine environment. The Glendon Limestone occurs at a depth of approximately 300 feet beneath the site. These deposits are overlain unconformably by the Miocene Catahoula Formation. [SERI 2005a, Section 2.5.1.2.2]

In the Miocene, the depositional environment at the site changed from a marine to a marginal shoreline environment, in which the Catahoula Formation was deposited. These deposits

consist of silty to sandy clays, clayey silts, and sands. The surface of the Catahoula Formation was deeply eroded at the site prior to deposition of the Pliocene to Pleistocene age Upland Complex. [SERI 2005a, Section 2.5.1.2.2]

In the Pliocene and Pleistocene, the depositional environment again changed from a marginal shoreline to an alluvial environment, in which alluvial deposits correlative with the Upland Complex were deposited. These deposits consist of coarse sand and gravel derived from both glacial and non-glacial sources. Pleistocene Upland Complex deposits unconformably overlie the eroded surface of the Catahoula Formation. [SERI 2005a, Section 2.5.1.2.2]

Late Pleistocene terraces were deposited in response to Wisconsin-age glacial cycles that supplied large volumes of sediment to the Mississippi Alluvial Valley. Subsequent stream incision eroded the terraces along north-northeast trending valleys that cross the site. [SERI 2005a, Section 2.5.1.2.2]

At various periods in the late Pleistocene, strong seasonally prevailing winds transported silt from unvegetated glacial outwash in the central U.S. As a result, the Peoria, Ferndale, Roxanna, and Lovelend loess sheets were deposited in the region between Vicksburg and Natchez. The youngest loess sheet, the Peoria Loess, is late Wisconsin in age. The average thickness of loess in the site location is about 65 feet. Throughout the Holocene, loess deposits were deeply eroded by tributary streams to the Mississippi River. During this time alluvial sediment also was deposited on the Mississippi River floodplain and in tributary stream valleys. Deposition of alluvial deposits during peak glacial outwash may have changed local base-levels, blocking stream outlets and leading to the ponding or deposition of silt and alluvium in tributary valleys. The subsequent drop in river-level in the current interglacial period is inferred to have caused incision and formation of the terraces remnants along Bayou Pierre and Big Black River. [SERI 2005a, Section 2.5.1.2.2]

Table 2.3-1
Geologic Formation of Claiborne, Copiah, Hinds, Jefferson, and Warren Counties, MS

Stratigraphic Unit	Thickness (ft)	Physical Character	Water-Bearing Properties
Alluvium (Holcene)[a]	0-200	Fine to coarse grained sand, silt, clay, and gravel	Deposits in tributary streams yield up to 100 gpm; Mississippi River Alluvium may yield up to 5,000 gpm; source for GGNS radial wells; wells in Warren County report yields of 75 to 1,400 gpm.
Loess (Pleistocene)	0-80	Tan to brown calcareous silt, clay, and gravel	Unimportant as an aquifer.
Terrace Deposits (Pleistocene)[a]	0-120	Fine to coarse grained sand, chert, and quartz gravel, numerous clay and silt lenses and layers	Domestic supplies of several gpm in uplands along Mississippi River and larger tributaries; source for GGNS potable water wells.
Citronelle Formation (Pliocene-Pleistocene)	0-100	Sand, chert, and quartz gravels	Yields of several gpm from shallow wells in southeastern Jefferson County; important aquifer in Crystal Springs area, Copiah County; large wells report yields of 250 to 700 gpm; not present in Claiborne County; included in the Southern Hills Aquifer system sole source aquifer designation.
Pascagoula Formation Hattiesburg Formation Catahoula Formation (Miocene)	0-400 0-900	Clay and sand, locally indurated, and gravel	Important aquifers in southwestern Mississippi (included in the Southern Hills Aquifer system sole source aquifer designation), a source for all types of wells, yields range from 100 to 700 gpm. Aquifer tests in wells in the Catahoula Formation in Claiborne County had yields ranging from 20 to 240 gpm; reported yields of 240 to 560 gpm.
Vicksburg Group, Units Undifferentiated (Oligocene)	160	Clay, marl, and limestone	Unimportant as an aquifer.

Table 2.3-1 (Continued)
Geologic Formation of Claiborne, Copiah, Hinds, Jefferson, and Warren Counties, MS

Stratigraphic Unit	Thickness (ft)	Physical Character	Water-Bearing Properties
Forest Hill Formation (Oligocene)	80-220	Gray fine sands and carbonaceous clays	Source for many small diameter wells in southwestern Hinds and Warren Counties; few rural wells in northern Claiborne County; source for public supply and industrial wells in Copiah, Hinds, and Warren Counties.
Yazoo Clay (Eocene)	400-500	Light bluish-gray and pale gray, calcareous, fossiliferous clay	Aquiclude
Moodys Branch Formation (Eocene)	10-45	Greenish-gray sand and marl	Unimportant as an aquifer.
Cockfield Formation (Eocene)	100-385	Gray clays, sandstones, and siltstones	Source for many wells in Hinds and northern Warren County; wells in Warren County report yields from 80 to 700 gpm; Cockfield aquifers contain salt water south of the Big Black River.
Cook Mountain Formation (Eocene)	100-400	Shale, sandy limestone, and chalk	Aquiclude
Sparta (or Kosciusko) Formation (Eocene)	300-1,020	Gray clays and shales, siltstone, and sandstone	Important source for many wells in Jackson area, Hinds County with reported yields of 15 to 1,260 gpm; supplies a few small wells in Warren County.
Wilcox Group, undifferentiated (Eocene)	1,150-3,310	Shale, siltstone, and sandstone	Importance limited to Jackson area, contains salt water elsewhere; one well reported to flow above ground surface.

Reference: SERI 2005a, Table 2.4-20

a. Although this table lists regional aquifers, those utilized by GGNS are localized.

2.3.1.2 Site Geology

The Holocene geologic units lie in stream valleys and along the Mississippi River floodplain at the site (Figure 2.3-1). Eastward of the bluffs occurring along the eastern flanks of the floodplain, the loess is underlain by the terrace deposits of the Upland Complex, which are then underlain by the Catahoula Formation. The Catahoula Formation is part of the Southern Hills regional aquifer system, a sole-source aquifer [USNRC 2006a, Section 5.3].

GGNS is located in the uplands portion of the site (Figure 2.3-1). The bluffs east of the floodplain at the site delineate a change in the upper stratigraphy. The upland plain, east of the bluffs, is a Pleistocene terrace rising to an elevation of about 150 feet above MSL. The surface of the upper plain is about 75 feet of loess overlaying about 40 feet of coarse grained alluvium sand and gravel deposits of the Upland Complex. The lowland, west of the bluffs, at an elevation of about 70 feet above MSL consists of a layer of Holocene alluvium over 100 feet in thickness including backswamp areas and meander belts of the Mississippi River. The Catahoula Formation underlies both the terrace deposits in the uplands and the alluvium in the lowlands. [USNRC 2006a, Section 2.4]

Figures 2.3-2 and 2.3-3 provides an east-west cross-section of site stratigraphy. The geologic units east of the bluffs on the uplands area of the site consist of Loess (Upper and Lower) underlain successively by the Upland Complex Alluvium (UCA), and Old Alluvium (UCOA), and Catahoula Formation. The loess is largely comprised of low permeability wind-deposited sediments. The UCA is a unit typically comprised of sands and clayey, silty sands. The UCOA is a unit typically comprised of coarse sands and gravels and clayey, silty sands. The Catahoula Formation is characterized as having a high percentage of fines and low permeability. Note that recent descriptions of the site have included changes in nomenclature for geologic formations to be consistent with the newer geologic references (e.g., Upland Complex was formerly named the Pleistocene Terrace Deposits). [SERI 2008a, Section 2.5.4.6.1]

2.3.1.3 Seismicity

GGNS is located within the Gulf Coastal Plain physiographic province. The region includes the Ouachita Mountains province and a buried continuation of the Southern Appalachian province. The Gulf Coastal Plain province is divided into sub-provinces including the Mississippi Alluvial Valley, Chenier/Delta Plain, Loess Hills, Prairie Coastwise Terrace, Southern Hills, Eastern Hills, and Western Hills. [SERI 2005a, Section 2.5.1.1.1 and Figure 2.5.2]

The Gulf Coastal Plain consists of two primary geological provinces, the Gulf Coast Basin and Mississippi Embayment. These geologic provinces encompass a variety of geologic features including localized uplifts, zones of salt migration, growth faults, pre-Quaternary tectonic faults, and basins. The Gulf Coastal Plain has been dominated by marine and fluvial processes along the Gulf of Mexico continental margin for several hundred million years. Thick sedimentary sequences deposited by the Mississippi River within the Gulf Coastal Plain played an important role in the geologic processes of the region since post-Miocene time. [SERI 2005a, Section 2.5.1.1]

A detailed description of the site and region is provided in the GGNS Unit 1 Updated Final Safety Analysis Report (UFSAR). This information has been reviewed and approved by the USNRC staff, and forms the basis for understanding the site geology. During the recent GGNS Unit 3 ESP and Combined Operating License (COL) site investigations, information related to seismic characteristics was updated based on review of data and information published since the 1986 Electric Power Research Institute (EPRI) study and discussions with current researchers familiar with the regional geology. In addition, new geologic maps showing the distribution of surficial deposits in the vicinity, site area, and site have been prepared, and new geologic cross-sections and subsurface contour maps have been prepared incorporating data from the geotechnical exploration program. [SERI 2005a, Section 2.5.1.1; SERI 2008a, Section 2.5.4.1.4]

Since 1986, additional geological, seismological, and geophysical research has been completed in the region. This more recent research has identified a potentially active seismic source, the Saline River source zone within the region that includes the trends of the Arkansas, Saline, and Ouachita River lineaments in southeastern Arkansas. Recent research also has improved the characterization of seismic source parameters associated with the New Madrid seismic zone, the source of the 1811–1812 earthquake sequence. [SERI 2005a, Section 2.5.1.1.5]

The region is characterized by extremely low rates of earthquake activity. Previous seismic hazard investigations, such as the original licensing studies for GGNS Unit 1, the 1986 EPRI study, and the 2002 USGS National Seismic Hazard maps, all indicate that the rate of earthquake activity in the Gulf Coastal Plain is among the lowest in the United States. The geologic setting and modern tectonic framework suggest that the earthquake hazard for the region will remain low for the foreseeable future. [SERI 2005a, Section 2.5.1.1]

The 2008 GGNS Unit 3 COL evaluation concluded there is no evidence for geologic hazards or human activities that would result in surface subsidence or unrelieved stresses in bedrock that could affect plant safety or performance. There have been no active or capable faults or geologic structures found at or within a five mile radius of the GGNS site, nor are any expected to be present based on the geologic and tectonic setting. No capable faults or tectonic structures were found during the site construction and excavations for the GGNS Unit 1 power block that were examined and logged by geologists. Based on a review of potential regional sources, potential for surface-fault rupture at the site can be considered negligible. In addition, there is no evidence of non-tectonic deformation in the site area, such as collapse structures, differential uplift, subsidence, salt diapirs, growth faults, or volcanic intrusion. [SERI 2008a, Section 2.5.4.1.4.2]

Based on reviews and evaluations, seismicity events are concentrated along the Reelfoot Rift, Ouachita Orogenic Belt, and Appalachian Mountains, primarily in regions underlain by continental crust. [SERI 2005a, Section 2.5.1.1.6.1] Although no earthquakes have occurred within the site vicinity, two moderate magnitude earthquakes occurred in 2006 within some of the EPRI Seismicity Owners Group source zones that encompass the Gulf of Mexico region and which lie partly within the GGNS region [SERI 2008a, Section 2.5.2]. Therefore, the GGNS Unit 3 COLA evaluations updated the seismic model for the site and found that the site peak ground acceleration at 100 Hz frequency is 0.11 "acceleration of gravity" [SERI 2008a, Section 2.5.2.5].

The GGNS Unit 1 UFSAR states that based on the seismicity of both the Gulf Coast Basin tectonic province and Mississippi Embayment tectonic province (New Madrid seismic zone), the safe shutdown earthquake is conservatively selected at 0.15 "acceleration of gravity" at foundation grade on the Catahoula Formation [GGNS 2010a, Section 2.5]. Therefore, GGNS Unit 1 is still bounded by the design basis safe shutdown earthquake.

2.3.2 Regional Groundwater

GGNS lies within the Mississippi Alluvial Plain section of the Coastal Plain Physiographic Province. Several important aquifer systems are in the vicinity of the site including the Mississippi River Valley Alluvial Aquifer system, Coastal Lowlands Aquifer system, and Mississippi Embayment Aquifer system. The site is south of the southern extent of the Mississippi River Valley Alluvial Aquifer system. However, the site is within the very northern extent of the Coastal Lowlands Aquifer system and near the center of the Mississippi Embayment Aquifer system. [USNRC 2006b, Section 2.4.12.3] The Vicksburg Group confining unit is formed by massive clay beds and separates the Mississippi Embayment Aquifer System from the overlying Coastal Lowlands Aquifer System. The units described in Table 2.3-1 above the Vicksburg Group, which includes the alluvium, loess, terrace deposits, and Miocene aquifer system (Southern Hills Aquifer system), are described by the USGS as being included in the Coastal Lowland Aquifer System. Stratigraphic units beneath the Vicksburg Group in Table 2.3-1 are defined in USGS literature as being part of the Mississippi Embayment Aquifer System. [USGS 2009, HA730-F, Figures 47 and 68]

The Coastal Lowlands Aquifer System consists of a gulfward-thickening, heterogeneous, and unconsolidated to poorly consolidated wedge of discontinuous beds of sand, silt, and clay that range in age from Oligocene to Holocene. Beneath the Coastal Lowlands Aquifer System is the Mississippi Embayment Aquifer System. At the site, the Mississippi Embayment Aquifer System consists of several aquifers that range from Late Cretaceous to Middle Eocene in age with a combined thickness of over 5,000 feet. [USNRC 2006b, Section 2.4.12.3]

The region of groundwater investigations discussed herein encompasses the area east of the Mississippi River. The area west of the Mississippi River is being excluded since the river forms an effective hydrologic boundary.

Geologic formations dip south across the region at an average of 26 feet 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 feet below land surface in the upland areas and is at or near the surface in the lowland areas. The stratigraphic position of the regional geologic formations, along with a brief description of their physical and water bearing characteristics, is presented in Table 2.3-1. [SERI 2005a, Section 2.4.12.1.1]

The principal sources of groundwater 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). [SERI 2005a, Section 2.4.12.1.1]

2.3.2.1 Holocene Mississippi River Alluvium

The Mississippi River Alluvium is the most prolific water bearing unit in the region. The Alluvium, up to 200 feet 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. The Mississippi River and its tributary streams and lakes also contribute recharge during high water levels. [SERI 2005a, Section 2.4.12.1.1]

2.3.2.2 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 east of the river, 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 feet in thickness. Rural domestic wells are completed at shallow depths in these deposits along the Mississippi River and its main tributaries and yield groundwater at several gallons per minute. Recharge to the terrace deposits is from underflow and downward seepage through overlying loess. [SERI 2005a, Section 2.4.12.1.1]

2.3.2.3 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 1,100 feet 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 feet. The recharge area for the Catahoula lies to the north in Warren and Hinds Counties beneath the alluvial plain and loess bluffs. [SERI 2005a, Section 2.4.12.1.1]

2.3.3 Local Groundwater

As indicated above, the primary stratigraphic units encountered at the site are the Mississippi River Alluvium, the Upland Complex Formation (Pleistocene Terrace Deposits), and the Catahoula Formation. A geologic cross-section is provided in Figures 2.3-2 and 2.3-3. A representation of surficial geologic units relevant to site groundwater is provided in Figure 2.3-1.

The morphology of the Mississippi River has defined much of the alluvial aquifer system near the site. The Holocene alluvium near the river has been affected by deposition and erosion. Faster-moving sections of the river are able to scour and cut down to the Catahoula Formation, whereas slower-moving sections of the river provide an opportunity for the sediment in the river to be deposited. [USNRC 2006a, Section 2.6.1.2]

2.3.3.1 Mississippi River Alluvium

As mentioned above, the Mississippi River Alluvium is the most prolific water-bearing unit in the region. The alluvium, up to 200 feet 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. The Mississippi River, tributary streams, and area lakes also contribute recharge during high-water levels. [GGNS 2010a, Section 2.4.13.1.1]

The Mississippi River Alluvium occupies the floodplain portion of the GGNS site. It consists of a surficial layer of clay and silt overlying lenses of sand, gravel, silt, and clay. In the area between Hamilton and Gin Lakes and the Mississippi River, the alluvium is predominantly fine-to-medium grained sand with varying amounts of gravel, silt, and clay. [GGNS 2010a, Section 2.4.13.1.2]

Alluvium thickness as determined by borings generally ranges from 95 to 182 feet at GGNS. The greatest thickness of gravel generally occurs at the base of the alluvium deposits just above the Catahoula Formation. East of the lakes and west of the bluffs, clay and silt are the principal constituents of the alluvium, with lesser amounts of sand and gravel present. [GGNS 2010a, Section 2.4.13.1.2]

Recharge to the alluvium is derived from infiltration of precipitation, westward flow of groundwater across the terrace alluvium contact at the bluffs, and the Mississippi River 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. [GGNS 2010a, Section 2.4.13.1.2]

Beneath and adjacent to the river, the alluvium is in close hydraulic connection with the river. The fluctuation of the Mississippi River causes fluctuation in the alluvial aquifer. Generally, at the site the alluvium discharges to the river. However, during floods the direction of flow in the alluvial aquifers can reverse. [USNRC 2006a, Section 2.6.1.2]

2.3.3.2 Upland Complex Formation

The loess overlies the water bearing deposits of the Upland Complex at GGNS. The majority of the loess is unsaturated. The piezometric surface and first zone of saturation occur within the lower ten feet of the loess (perched water of limited extent). The loess is not a source of groundwater supply.

The sediments of the UCA (Figure 2.3-2) are fully saturated and contain permeable sands as well as clayey, silty sands and sandy clays. The UCOA contains highly permeable zones of coarse sands and gravels in addition to less permeable clayey and silty sands. Groundwater elevations measured on March 20, 2007, during site characterization for a proposed GGNS Unit 3 COLA indicate groundwater elevations in the loess and Upland Complex are approximately 74 to 75 feet above MSL in the area west of GGNS. [SERI 2008a, Section 2.5.4.6.1] Groundwater in the Upland Complex is under unconfined water table conditions.

2.3.3.3 Catahoula Formation

As previously discussed, aquifers of the Miocene series underlie the entire region and consist 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 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 feet. The depth to Miocene aquifers varies greatly over the region from near surface in the north to about 1,100 feet in southern areas. The recharge area for the Catahoula lies to the north of GGNS in Warren and Hinds Counties beneath the alluvium plain and loess bluffs. [GGNS 2010a, Section 2.4.13.1.1]

The Catahoula Formation is continuous across the entire GGNS site and lies beneath the floodplain alluvium and terrace deposits and at a few locations directly beneath the loess (Figures 2.3-2 and 2.3-3). It consists of lenticular beds of locally indurated fine sand, silty clay, and clayey silt with occasional silt and fine sand seams. [GGNS 2010a, Section 2.4.13.1.2]

The upper portion of the Catahoula Formation is impermeable and acts as a confining unit; however, thin sand lenses are encountered in the upper portion. Groundwater levels in wells screened in the Catahoula Formation had a higher potentiometric head than the level of the formation itself, indicating the water is under confined conditions. Wells installed for the proposed GGNS Unit 3 COLA site characterization indicated the water-bearing sand lens within the upper Catahoula Formation are separated from the Upland Complex by approximately 50 feet of less permeable Catahoula Formation deposits. Pump tests in the Upland Complex did not result in impacts to water level changes in the well screened within the Catahoula Formation when the well in the Upland Complex was being pumped. [SERI 2008a, Section 2.4.12.1.3.1]

2.3.3.4 Site Groundwater Conditions

Figure 2.3-4 shows the locations of 44 groundwater monitoring wells that were installed in 23 locations during the proposed GGNS Unit 3 COLA project to further characterize the groundwater resources at the site [SERI 2008a, Section 2.4.12.2.3]. The information regarding the GGNS Unit 3 groundwater monitoring data are being provided for a better understanding of the groundwater conditions at GGNS.

GGNS Unit 3 wells have a 4-digit numerical designation. Nested wells were installed in the selected boring locations in the Upland Complex, Mississippi River Alluvium, and upper Catahoula Formation as follows: [SERI 2008a, Section 2.4.12.2.3]

- 12 wells were screened in the lower portion of the loess (a well was installed only if moisture was encountered in the lower portion of the loess), designated with suffix "A" to monitor for perched groundwater.

- 19 wells were screened in the Upland Complex or Mississippi River Alluvium, designated with suffix "B".

- 9 wells were screened in thin sand lenses encountered in the upper portion of the Catahoula Formation, designated with suffix "C".

- 4 wells were screened in the Upland Complex to provide water levels during pump tests, designated with prefix "OW" and a 4-digit numerical designation. [SERI 2008a, Section 2.4.12.2.3]

Water level monitoring data show three distinct units in which groundwater occurs in the area of the proposed GGNS Unit 3 west of GGNS Unit 1. These measured water levels indicate hydraulic separation between perched groundwater, encountered in some locations, the water table in the Upland Complex, and confined groundwater conditions in the Catahoula Formation. [SERI 2008a, Section 2.4.12.2.3]

The perched layers were generally encountered at elevations between approximately 70 to 90 feet above MSL. Eight of the 12 wells installed in the loess ("A" wells) were dry at every gauging event, indicating that perched groundwater is generally of isolated extent. [SERI 2008a, Section 2.4.12.2.3]

The potentiometric surface of the water table aquifer in the Upland Complex during the monitoring period was approximately 72 to 76 feet above MSL. The potentiometric surface of water in the upper portion of the Catahoula Formation during the monitoring period was between 68 to 72 feet above MSL. Approximately three feet of hydraulic separation exists between the Upland Complex potentiometric surface and the potentiometric surface of groundwater in the Catahoula Formation, although the actual water-bearing zone in the Catahoula Formation is typically 85 feet beneath the measured water level of wells screened in the Catahoula Formation. This separation indicates the groundwater in the Catahoula Formation is locally confined or semi-confined. Further, these data indicate that there is limited communication locally between the Upland Complex and the Catahoula Formation groundwater. [SERI 2008a, Section 2.4.12.2.3]

While water levels in the monitored wells generally increase or decline together, closer review of these data reveal occasional lag or differential movement of water levels between wells in the Upland Complex and those in the upper portion of the Catahoula Formation. The measured water level increase or decline also differs between the formations. Water levels in some of the upper layers of the Catahoula Formation show greater seasonal variation than the water levels monitored in the Upland Complex. For example, the seasonal variation in levels measured in well MW1007C varied by 4.3 feet, while the variation in well MW1007B varied by 3.3 feet. In February 2007, the water level measurements of wells MW1007B and MW1007C revealed a potentiometric hydraulic head differential of 5.4 feet (75.6 feet MSL for well MW1007B versus 70.2 feet MSL for well MW1007C). These data are consistent with data reported for previous GGNS Unit 1 investigations, in that the water levels generally tend to increase or decline together, but show distinct hydraulic separation between the formations. [GGNS 2010a, Section 2.4.13.2.3; SERI 2008a, Section 2.4.12.2.3]

While the terrace deposits have been called the Upland Complex in most recent site descriptions, hydrogeologic descriptions have been consistent with the hydrogeologic characterization presented in the GGNS Final Environmental Statement (FES) and the site characteristics presented in the GGNS UFSAR. The groundwater gradient observed in the Upland Complex is generally to the west toward the Mississippi River. The GGNS UFSAR provides groundwater gradient maps for measurements in May 1973, October 1973, August 1979, November 1979, and December 1979. The May 1973 measurements were conducted when the Mississippi River was under flood conditions with the highest discharge in the last 70 years. The December 1979 measurement was also conducted when the river was under flood conditions. With the exception of the May 1973 map, all the GGNS UFSAR maps show a groundwater gradient to the west with water level contours indicating an approximate water level of 65–75 feet MSL in the area west of GGNS Unit 1 in the area considered for locating GGNS Unit 3. The May 1973 map shows an eastward groundwater gradient in the GGNS Unit 3 area, with a water level of 84 feet MSL under flood conditions. [SERI 2008b, Section 2.3.1.2.2; GGNS 2010a, Figures 2.4-27, 2.4-32 to 2.4-35, 2.4-38, 2.4-39]

GGNS Unit 1 is located on the eastern side of the property near the topographic high at the site. Surface elevations peak at approximately 200 feet MSL near the northeast corner of the Protected Area. The center of the GGNS Unit 1 reactor is located approximately 0.4 miles from the nearest property boundary to the east. Surface water drainage from the site is toward the Mississippi River. However, the general topography to the east of the site boundary begins a decline to the southeast toward Bayou Pierre, with the surface elevations declining from approximately 180 feet MSL to approximately 50 feet MSL at the point of Bayou Pierre nearest to the GGNS site.

As discussed in Section 2.3.1, the Upland Complex unconformably overlies the Catahoula Formation, with the Catahoula providing strata of low permeability preventing or limiting downward migration of groundwater. The UCA was excavated and removed down to the top of the Catahoula, and then GGNS Unit 1 was constructed along a ridge of the Catahoula Formation that rises to an elevation of approximately 90 feet MSL beneath the Unit 1 reactor building [GGNS 2010a, Figure 2.5-30]. Figure 2.3-3 provides a cross-sectional representation of the Upland Complex alluvial materials and Catahoula Formation beneath GGNS Unit 1 [SERI 2008a, Section 2.5.4]. Figure 2.3-5 shows the surface of the Catahoula Formation developed from the GGNS Unit 1 site characterization. [GGNS 2010a, Section 2.5].

Due to the impervious surface of the Catahoula Formation, groundwater within the Upland Complex flows above and along the Catahoula/Upland Complex contact. Based on the GGNS Unit 1 site characterization, the surface of the Catahoula does not necessarily mirror the surface topography. The surface of the Catahoula Formation drops off in elevation around GGNS Unit 1, except to the southeast as illustrated in Figure 2.3-5. The Catahoula surface would be expected to influence groundwater flow direction and potentially contribute to groundwater flow toward the northeast from the eastern side of the Protected Area. Previous site groundwater characterization investigations have concluded that the groundwater flow is toward the west from GGNS Unit 1. Based on groundwater monitoring data collected in November 1990, the potentiometric surface of the groundwater is higher in the Protected Area than that measured in

most monitoring wells outside the Protected Area, except to the southeast. The groundwater monitoring data collected in 1990 indicated that in addition to the flow of groundwater toward the west, there is a potential for a component of groundwater flow toward the northeast and/or east. [GGNS 2010a, Figure 2.4-48] Groundwater monitoring data collected in 2010 and 2011 from wells installed in the Upland Complex appear to confirm that groundwater flows toward the northeast from the eastern portion of the Protected Area.

Aquifer tests were completed to characterize groundwater conditions at various locations during the GGNS Unit 1 site characterization. Summaries of this information are included in the GGNS FER and UFSAR. Additional pump tests were completed in 2006 and 2007 to refine the hydrogeologic characteristics of select water-bearing strata necessary to support the GGNS Unit 3 COLA site characterization. The aquifer tests for GGNS Unit 3 generally confirmed and were bounded by the range of aquifer parameters developed for the GGNS Unit 1 characterization for the three onsite aquifers.

The greatest volume of groundwater is withdrawn by the radial well system. The transmissivity of the Mississippi River Alluvium is indicated to range from 21,500 to 163,500 gpd/ft, depending on location of testing and amount of sand and gravel encountered at that location [GGNS 2010a, Table 2.4B-1]. Generally, the greatest transmissivity is encountered near the river. Aquifer tests completed to design the GGNS radial well system along the banks of the Mississippi River at GGNS indicated transmissivity ranged from 169,302 gpd/ft to 203,150 gpd/ft [Bechtel]. The GGNS Unit 3 aquifer evaluation did not include additional testing in the area of the GGNS Unit 1 radial wells because direct surface water withdrawal was chosen for GGNS Unit 3 cooling water. A step-test from a well located near the bluff completed in the Mississippi River Alluvium indicated a transmissivity of only 12,900 gpd/ft. [SERI 2008a, Section 2.4.12.2.4] This is less than previous estimates, but is likely due to less sand and gravel penetrated in the deposits near the bluff. As indicated from GGNS Unit 1 aquifer tests in the Mississippi River Alluvium, aquifer results may vary dependent upon location of the well, test method utilized, and well penetration of the total aquifer thickness [SERI 2008a, Section 2.4.12.2.4].

Aquifer tests completed for GGNS Unit 1 site characterization indicated the transmissivity of the Upland Complex (formerly described as terrace deposits) is estimated to range from 120,300 gpd/ft to 401,600 gpd/ft depending upon the method of determination [GGNS 2010a, Table 2.4B-1]. An aquifer test performed for the GGNS Unit 3 COLA characterization near the GGNS Unit 3 power block indicated estimated transmissivity of the Upland Complex at approximately 92,000 gpd/ft, which is slightly less than the distance-drawdown transmissivity estimate of 120,300 gpd/ft obtained from a pump test of TW-1 conducted during the GGNS Unit 1 characterization [SERI 2008a, Section 2.4.12.2.4].

An aquifer test of the water bearing unit of the Catahoula Formation performed for the GGNS Unit 3 COLA characterization indicated an estimated transimissivity of approximately 300 gpd/ft with an intrinsic permeability is 7.4×10^{-9} cm^2 [SERI 2008a, Section 2.4.12.2.4]. This compares well with the GGNS Unit 1 estimate of Catahoula permeability of 6.3×10^{-9} cm/sec. [GGNS 2010a, Table 2.4B-1]

As discussed in Section 3.2.6, GGNS participates in the Nuclear Energy Institute (NEI) industry-wide voluntary Groundwater Protection Initiative (GPI) to enhance nuclear power plant operators' management of groundwater protection. In 2007, after the initial site characterization was completed, GGNS began sampling groundwater from existing onsite wells situated in the Upland Complex aquifer to monitor for potential releases of licensed material via groundwater pathways at the site in accordance with nuclear fleet administrative and site procedures [Entergy 2008a; Entergy 2011a; GGNS 2011j]. Since 2007, additional wells have been installed and existing wells situated in the Catahoula aquifer were sampled to further enhance GGNS' monitoring efforts. GGNS has sampled several onsite wells since 2007 for informational purposes. Representative wells currently sampled under the GPI program are shown in Figure 3.2-3. Results associated with GGNS groundwater monitoring efforts are discussed in Section 9.1.3.8.

2.3.3.5 Groundwater Quality

The GGNS facility uses radial wells adjacent to and with laterals extending beneath the Mississippi River to provide cooling water. The high rate of water induced to infiltrate from the Mississippi River into the Holocene alluvium has ensured that the dissolved solids concentrations of the groundwater in the vicinity of the radial wells are nearly identical to the water quality of the Mississippi River. Suspended sediment in the river water is trapped in the stream bed, thereby reducing the suspended solids in the cooling water. The water quality of the groundwater in the Catahoula Formation does not appear to have been influenced by the construction or operation of the GGNS facility. [USNRC 2006a, Section 2.6.3.2]

GGNS also uses wells in the Upland Complex terrace deposits as the source of water for several purposes, including potable water needs. The water is sampled as required by the Mississippi Department of Health (MDH) pursuant to the Safe Drinking Water Act. The groundwater quality from the Catahoula Formation, although very hard, is suitable for potable uses, with water quality generally decreasing as wells go deeper below the Catahoula Formation [USNRC 2006a, Section 2.6.3.2]. However, as a note, GGNS does not withdraw groundwater from the Catahoula formation.

For public water supplies listed in Table 2.10-1 (GGNS excluded), the groundwater in the area is generally good; however, USEPA records show several of the community water supply systems have violations due to naturally occurring combined radium, combined uranium, radon, and gross alpha concentrations, while some report problems with coliform and trihalomethanes [USEPA 2010].

2.3.4 Groundwater Use

2.3.4.1 Regional Groundwater Use

Regional formations important to groundwater supply along with a brief description of their physical and water bearing characteristics are presented in Table 2.3-1.

There are few population concentrations and little industry located in the region, and most water wells are used for domestic purposes. Use of alluvium aquifers is limited to several industrial

wells in Warren County and shallow domestic wells along the Mississippi River and its larger tributaries. Pleistocene terrace deposits provide water for domestic wells in the upland areas of the region and one small public supply in Warren County. The Citronelle Formation supplies several shallow municipal, industrial, and domestic wells in the vicinity of Crystal Springs in Copiah County; however, use is very limited outside of this area. [SERI 2005a, Section 2.4.12.2.1]

Aquifers of the Miocene series provide water for more than 95% of the public, domestic, and industrial wells in Claiborne and Jefferson Counties and about 50% of the wells in Copiah County. Use of Miocene aquifers in Warren and Hinds Counties is limited to a few rural domestic wells. Groundwater from the Forest Hill Formation is used primarily for domestic purposes, but this source also supplies several small public and industrial wells in Hinds and Warren Counties. [SERI 2005a, Section 2.4.12.2.1]

Public water supply and industrial wells in Copiah County utilize the Catahoula, Citronelle, Miocene series, and Forest Hill Sand Formations. Public water supply and industrial wells in Hinds County utilize the Cockfield Formation, Sparta Sand, Meridian-Upper Wilcox, Forest Hill Sand, and Catahoula Formation. The Kosciusko and Cockfield Formations supply wells of all types in Hinds County and, to a lesser extent, in Warren County. Use of these aquifers is restricted in areas to the south because of increasing depth and salinity. Public water supply and industrial wells in Jefferson County utilize the Catahoula and Miocene series formations. Public water supply and industrial wells in Warren County utilize the Mississippi River Alluvium aquifer, Cockfield Formation, Forest Hill Sand, and Catahoula Formation. [SERI 2005a, Section 2.4.12.2.1]

2.3.4.2 Vicinity Groundwater Usage

Public water supply wells in Claiborne County (excluding GGNS) are supplied by the Catahoula Formation or Miocene aquifer with well depths ranging from 166 to 960 feet. Active public water supply systems located in Claiborne County as of May 2009, not including GGNS, are shown in Table 2.10-1. The closest area of concentrated groundwater withdrawal is the Port Gibson municipal water system about five miles southeast of the site. Water for Port Gibson is provided by five wells completed in the Catahoula Formation and withdrawals average 0.85 mgd. [MDEQ 2009a; SERI 2005a, Section 2.4.12.2.1]

According to information on water use for 1995, total groundwater withdrawals in Claiborne County were 33.9 mgd. Table 2.3-2 provides a breakdown of groundwater usage in Claiborne County.

Table 2.3-2
Claiborne County Water Use Data, 1995

Sector	Quantity (mgd)
Commercial	0.17
Domestic (self-supplied)	0.23
Irrigation	0.12
Livestock	0.08
Public supply	1.25
Thermoelectric power (GGNS Unit 1)	32.05

Reference: SERI 2005a, Section 2.4.12.2.1

NUREG-1817 determined that the total estimated water use in Claiborne County was 34.3 mgd based on 2000 USGS data. Groundwater comprises that entire total except for 0.4 mgd of surface water. [USNRC 2006a, Section 2.6.2]

GGNS groundwater is supplied from the Mississippi River Alluvium (radial wells) and the Upland Complex (potable wells) aquifers. Residents within the vicinity of GGNS are served by CS&I Water Association which withdraws water from the Miocene aquifer, and the Town of Port Gibson which is reported as withdrawing from the Catahoula [MDEQ 2009a]. Since GGNS withdraws groundwater from the Mississippi River Alluvium and Upland Complex (potable wells) aquifers, the Miocene aquifers (Pascagoula, Hattiesburg, and Catahoula) are unaffected.

MDEQ requires all groundwater wells and borings completed within the state to be registered. Based on Entergy's review, MDEQ records list more than 120 wells completed within a 5-mile radius of GGNS, including abandoned wells and soil borings, several of which are registered to SERI, Mississippi Power & Light (MP&L), Entergy, or entities associated with GGNS. Most other registered wells within the 5-mile radius are shown as domestic or residential. Since CS&I Water Association #1 provides rural water to the majority of this area, some of the wells in the MDEQ database most likely are no longer active. [MDEQ 2010a] For example, a well registered to the GGMP is included in the 2010 MDEQ database. However, the well is not permitted by MDEQ for withdrawal and is not included in their public water supply records. Site reconnaissance and discussion with GGMP site personnel (September 2010) indicated that although the well remains in the MDEQ databases, the well is no longer in operation. GGMP's current sole source of water supply is from CS&I Water Association #1, which withdraws groundwater from the Miocene aquifer, approximately six miles to the east-northeast of GGNS [MDEQ 2009a].

MDEQ well registrations also include a well at the Shady Rest Grocery (now closed) for domestic supply located approximately one-half mile east of the radial wells on Grand Gulf Road. Based on the depth reported for the well of 240 feet, it is believed that this well would withdraw from the Catahoula Formation, but site reconnaissance (September 2010) indicates the well is inactive. A

third well potentially located in the alluvium is registered as an industrial well to the Claiborne County Port Commission located approximately one mile south of the GGNS radial wells. [MDEQ 2010a] Site reconnaissance (September 2010) was unable to locate the well.

In April 2011, GGNS personnel conducted a well survey on Bald Hill Road to identify residences or other facilities utilizing private wells to the east of the GGNS site. Based on the well survey, the following was determined:

- There are four wells located at a distance of approximately one mile south-southeast from the center of GGNS Unit 1 (Figure 2.3-6). Three of the wells, located in the terrace deposits, previously provided water to the Arnold Acres Trailer Park which has now been closed. Two of these wells have been capped; however, the remaining well provides water to one residence and another house that is currently unoccupied. The house that is currently unoccupied also has an operable well, but it is not being used for human consumption.

- There is one well that could potentially be operable since a power supply was connected to it at an unoccupied residence located at a distance of approximately two miles south-southeast from the center of GGNS Unit 1 (Figure 2.3-6). However, due to the distance from the GGNS site and the location of Bayou Pierre (i.e., intercepts groundwater flow) this well would most likely never be affected by GGNS.

- Available information indicates all other residences on Bald Hill Road are served by a community water system.

None of the wells discussed above were listed in the MDEQ well database.

Based on available information, there are no known withdrawals from the Mississippi River Alluvium aquifer other than GGNS between the Big Black River to the north, and Bayou Pierre River to the south. Public water supply wells in Claiborne County (excluding GGNS) are supplied by the Catahoula Formation or Miocene aquifer with well depths ranging from 166 to 960 feet MSL. Active public water supply systems located in Claiborne County as of May 2009, not including GGNS, are shown in Table 2.10-1. The closest area of concentrated groundwater withdrawal is the Port Gibson municipal water system about five miles southeast of the site. Water for Port Gibson is provided by five wells completed in the Catahoula Formation and withdrawals average 0.85 mgd. [MDEQ 2009a; SERI 2005a, Section 2.4.12.2.1] In addition, groundwater withdrawals are regulated by MDEQ [MDEQ 2009b]. Therefore, all existing GGNS groundwater withdrawals, including those from the radial wells, are regulated by a groundwater permitting program. These permits are granted considering their identified potential impact on other uses in the area.

The MDEQ's Wellhead Protection Program works to identify and properly manage potential sources of contamination located near public water supply wells, offering a proactive approach to groundwater protection. The Mississippi Rural Water Association and MDEQ are utilizing an USEPA national grant to develop Wellhead Protection Plans for 12 public water systems per

year. Over 100 plans have been completed since 1994. The Port Gibson and CS&I Water Association #1 well fields are the only wellhead protection areas identified within a 6-mile radius of GGNS, with the exception of the area surrounding GGNS's non-community, non-transient water supply system [MDEQ 2010b].

2.3.4.3 GGNS Groundwater Use

There are 16 groundwater wells currently permitted by MDEQ for withdrawal purposes at the GGNS site as listed in Table 2.3-3 and shown in Figure 2.3-7. Eight wells were installed for dewatering around GGNS Unit 1. As indicated in Table 2.3-3, there has been no need for plant dewatering activities in recent years; therefore, there has been no need to operate the eight dewatering wells. Three wells (North Construction Well and the North and South Drinking Water Wells) are currently installed near the bluff in the Upland Complex terrace deposits for groundwater withdrawal. It should be noted that although an error in permitting led to an inaccurate conclusion that GGNS potable water wells were completed in the Catahoula, GGNS does not withdraw groundwater from the Catahoula Formation as previously discussed in Section 2.3.3.5 [GGNS 2007a; MDEQ 2007]. The North Construction Well and the North and South Drinking Water Wells (Construction Wells 1, 3, and 4, respectively, listed in Table 9.1-1) are used for domestic water, once-through cooling for plant air conditioners, and for regenerating the water softeners at the Energy Services Center.

There are currently four radial wells which supply water to the Plant Service Water (PSW) System. PSW is supplied from radial collector wells located in the floodplain that parallels the Mississippi River (Figure 2.3-7) as discussed in Section 3.2.2. The radial collector wells, which are permitted with the MDEQ with a maximum capacity of 10,000 gpm each, are designed to derive water from the Mississippi River via induced infiltration.

Based on 2005, 2008, 2009, and 2010 annual average water usage (Table 2.3-3), groundwater withdrawn for PSW System makeup has averaged approximately 22,396 gpm. In conjunction with EPU, a new radial well is being installed to ensure that adequate plant cooling water is maintained. Once operational (March 2012 schedule), average cooling water withdrawal from all radial wells combined is expected to increase to approximately 27,860 gpm (62 cfs) for cooling tower makeup. [GEHNE, Section 3.3.1]

There are also four areas at GGNS that are served by the CS&I Water Association #1. These are the recreational vehicle trailer park, firing range, Health Physics calibration laboratory, and an environmental garden. Total water usage for all four areas in 2010, which was an outage year, was 286,740 gallons.

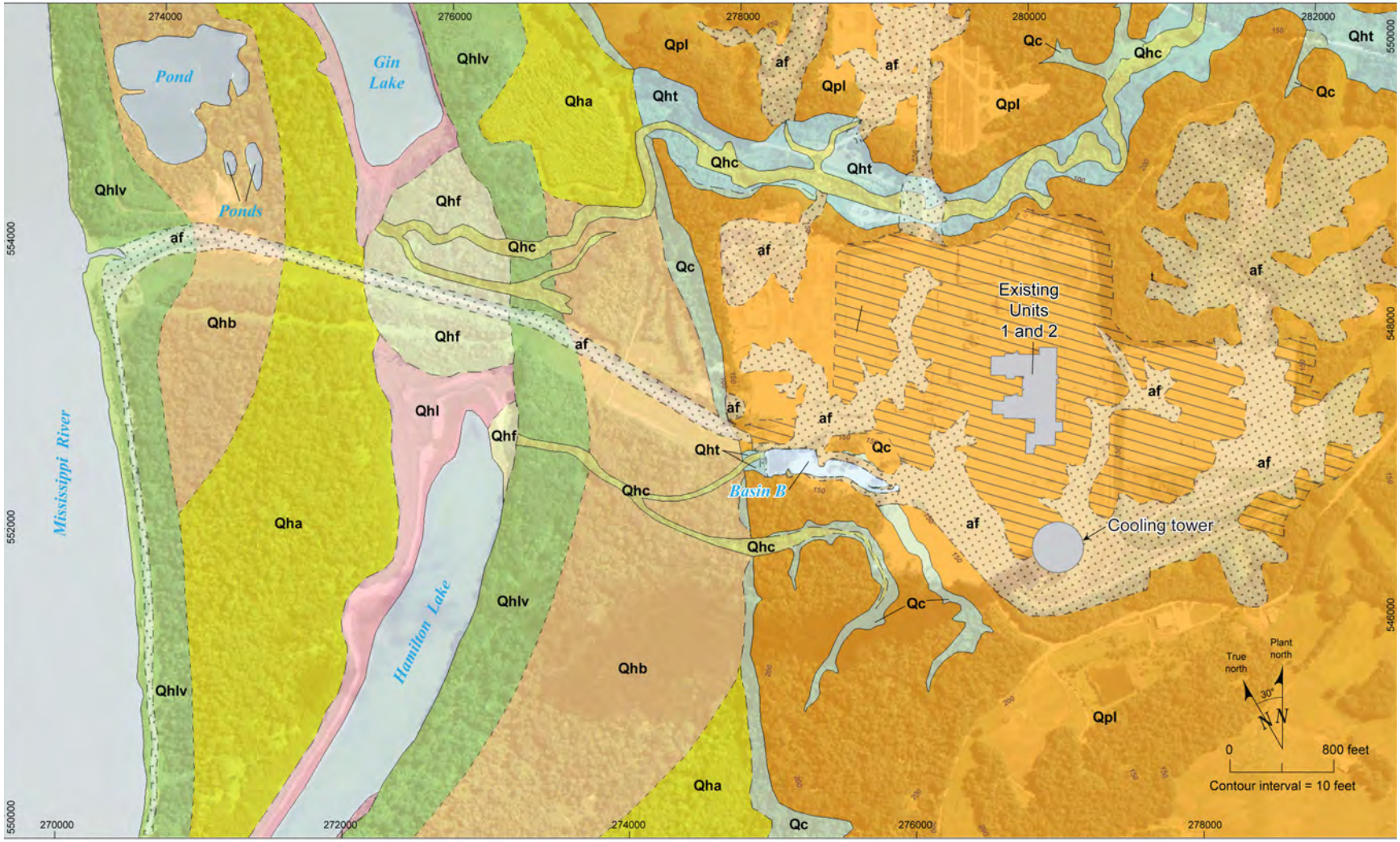
Table 2.3-3
GGNS Groundwater Well Withdrawals[a]

Permit No.	Description	Well Depth (ft)	Rated (gpm)	Total Gallons (2005)[b]	Total Gallons (2008)[c]	Total Gallons (2009)[c]	Total Gallons (2010)[d]
MS-GW-02970	Radial Well 3	123	10,000	2.68 E9	3.25248 E9	3.26099 E9	3.035 E9
MS-GW-00371	Radial Well 5	128	10,000	3.76 E9	3.45403 E9	4.16753 E9	3.680 E9
MS-GW-02971	Radial Well 1	122	10,000	1.36 E9	2.32550 E9	1.54579 E9	1.240 E9
MS-GW-02969	Radial Well 4	125	10,000	4.29 E9	1.84822 E9	4.09741 E9	4.311 E9
MS-GW-16714	Radial Well 6[e]	**155**	**10,000**	**NA**	**NA**	**NA**	**NA**
		Annual Average GPM		**20,674**	**20,701**	**24,870**	**23,337**
MS-GW-02967	North Construction Well	154.8	400	7.44 E4	4.62 E4	5.45 E4	5.775 E4
MS-GW-14989	North Drinking Water Well	162	500	1.92 E7	1.76 E7	1.64 E7	1.6097 E7
MS-GW-15026	South Drinking Water Well	163	500	1.95 E7	1.77 E7	1.67 E7	1.6306 E7
		Annual Average GPM		**74**	**67**	**63**	**62**
MS-GW-02977	Dewatering Well 3	48.4	200	0	0	0	0
MS-GW-02979	Dewatering Well 1	55.2	200	0	0	0	0
MS-GW-02978	Dewatering Well 2	48.3	200	0	0	0	0
MS-GW-02976	Dewatering Well 4	42.8	200	0	0	0	0
MS-GW-02975	Dewatering Well 5	55.4	200	0	0	0	0
MS-GW-02973	Dewatering Well 7	42.5	200	0	0	0	0

Table 2.3-3 (Continued)
GGNS Groundwater Well Withdrawals[a]

Permit No.	Description	Well Depth (ft)	Rated (gpm)	Total Gallons (2005)[b]	Total Gallons (2008)[c]	Total Gallons (2009)[c]	Total Gallons (2010)[d]
MS-GW-02972	Dewatering Well 8	31.3	200	0	0	0	0
MS-GW-02974	Dewatering Well 6	59.7	200	0	0	0	0

a. No water use reporting was required by MDEQ in 2006 and 2007.
b. Reference: GGNS 2006a
c. Reference: GGNS 2010b
d. Reference: GGNS 2011i
e. Radial Well 6 scheduled to be completed and operational in March 2012.



Notes: 1. Projection NAD 27 State Plane Mississippi West FIPS.
2. Vertical datum NAVD 88.
3. See Sheet 2 for Explanation.

Source: SERI 2008a, Figure 2.5.4-20

Figure 2.3-1
GGNS Site Geological Map
Sheet 1

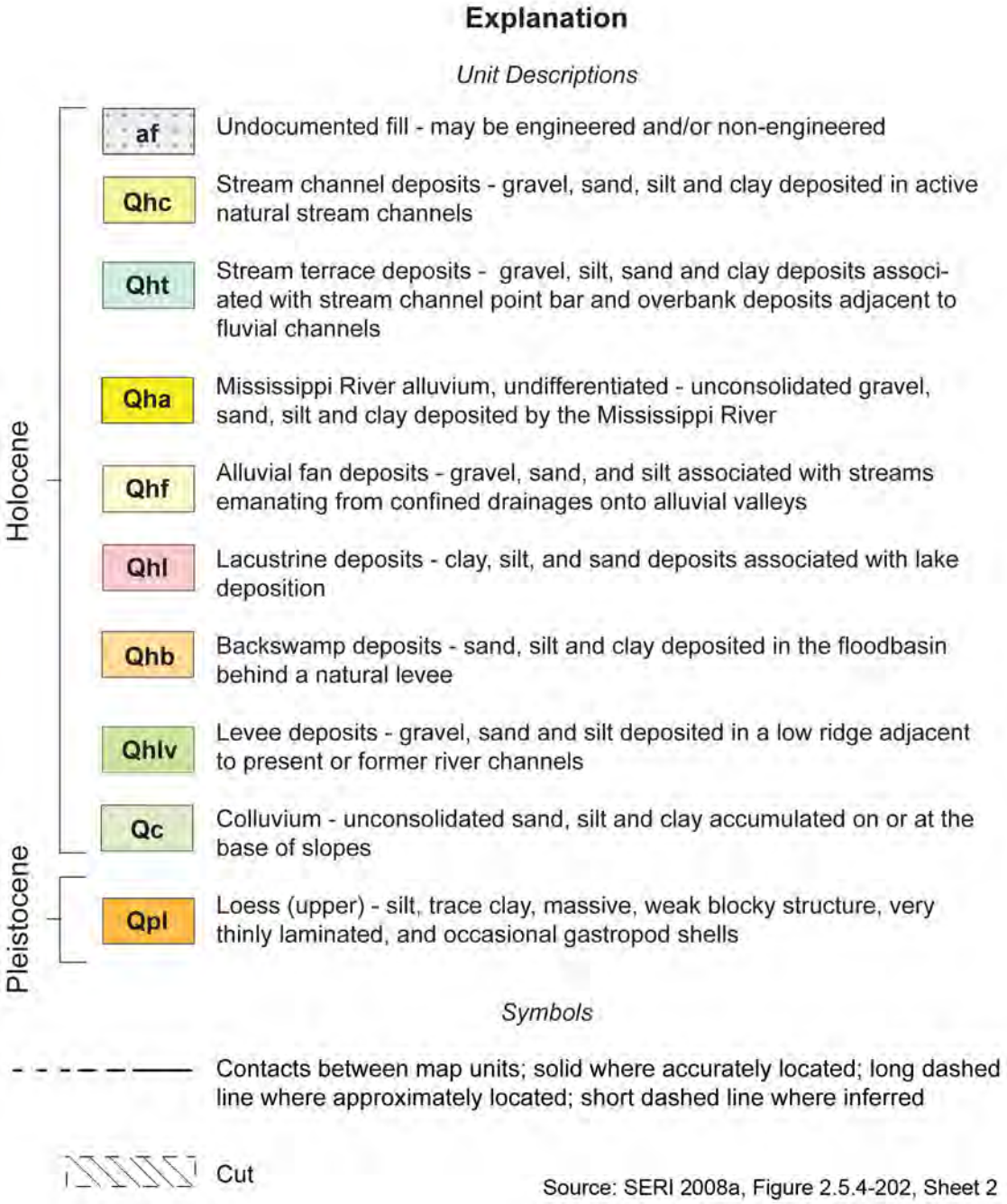
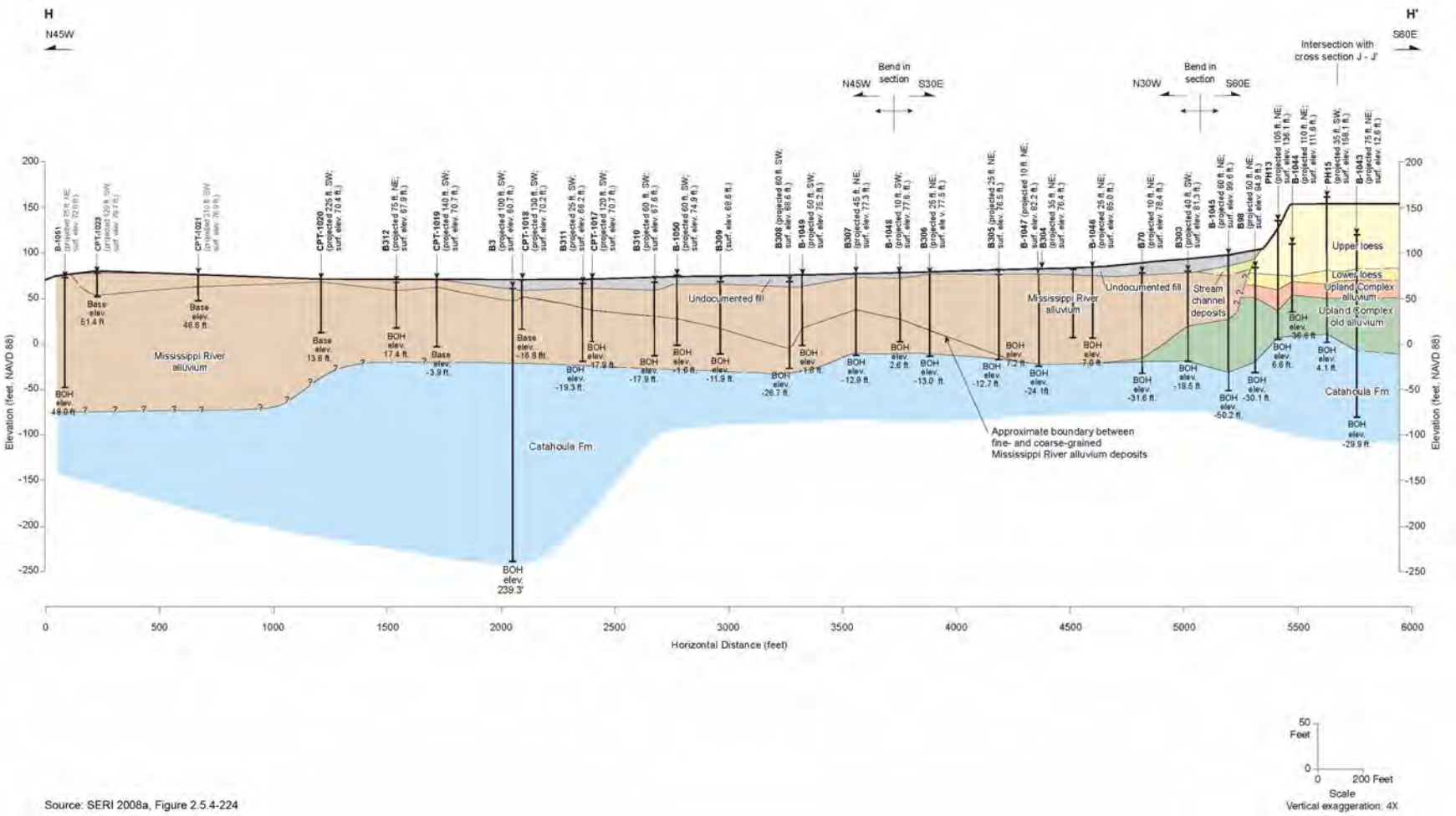
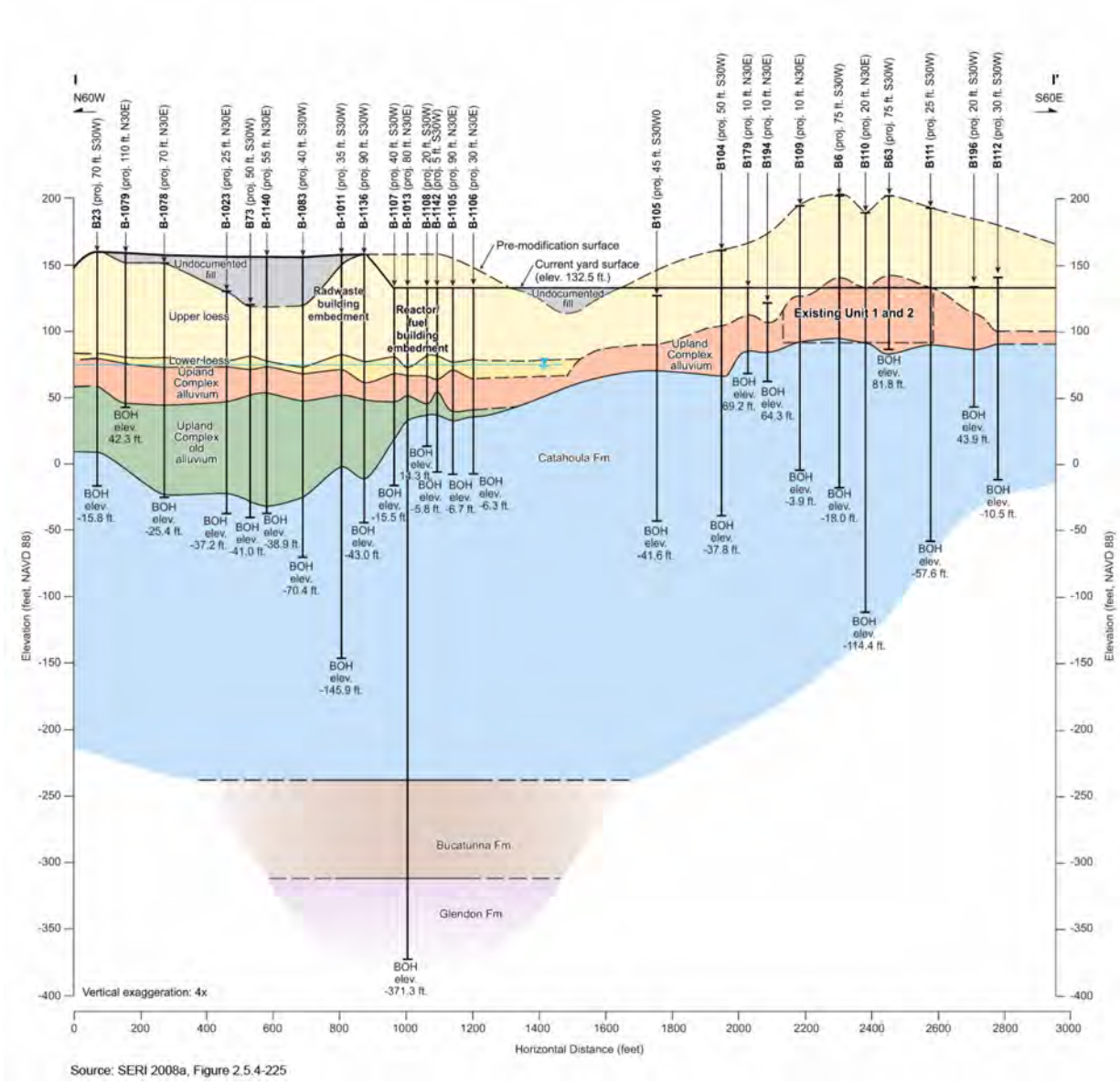


Figure 2.3-1
GGNS Site Geological Map Legend
Sheet 2



Source: SERI 2008a, Figure 2.5.4-224

Figure 2.3-2
Cross-Section of Floodplain Aquifers and Upland Terrace



Source: SERI 2008a, Figure 2.5.4-225

Figure 2.3-3
Cross-Section of GGNS Upland Area

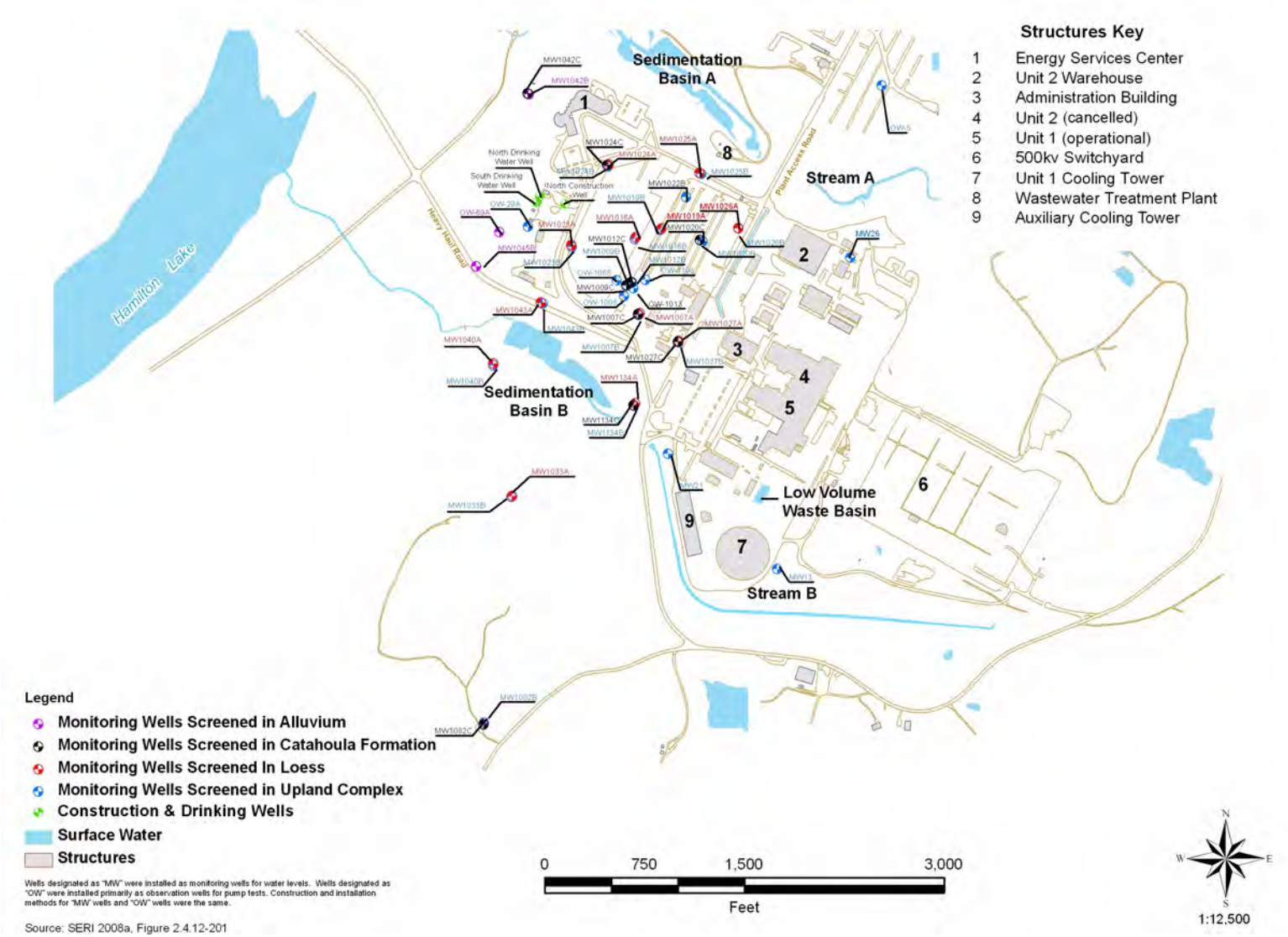


Figure 2.3-4
GGNS Unit 3 COLA Groundwater Monitoring Wells

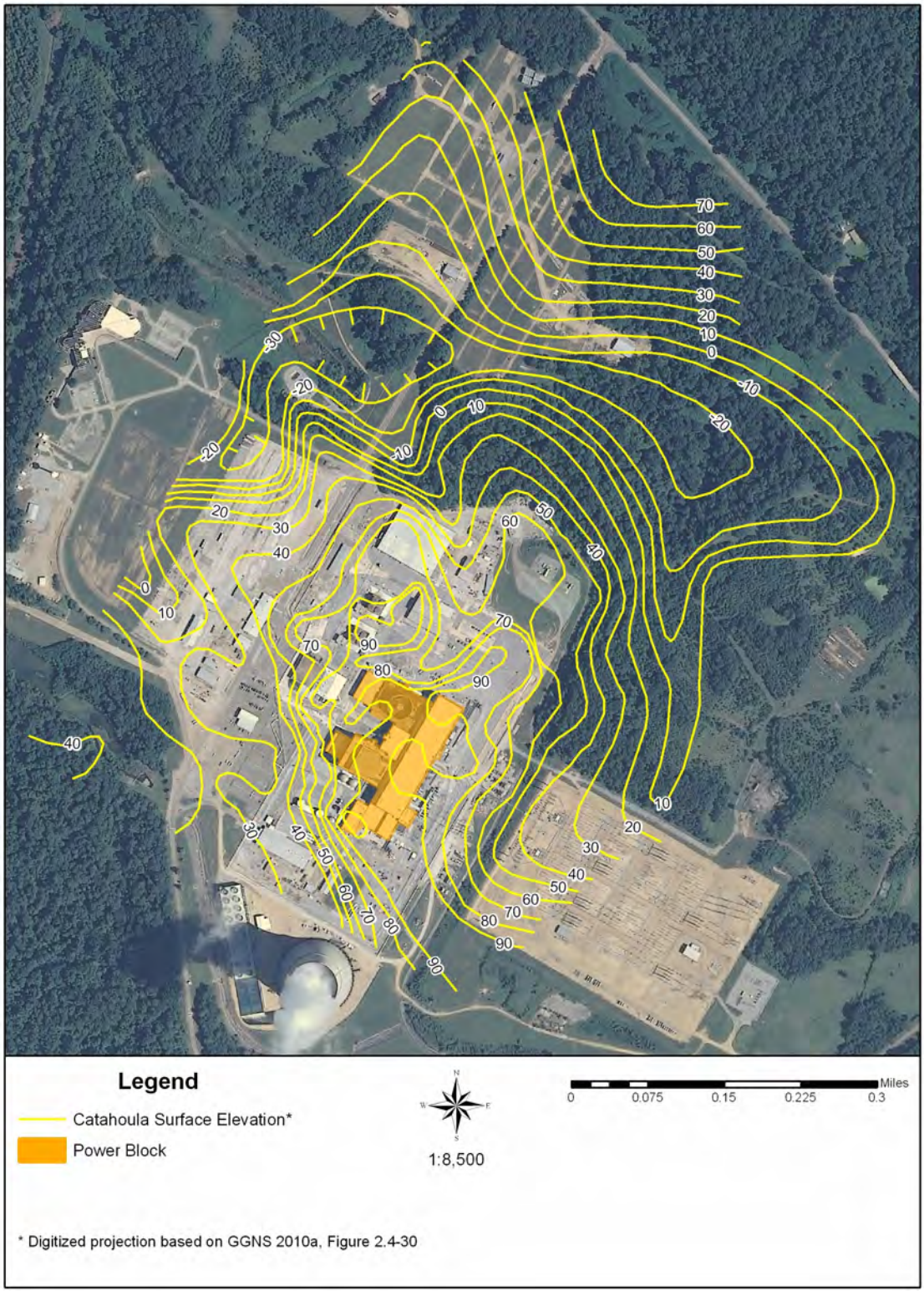


Figure 2.3-5
Catahoula Surface Elevation

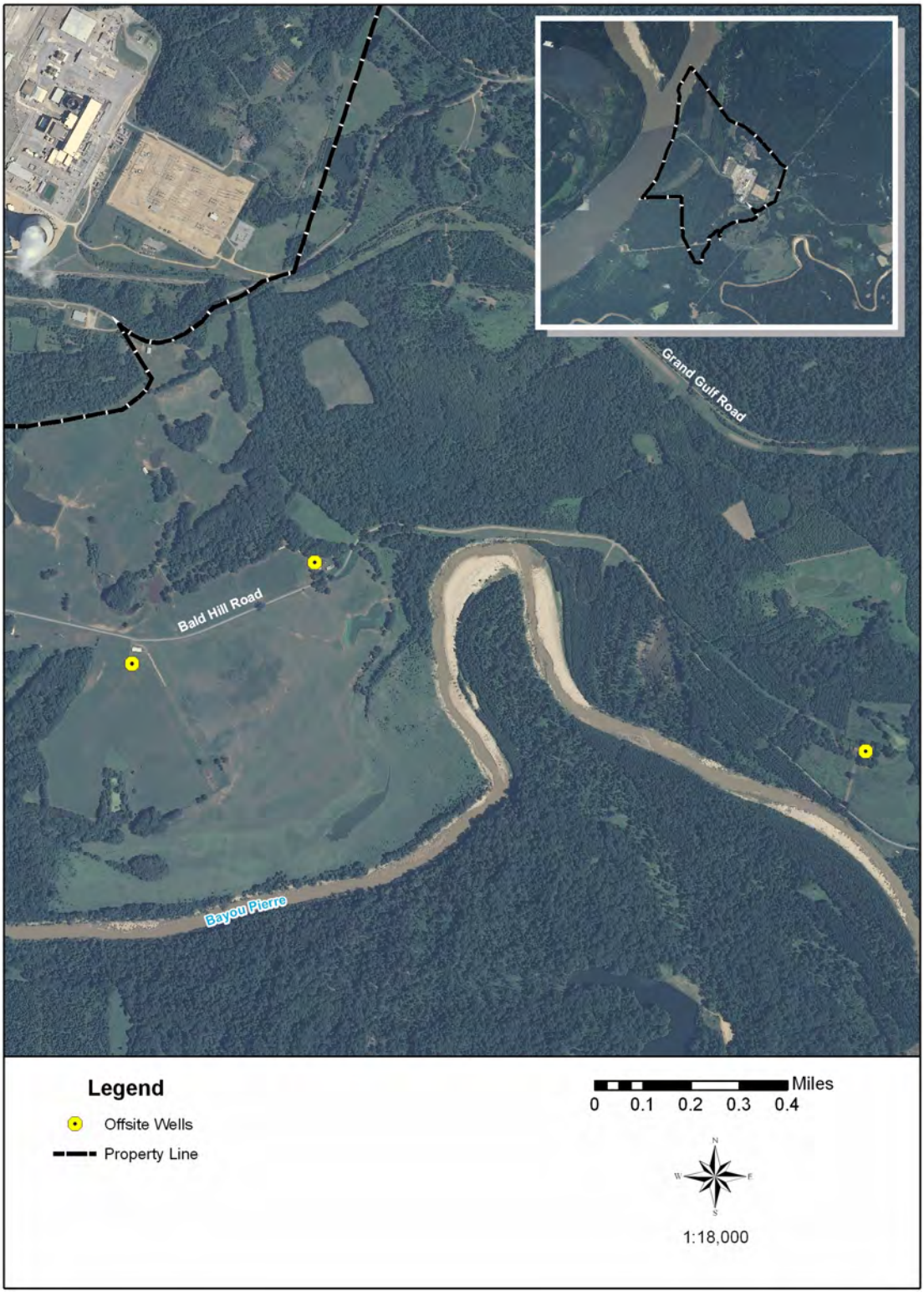


Figure 2.3-6
Offsite Residential Wells Nearest GGNS

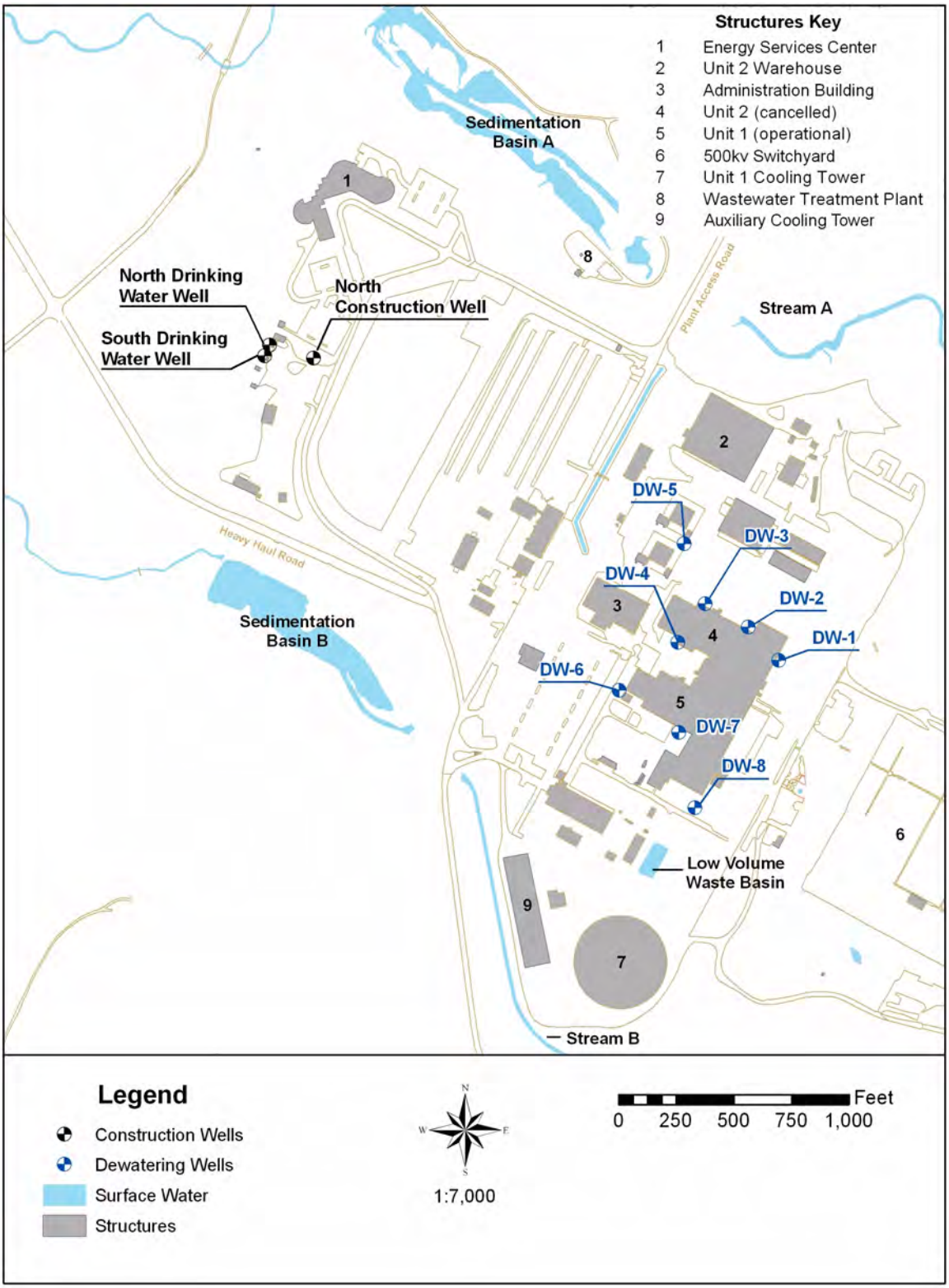


Figure 2.3-7
GGNS Permitted Groundwater Well Locations
Sheet 1 of 2

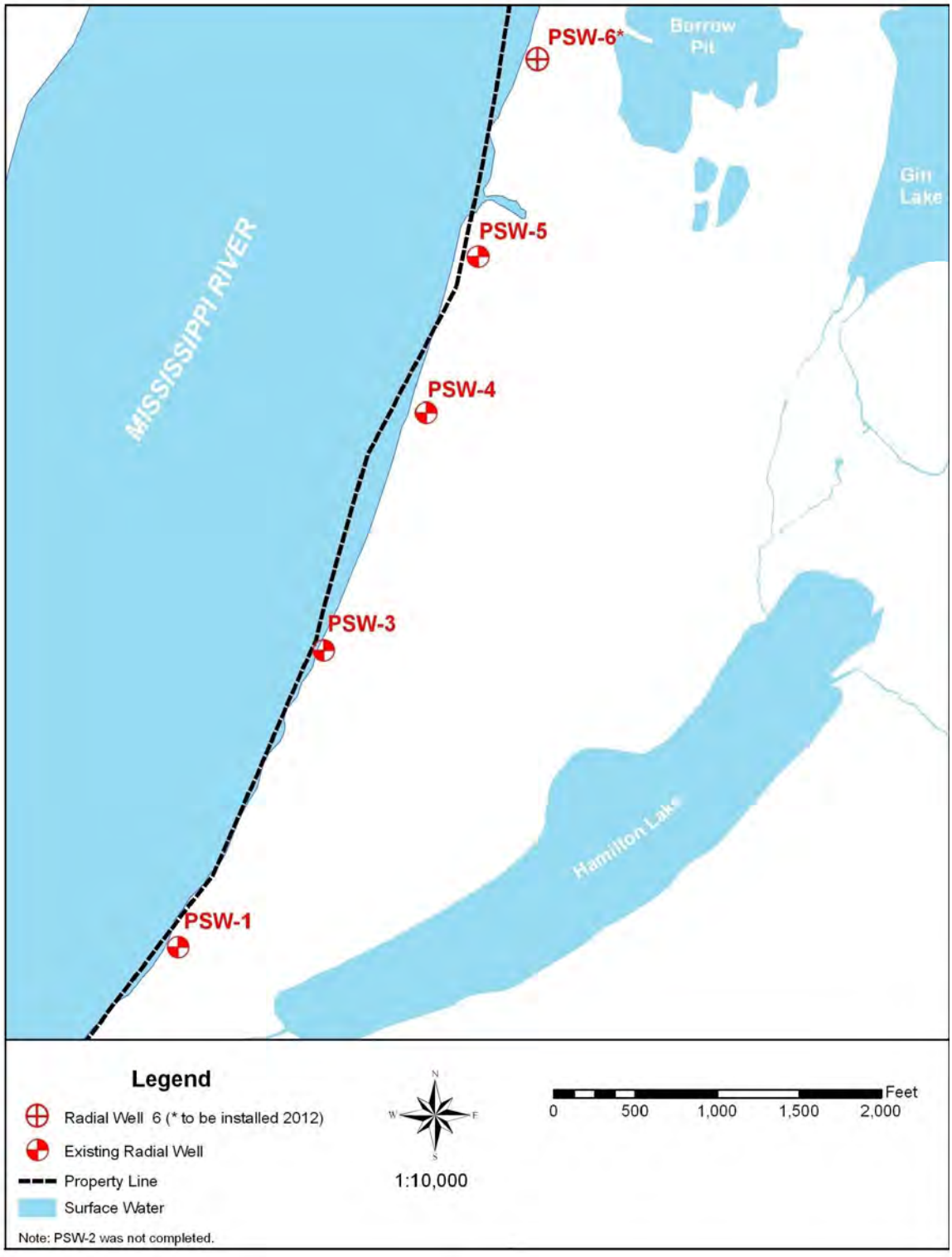


Figure 2.3-7
GGNS Permitted Groundwater Well Locations
Sheet 2 of 2

2.4 Critical and Important Terrestrial Habitats

GGNS and its associated transmission system overlap the Mississippi Valley Alluvial Plain and Mississippi Valley Loess Plains ecoregions. The transmission lines included within the scope of license renewal are discussed in Section 3.2.10. The Mississippi Valley Alluvial Plain ecoregion consists of a broad, flat alluvial plain with river terraces, swales, and levees providing the main elements of relief. Soils are typically finer-textured and more poorly drained than the upland soils of the adjacent Mississippi Valley Loess Plains ecoregion. Bottomland deciduous forest vegetation covers the Mississippi Valley Alluvial Plain ecoregion where it has not been cleared for cultivation. The Mississippi Valley Loess Plains ecoregion consists primarily of irregular plains, some gently rolling hills, and bluffs near the Mississippi River. Thick loess is one of the distinguishing characteristics. Oak-hickory and oak-hickory-pine forest were the natural vegetation in this ecoregion. In the Mississippi portion of this ecoregion, there is a mosaic of forest and cropland. [USNRC 2006a, Section 2.7.1]

2.4.1 Site Ecology

The vast majority of the site has been left undisturbed since construction of GGNS. The site is roughly bisected by a north-south line of bluffs located parallel to and east of the Mississippi River. The site consists of seasonally inundated bottomland west of the bluffs along the river and uplands atop the bluffs. About one-half of the site is bottomland, including forested, shrub, and emergent marsh wetlands (Figure 2.4-1). The other half of the site supports upland habitat, including forests, fields, and small wetlands, in areas that were not cleared during construction of GGNS. Generally, wildlife species found on site are representative of those commonly found in central Mississippi and northern Louisiana along the Mississippi River. [USNRC 2006a, Section 2.7]

Table 2.4-1 indicates that approximately 40 percent of the GGNS site is bottomland, including forested, shrub, and emergent marsh wetlands. Approximately 64 percent of the GGNS site remains forested. There are hardwood stands south and west of the cooling towers referred to collectively as the "South Woods." Biodiversity in these stands is enhanced by complex topography that consists of a series of narrow ridges with steep slopes, ravines, and bluffs. More than 20 species of trees occupy this area. Cherrybark oak (*Quercus pagoda*), water oak (*Q. nigra*), Texas oak (*Q. texana*), American elm (*Ulmus americana*), sweet gum (*Liquidambar styraciflua*), bitternut hickory (*Carya cordiformis*), and pecan (*C. illinoiensis*) are all common in the overstory with many trees 30 inches or more in diameter. The GGNS site has been selectively logged in the past as evidenced by the existence of stumps, many of which are of larger diameter than the existing trees. [SERI 2008b, Section 2.4.1.1]

Dominating the understory are black cherry (*Prunus serotina*), winged elm (*U. alata*), cane (*Arundinaria gigantean*), American beautyberry (*Callicarpa americana*), and pawpaw (*Asimina triloba*). The herb layer is sparse on ridges with loose oat-grass (*Chasmanthium laxum*) and Cherokee sedge (*Carex cherokeensis*) common. The latter species is often considered a species of special interest in other areas of the south and southeast but is relatively common on the GGNS site. [SERI 2008b, Section 2.4.1.1]

The canopy in ravines and on lower, richer slopes is dominated by beech (*Fagus grandifolia*), tulip poplar (*Liriodendron tulipifera*), and basswood (*Tilia heterophylla*). The most interesting floristic element of the ravines, however, is the abundance of ferns in the understory. Fern colonies include christmas fern (*Polystichum acrostichoides*), mariana maiden fern (*Macrothelypteris torresiana*), southern shield fern (*Thelypteris kunthii*), maidenhair fern (*Adiantum pedantum*), bladder fern (*Cystopteris protrusa*), Japanese net-veined holly fern (*Cyrtomium falcatum*), and spider brake fern (*Pteris multifida*). All of these species are common in the South Woods. [SERI 2008b, Section 2.4.1.1]

There are also invasive plant species at GGNS and likely along the transmission lines, both exotic and native. The ten worst invasive weeds in Mississippi include kudzu (*Pueraria lobata*), Chinese privet (*Ligustrum sinense*), tropical soda apple (*Solanum viarum*), purple loosestrife (*Lythrum salicaria*), water hyacinth (*Eichornia crassipes*), alligatorweed (*Alternanthera philoxeroides*), Chinese tallow tree (*Triadica sebifera*), Japanese honeysuckle (*Lonicera japonica*), cogongrass (*Imperata cylindrica*), and Johnsongrass (*Sorghum halepense*) [MSUES]. Kudzu is known to be present on some northern portions of the GGNS property.

Table 2.4-1 contains the land cover type and percentage at the GGNS site. Table 2.4-2 contains the land use within a 6-mile radius of GGNS, including the in-scope transmission line ROW. Figure 2.4-1 and Figure 2.4-2 provide information on land use, cover, and wetlands at the GGNS site. It should be noted that based on aerial photographs, the main channel of the Mississippi River north of the barge slip (Figure 2.1-3) has moved to the east in the intervening 30 years between 1971 and 2001, as evidenced by the property line extending into the river. This represents a loss of about 85 acres of terrestrial habitat. However, as previously stated, the USACE has stabilized the banks of the river by constructing revetments; therefore, further erosion of the eastern bank is not anticipated. [USNRC 2006a, Section 2.7.1]

Table 2.4-1
GGNS Property Land Use and Cover

Description	Percentage
Barren Land (Rock/Sand/Clay)	4.57
Cultivated Crops	3.30
Deciduous Forest	17.87
Developed, Low Intensity	0.22
Developed, Medium Intensity	0.05
Developed, Open Space	4.44
Emergent Herbaceous Wetlands	0.60
Evergreen Forest	0.86
Grassland/Herbaceous	1.53

Table 2.4-1 (Continued)
GGNS Property Land Use and Cover

Description	Percentage
Mixed Forest	6.06
Open Water	10.22
Pasture/Hay	0.04
Shrub/Scrub	10.93
Woody Wetlands	39.31
Total	**100**

Reference: MRLCC

Table 2.4-2
GGNS Vicinity and Transmission ROW Land Use

Land Use Class	6-Mile Vicinity		Transmission Line ROW	
	Acres	Percent	Acres	Percent
Agricultural	8,777	11.3	246	14.7
Developed Nonresidential	346	0.4	3	0.2
Residential	1,245	1.6	28	1.7
Undeveloped	49,703	64.0	1,296	77.7
Water or Wetlands	17,589	22.6	96	5.8
Total Area	**77,660**		**1,669**	

Reference: USNRC 2006a, Table 2-1

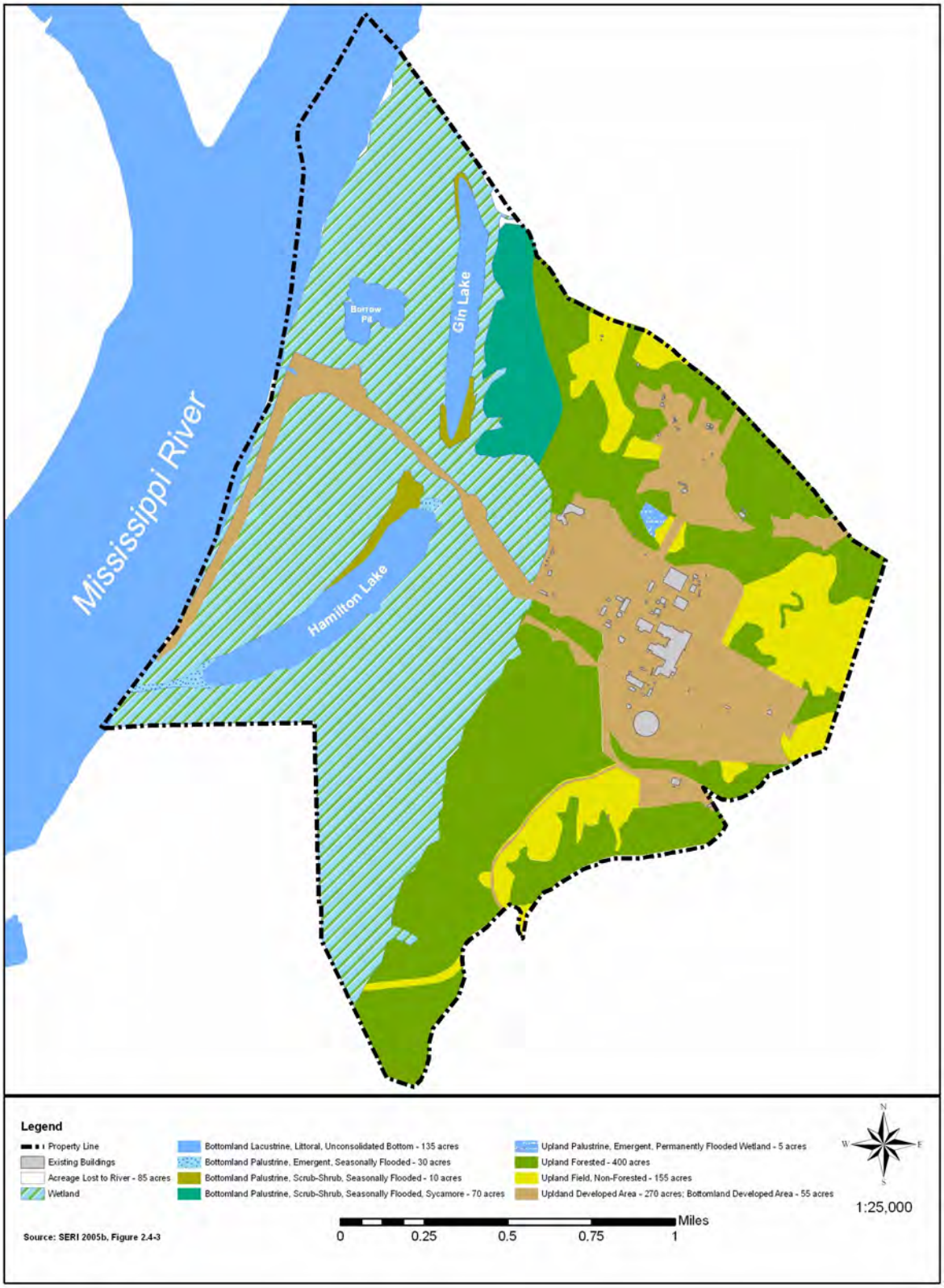


Figure 2.4-1
GGNS Property Habitat Types

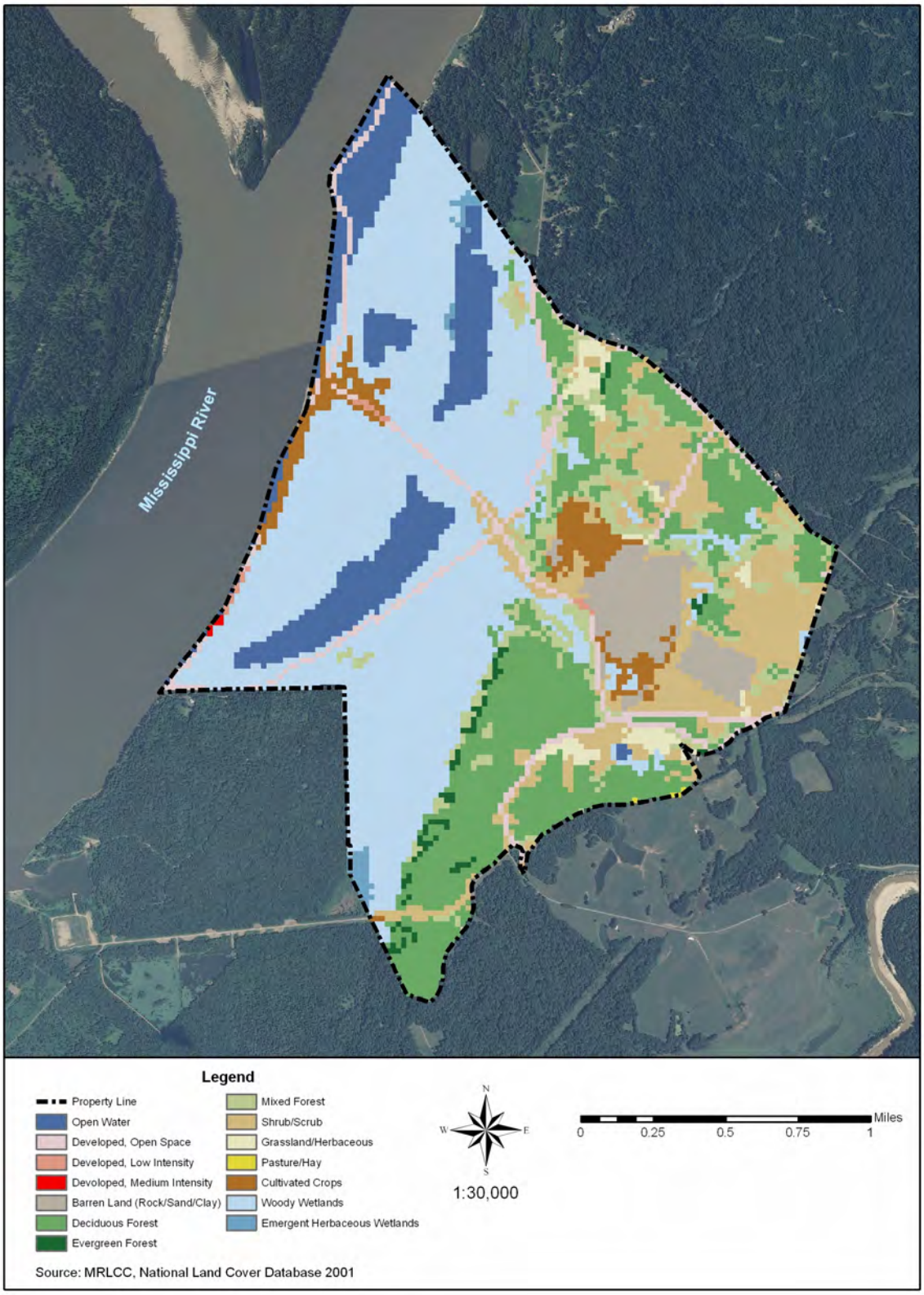


Figure 2.4-2
Land Use and Land Cover at GGNS

The ecological descriptions in the GGNS FER adequately describes current conditions at GGNS. SERI's 2005 environmental report for the GGNS ESP updated terrestrial information to indicate where biological conditions at GGNS differed from those in existence prior to construction of GGNS. [USNRC 2006a, Section 2.7.1.1; MP&L, Section 2.2; SERI 2005b, Section 2.4.1]

About one-half of the site is bottomland, including forested, shrub, and emergent marsh wetlands. The other half of the site supports upland habitat types, including forests, fields, and small wetlands, in areas that were not cleared during construction of GGNS. [USNRC 2006a, Section 2.7.1.1]

During 1972 and 1973, before the construction of GGNS, at least 420 species of vascular plants representing 285 genera and 105 families were observed on-site. Of the 64 tree species, all but three are deciduous. The composition of understory vegetation varied by location and season, with the largest number of plant taxa occurring in the uplands during the summer, and the smallest number of taxa in the bottomland during winter. The uplands are more diverse than the bottomland primarily because of the lack of Mississippi River inundation and its scouring effects on understory vegetation. [USNRC 2006a, Section 2.7.1.1]

2.4.1.1 Terrestrial Habitats

Terrestrial habitats at GGNS can now, as in the 1970s, generally be classified as upland and bottomland forest, upland and bottomland clearings (since planted with loblolly pine (*Pinus taeda*) and American sycamore (*Platanus occidentalis)*, respectively), and upland and bottomland wetlands. Most of the currently developed area is located in the uplands. The terrestrial habitats on the site are described in the following paragraphs. [USNRC 2006a, Section 2.7.1.1]

Bottomland emergent wetlands (dominated by plants that rise above the surface of the water) may be characterized as palustrine and seasonally flooded. These cover approximately 30 acres and are located at the south and north ends of Hamilton Lake. These wetlands are dominated by grasses, such as redtop panicgrass (*Panicum rigidulum*) and sedges (*Carex* spp.); their level of inundation varies seasonally and from year to year. [USNRC 2006a, Section 2.7.1.1]

Bottomland scrub-shrub (dominated by sapling trees and shrubs) wetlands may be characterized as palustrine and seasonally flooded. Those located east of Gin Lake cover approximately 70 acres and most likely were a former bottomland field cultivated for forage. The field has been planted with American sycamore trees, which are uniformly about 20 feet in height. In 2002, the perimeter of this area was cultivated to enhance deer habitat and attract deer to the area for hunting. [USNRC 2006a, Section 2.7.1.1]

Other bottomland scrub-shrub wetlands are located on the north, northwest, and south ends of Gin Lake, and on the northwest bank of Hamilton Lake. These cover approximately 10 acres and are dominated by black willow (*Salix nigra*) and swamp privet (*Forestiera acuminata*). Little herbaceous understory vegetation occurs in these wetlands probably because of recurrent flooding in spring. Common button bush (*Cephalanthus occidentalis*) is found in these wetlands on the south end of Gin Lake. [USNRC 2006a, Section 2.7.1.1]

Upland hardwood forests are a combination of three deciduous forest community types: oak (*Quercus* spp.), American elm, and oak-sweetgum. These dominate upland areas and cover approximately 400 acres. Like bottomland hardwood forests, the growth of understory vegetation in upland hardwood forests is limited by canopy closure. However, unlike bottomland forests, upland forests are rarely inundated with water for prolonged periods, so flooding is less a limiting factor on growth of understory vegetation. Consequently, upland forests exhibit a more diverse plant community than bottomland forests, both in structure and taxonomic composition. [USNRC 2006a, Section 2.7.1.1]

Upland fields cover approximately 155 acres at the GGNS site and have been planted with loblolly pine. [USNRC 2006a, Section 2.7.1.1]

2.4.1.2 Common Wildlife

Forests with diverse plant species and well-developed vertical structure provide many ecological niches that support diverse wildlife populations. The majority of the undeveloped portion of the GGNS site consists of bottomland and upland hardwood forests. Hardwood forests, particularly those in the uplands, are diverse. Generally, as hardwood forests increase in age, the structure of their herb, forb, shrub, mid-story, and canopy layers also increases. Bottomland hardwood forests, while they may not be as rich in species as upland hardwood forests, can be highly productive in terms of wildlife, in part because of annual inundation that continually replenishes soil nutrients. [USNRC 2006a, Section 2.7.1.1] Wildlife common to the site is described in the following paragraphs.

Several mouse and rat species, eastern gray squirrel (*Sciurus carolinensis*), eastern fox squirrel (*Sciurus niger*), nine-banded armadillo (*Dasypus novemcinctus*), bobcat (*Lynx rufus*), eastern cottontail (*Sylvilagus floridanus*), swamp rabbit (*Sylvilagus aquaticus*), gray fox (*Urocyon cinereoargenteus*), and the opossum (*Didelphis marsupialis*) were encountered on the GGNS site in 1972 and 1973 prior to construction of GGNS [USNRC 2006a, Table 2-5 and Section 2.7.1.1] The whitetail deer (*Odocoileus virginianus*) is the largest of the mammal species. Based on the Enercon October 2002 reconnaissance visit to the GGNS site, a substantial deer population continues to use both upland and bottomland forests. In October 2002, two areas were observed where a local archery hunting club of SERI employees had disked and seeded the ground with grass to attract wildlife. One area was in a natural clearing in a bottomland forest stand east of Radial Well No. 1. The other area was in a former bottomland field northwest of GGNS near Gin Lake. These areas are on the order of several acres but comprise only a small portion of the site. Beaver (*Castor canadensis*) use bottomlands and onsite streams, and raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), and various unidentified small mammals (for example, mice and shrews) use both uplands and bottomlands. Bottomlands are used by feral hogs. [USNRC 2006a, Section 2.7.1.1]

Forest community birds include year-round, summer and winter residents. Examples include the blue jay (*Cyanocitta cristata*) and northern cardinal (*Cardinalis cardinalis*), which are year round residents; the Acadian flycatcher (*Empidonax virescens*) and yellow-billed cuckoo (*Coccyzus americanus*), which are summer residents; and the American robin (*Turdus migratorius*) and

ruby-crowned kinglet (*Regulus calendula*), which are winter residents. Field forest community birds also include year-round, winter, and summer residents. Examples include the mourning dove (*Zenaida macroura*) and red-winged blackbird (*Agelaius phoeniceus*), which are year-round residents; the orchard oriole (*Icterus spurius*) and northern rough-winged swallow (*Stelgidopteryx serripennis*), which are summer residents; and the field sparrow (*Spizella pusilla*) and lark sparrow (*Chondestes grammacus*), which are winter residents. [USNRC 2006a, Section 2.7.1.1]

Water-dependent birds observed on Hamilton and Gin Lakes include herons (for example, great blue heron (*Ardea herodias*), tricolored (Louisiana) heron (*Egretta tricolor*)), egrets (such as the cattle egret (*Bubulcus ibis*) and great (common) egret (*Ardea alba*), ibis (such as the white ibis), wood stork or wood ibis, belted kingfisher (*Ceryle alcyon*), American coot (*Fulica americana*), pied-billed grebe (*Podilymbus podiceps*), and several waterfowl species (for example, the mallard (*Anas platyrhynchos*), northern pintail (*Anas acuta*), and wood duck (*Aix sponsa*)). Use of the lakes by water-dependent species is seasonal. Of the water birds, only the wood duck, great blue heron, and belted kingfisher are permanent residents. The remaining species are primarily summer residents, with the exception of the American coot and pied-billed grebe, which occur in the area from fall through early spring. [USNRC 2006a, Section 2.7.1.1]

Birds of prey observed on or near the GGNS site include vultures (such as, the black vulture (*Coragyps atratus*) and turkey vulture (*Cathartes aura*)), hawks (for example the broadwinged hawk (*Buteo platypterus*), northern harrier (*Circus cyaneus*), red-shouldered hawk (*Buteo lineatus*), red-tailed hawk (*Buteo jamaicensis*), and sharp-shinned hawk (*Accipiter striatus*)), falcons (such as the American kestrel (*Falco sparverius*)), kites (such as the Mississippi kite (*Ictinia mississippiensis*)), and owls (for example, the great horned owl (*Bubo virginianus*), and eastern screech-owl (*Otus asio*)). Black and turkey vultures, the red-tailed and red-shouldered hawks, and all the owl species are year-round residents. The broad-winged hawk and Mississippi kite are summer residents, and the northern harrier, American kestrel, and sharp-shinned hawk occur on-site only during migration. With the exception of the northern harrier (an inhabitant of grasslands and marshes), woodlands and wooded margins are the preferred habitat for the birds of prey observed. [USNRC 2006a, Section 2.7.1.1]

Of the upland game birds observed on or near the GGNS site, the mourning dove, northern bobwhite (*Colinus virginianus*), and wild turkey (*Meleagris gallopavo*) are year-round residents. The mourning dove is also the most abundant of the upland game birds onsite. All the bird species noted above are considered common, with the exception of the wood stork and Louisiana heron. [USNRC 2006a, Section 2.7.1.1]

The Mississippi River has historically been a major bird migration corridor within North America. Every spring and fall millions of birds representing almost 300 species migrate through the Mississippi River corridor or remain as year-round residents. [USGS 1999] Located in the Mississippi flyway, GGNS may provide or be located near habitat for a number of migratory birds. Surveys of resident and migratory birds conducted at the site prior to the operational start of GGNS Unit 1 identified 140 species on or near the site. With the exception of the white ibis and the Louisiana heron (*Hydrannassa tricolor*), all were believed to occur regularly in the area. [MP&L, Section 2.2.2.3]

As discussed in Chapter 9, GGNS maintains a Federal Migratory Bird Depredation Permit to primarily manage two species that transit the site: barn swallows (*Hirundo rustica*) and cliff swallows (*Petrochelidon pyrrhonta*). This permit authorizes GGNS to take 200 cliff swallows, 200 cliff swallow nests (including eggs), 200 barn swallows, and 200 barn swallow nests (including eggs). To minimize the legal taking of these migratory birds, GGNS utilizes to the extent practical non-lethal control measures such as removing abandoned nests after the migration is begun and cleaning the nest sites to remove residuals that encourage nesting the following season, painting structures to discourage nest rebuilding the next year, periodic relocation of fake predators such as owl-netting, plastic door coverings, noise makers, and wire barricades.

Although no trend has been identified by GGNS, approximately three bird death incidents have been noted at the site from 2006 through 2010. In 2006, two dead birds were identified in the Turbine Building, and in 2010, a dead bird was identified next to a work bench adjacent to the Motor Control Center. None of the incidents triggered any offsite regulatory notifications. [GGNS 2006b; GGNS 2010d]

Thirty-four reptilian species and 14 amphibian species were collected or observed on the GGNS site from 1972 through 1973. Field collections and observations indicated that 19 reptilian and eight amphibian species commonly occurred in the area. None of the reptiles or amphibians occurring in the area have been designated as rare and endangered by the USFWS. Field collections indicated that the red-eared turtle (*Pseudemys scripta*), three-toed box turtle (*Terrapene carolina*), and stinkpot (*Sternothaerus odoratus*) were the most abundant turtles on the site. [MP&L, Section 2.2.2.5].

Twenty-five water snakes (representing five species of Natrix) were collected from stockponds, Hamilton and Gin Lakes, and the flooded bottomlands. The majority was collected from shallow pools of water that were created by the gradual draining of floodwaters from the bottomlands. Of the 25 water snakes collected, ten were common (broad-banded) water snakes (*Natrix sipedon*), and nine were diamond-backed water snakes (*Natrix rhombifera*). Collection of terrestrial snakes and field observations indicated that the gray rat snake (*Elaphe obsoleta*), speckled kingsnake (*Lampropeltis getulus*), black racer (*Coluber constrictor*), and eastern hognose snake (*Heterodon platyrhinos*) were the most common terrestrial snakes on the site. Field observations indicated that terrestrial snakes were generally inactive when the mean weekly air temperature was normally less than 50°F. [MP&L, Section 2.2.2.5]

The American alligator has been observed on or near the GGNS site since May 1973. Prior to May 1973, no alligators had been observed on the site. One alligator had been sighted, however, on the bank of the Big Black River in September 1972. [MP&L, Section 2.2.2.5] During the 2002 reconnaissance visits, two alligators were observed, one in a small pond immediately adjacent to the wastewater 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, local wildlife agencies are occasionally asked to capture and relocate large alligators. [SERI 2005b, Section 2.4.1.2]

The American toad (*Bufo americanus*) and Fowler's toad (*Bufo woodhousel fowleri*) were abundant in all terrestrial habitats. The spade foot toad (*Scaphiopus holbrookii*) was only collected in the loessial bluff forest. Frogs inhabited the lakes, streams and stockponds, with the bronze frog (*Rana clamitans*) being the most abundant. Of the salamanders, the amphiuma and the lesser siren (*Siren intermedia*) were collected only in the flooded bottomlands near Hamilton and Gin Lakes. The mole salamander (*Ambystoma talpoideum*) and slimy salamander (*Plethodon glutinosus*) were collected only in the loessial bluff forest. [MP&L, Section 2.2.2.5]

2.4.1.3 Terrestrial Monitoring

Other than terrestrial monitoring associated with the site's radiological environmental monitoring program (REMP) described in the GGNS Offsite Dose Calculation Manual (ODCM), there are no terrestrial monitoring programs conducted at the site.

2.4.1.4 Site Management Programs

The site area is managed in accordance with the USACE Section 404 permitting process, MDEQ's stormwater permitting program for construction activities, GGNS' NPDES Permit MS0029521, and GGNS' existing Baseline Stormwater General NPDES Permit MSR000883, as appropriate. In addition, any land disturbance activities are reviewed as required by procedure to ensure that best management practices appropriate for the environment are used to protect terrestrial habitat and wildlife, threatened and endangered species, wetland areas, and water quality [Entergy 2008e].

2.4.2 Transmission Line Ecology

EMI owns two Federal Energy Regulatory Commission regulated 500 kV transmission line ROW that originate from the GGNS switchyard. The Baxter-Wilson transmission line ROW extends north 22 miles from the switchyard to the Baxter-Wilson substation adjacent to the Baxter-Wilson combined-cycle power plant just south of Vicksburg, Mississippi [MP&L, Section 3.9.1.1]. The Franklin transmission line ROW extends southeast 43.6 miles traversing the Homochitto National Forest, to the Franklin substation near McCall Creek in northeastern Franklin County, Mississippi [MP&L, Section 3.9.1.3].

The GGNS FER described the terrestrial ecological conditions in the early 1980s. Plant communities and common wildlife associated with loessial bluff hardwood forest, bottom land hardwood forest, mixed hardwood-pine forest, pine forest, and fields were similar to that described above for the GGNS site. Forests in the western portion of Mississippi are typically dominated by oak, hickory, and sweetgum in loessial bluffs; oak, sugarberry, and green ash in river bottomlands; and loblolly pine and shortleaf pine in upland hills. In most instances, the same forest-dependent wildlife species are commonly found in all three forest communities. [MP&L, Section 3.9.4.4]

The Baxter-Wilson ROW traverses a rural, sparsely populated area with agriculture and forestry as the predominating land uses. This route passes through approximately 10.3 miles of hardwood forest, markedly irregular loessial bluff terrain, 1.7 miles of relatively flat hardwood-

forested Big Black River bottomland, and 10 miles of farmland located on the Mississippi River floodplain. The Franklin route traverses approximately 10 miles of loessial bluff hardwood forest and fields, and 34 miles of pine and hardwood forested gently rolling hills interspersed with small farms. [MP&L, Section 3.9.3.1]

Table 2.4-2 provides a more recent summary of land cover in the existing transmission line ROWs. Based on review of land use, approximately 35% of the linear area associated with the in-scope transmission lines crossed agricultural land 30 years ago, compared to only approximately 15% today. Approximately 63% of the transmission lines crossed forested land compared to approximately 78% being classified as undeveloped today. Based on review of the wildlife observed at the time of the transmission line construction and the observations completed during Enercon's reconnaissance in 2002, the flora and fauna are believed to have changed little.

2.4.2.1 Transmission Line Management Programs

EMI's vegetation management practices associated with the in-scope transmission lines are procedurally controlled as discussed in Section 3.2.10 to be protective of terrestrial habitat and wildlife. In addition, a segment of the Franklin transmission line must also meet the requirements of the U.S. Department of Agriculture (USDA) - Forest Service Special Use Permit for the construction, operation, and maintenance of the line that passes through the Bude Range District of Homochitto National Forest (approximately 38.6 acres of ROW) [USDA 1976].

Based on conversation with Entergy Transmission personnel, there have been no recorded avian mortalities or concerns raised in the past along the Baxter-Wilson and Franklin transmission line corridors. [Entergy 2010c]

2.4.3 State-Listed Critical or Important Habitats

Entergy's review identified no state-listed critical or important habitats in the vicinity of the site or along the associated in-scope transmission line ROWs. Critical and important habitats are those areas that are managed by a state for species that are listed at the state level as endangered, threatened, or of concern. Even though state-listed species are known to occur in Claiborne County, Mississippi, no state-listed critical or important habitats are designated within a 6-mile radius of GGNS or along the associated transmission lines [MMNS; LWFD]. Based on consultations, neither the MNHP or the LNHP have designated critical or important habitats near the site (Attachment A).

2.4.4 Federally Listed Critical or Important Habitats

As discussed in Section 2.5, eight federally listed threatened or endangered species, including one candidate species, are potentially encountered on the GGNS site, within the vicinity of GGNS, or along the associated in-scope transmission line ROWs. Entergy's review identified no designated critical habitat for these species within a 6-mile radius of GGNS or along the associated transmission lines based on the USFWS Critical Habitat portal [USFWS 2010a]. Critical habitat was designated by the USFWS in March 2009 for the Louisiana black bear in

Tensas County, Louisiana, along the Tensas River drainage basin a little more than 16 miles west of GGNS at the closest point [74 FR No. 45, pgs.10349-10409]. Based on consultations, the USFWS regional offices in Mississippi and Louisiana and the National Oceanic and Atmospheric Administration (NOAA) concurred with Entergy's conclusion (Attachment A).

2.5 Threatened or Endangered Species

2.5.1 Federally Listed Species

As shown in Table 2.5-1 and discussed in more detail below, species currently protected under the ESA, including candidate species, that have geographic ranges which could potentially include the GGNS site, vicinity and/or, transmission lines include two mammals, three birds, two fish, and two macroinvertebrates. These are the Louisiana black bear, American black bear, wood stork, interior least tern, redcockaded woodpecker, pallid sturgeon, bayou darter, fat pocketbook mussel, and rabbitsfoot mussel. Since the Florida panther is currently considered to be extirpated from Mississippi and the American alligator is listed due to similarity of appearance to the American crocodile, they are not included in Table 2.5-1. In addition, the Gulf sturgeon (A*cipenser oxyrinchus desotoi*) was identified as being present in the Mississippi River in the region of Vicksburg, Mississippi, by the NOAA; however, NOAA specified that the GGNS project area was not within designated Gulf sturgeon critical habitat and deferred to the USFWS as the lead agency for having jurisdictional responsibilities on the Mississippi River [NOAA]. Since the USFWS, MNHP, and LNHP did not list the Gulf sturgeon in their response letters to Entergy (Attachment A), this species is not included in Table 2.5-1.

2.5.1.1 Louisiana and American Black Bears

Black bears have been observed on or near the GGNS site, within the vicinity of GGNS, and in the area of the Franklin and Baxter-Wilson transmission line ROW corridors. The historic range of the Louisiana black bear included southern Mississippi (south of and including Washington, Humphreys, Holmes, Attala, Neshoba, and Lauderdale counties), all of Louisiana, and eastern Texas. Two subspecies of black bear historically occupied Mississippi, the Louisiana black bear in the south and the American black bear in the north. Because the two subspecies are indistinguishable by sight, other free-living American black bears within the historic range of the Louisiana black bear are designated federally threatened by similarity of appearance. [USNRC 2006a, Section 2.7.1.2]

The historic habitat of the Louisiana black bear has suffered extensive modification, having been reduced by more than 80 percent as of 1980. The remaining habitat has been reduced in quality by fragmentation and conversion to agriculture. Habitat destruction or modification is the primary threat to the Louisiana black bear. Human-related mortality also continues to pose a threat to the subspecies. The key habitat requirements of black bears are food, water, cover, and den sites that are spatially arranged across sufficiently large, relatively remote blocks of land. Remoteness is relative to forest tract size and the presence of roads. Examples of remoteness relative to black bears include a tract of timberland 0.5 mile from well maintained roads and development, a forested tract of more than 2,500 acres, or a tract with 0.3 mile or less of road per 0.4 square mile

of forest. Much of the GGNS site and immediate environs to the north and south closely approach or satisfy one or more of these criteria. [USNRC 2006a, Section 2.7.1.2]

Louisiana black bears typically inhabit heavily wooded bottomland hardwoods and swamps, although adjacent upland habitat types are also used. Occupied Louisiana black bear habitat has been defined by the USFWS as only those areas where there is evidence of reproduction, such as a female with cubs. Presently within the historic range of the Louisiana black bear, two known breeding bear populations occur in two Louisiana river basins. One range is the Tensas River Basin, consisting of Franklin, Madison, and Tensas parishes. The Tensas River Basin is located in rural northeastern Louisiana and contains an estimated 160 bears. Tensas Parish is located directly across the Mississippi River from Claiborne County and the GGNS site. The other range is the Atchafalaya River Basin, located in south-central Louisiana and divided into two units: upper and lower/coastal. The upper and coastal units support subpopulations of 52 and 92 bears, respectively. [USNRC 2006a, Section 2.7.1.2]

As discussed in Section 2.4.4, critical habitat was designated by the USFWS in March 2009 for the Louisiana black bear in Tensas County, Louisiana, along the Tensas River drainage basin a little more than 16 miles west of GGNS at the closest point [74 FR No. 45, pgs. 10349-10409]. The Louisiana black bear may use the Mississippi River environs as a travel corridor between the Tensas River Basin and upper Atchafalaya River Basin, and it could thus serve as an important link between the two [USNRC 2006a, Section 2.7.1.2].

The GGNS site provides large tracts of bottomland and upland hardwood forests that are contiguous with other relatively large, adjacent expanses of hardwood forest. These are suitable for bears because they are relatively remote by the above standards and subject to relatively little human disturbance, particularly those on the site, because of public access restrictions. Public access restrictions may protect bears from illegal hunting and collisions with cars because of the low traffic volume on roads in and around the site. Black bears are generally highly adaptable and tend to survive in a variety of situations where they are protected from over-harvesting and other negative interactions with humans. Because bears coexist readily with humans when provided areas in which they can avoid contact, the possibility that Louisiana black bears still inhabit the site is high. [USNRC 2006a, Section 2.7.1.2]

During a black bear habitat survey conducted on the GGNS property (2006-2007), a probable ground den approximately 400 feet north of the heavy haul road and 3,800 feet east of the river bank was observed. Possible foraging areas consisting of blackberry (*Rubus trivialis*) thickets were also noted. They were scattered but relatively common throughout the entire area. However, with the exception of the possible ground den in the bottomland, there is no actual evidence of the current use of the site by bears. [SERI 2008b, Section 2.4.1.2.2]

Some black bear sightings have been in Mississippi counties other than Claiborne (Franklin, Jefferson, and Warren) that are crossed by the transmission line ROWs (Baxter-Wilson and Franklin). The subspecies is known to occur only in the western most portion of Franklin County where hardwood forests are more prevalent. The subspecies is also known to occur only in the western most portion of Jefferson County near the Mississippi River. The Franklin transmission

line ROW traverses the northeastern portions of Franklin and Jefferson counties and is thus at least 20 miles distant from the nearest sighting of the Louisiana black bear in these counties. However, the subspecies is known to occur along the Mississippi River in Warren County in the general area crossed by the Baxter-Wilson transmission line ROW. [USNRC 2006a, Section 2.7.1.2]

2.5.1.2 Wood Stork

The wood stork occurs primarily in freshwater wetlands, including ponds, bayheads, flooded pastures, oxbow lakes, and ditches. Nesting usually occurs in bald cypress trees in swamps, although breeding has also been observed in mangroves. Wood storks apparently nest whenever there are periods of falling water, which usually happens during the winter and spring within its breeding range. Reduced water levels tend to concentrate fish into smaller, more easily fishable areas. [MDWFP]

The wood stork is a highly colonial species, usually nesting and feeding in flocks. The wood stork has been occasionally sighted in all states east of the Mississippi River, and sporadically sighted in some states west of the Mississippi River. Breeding populations of the wood stork are federally listed as endangered and currently occur or have recently occurred only in Alabama, Florida, Georgia, and South Carolina. [USNRC 2006a, Section 2.7.1.1].

Non-breeding wood storks have been known to occur on and in the near vicinity of the GGNS site. Wood storks were observed during the summer season on Gin and/or Hamilton lakes during the 18 year period prior to the construction of GGNS. The wood stork would currently be considered a possible non-breeding transient to the GGNS and vicinity. [USNRC 2006a, Section 2.7.1.1]

2.5.1.3 Interior Least Tern

The interior least tern is a colonial species which nests on flat, unvegetated to sparsely vegetated sandbars near shallow-water feeding areas. The nest is a small depression in sand or gravel, usually located close to debris such as logs or brush. Time of nesting is dependent upon when water levels are low enough to expose sandbars in the Mississippi River, but usually occurs between late May and June. Normally two eggs are laid, but as many as five eggs have been observed in a single nest. The eggs hatch in about three weeks and the chicks are able to wander from the nest within a day. The young begin to fly about three weeks after hatching, although they remain partially dependent upon the parents for some time after they learn to fly. Least terns apparently begin breeding when they are two or three years old and may live for 20 years. [MDWFP]

The nearest areas occupied by least terns upstream and downstream from the GGNS site (RM 405) were at Yucatan Dikes (RM 409.8), Togo Island Dikes (RM 413.6), and below Bondurant Towhead Dikes (RM 393.0). [USNRC 2006a, Section 5.4.3.1]

The point along the Baxter-Wilson transmission line ROW within Warren County that is closest to the Mississippi River is at its terminus at the Baxter-Wilson Substation (RM 433.1), located 0.46

miles from the river. The nearest areas occupied by terns downstream and upstream of the Baxter-Wilson Substation were below Racetrack Dikes (RM 429.0) (nesting colony of 91 adults on the Mississippi side of the river) and at Milliken Bend (RM 456.0) (one adult tern observed on the Louisiana side of the river). Both locations are at least four miles from the Baxter-Wilson Substation. Between Togo Island Dikes (RM 413.6) and below Racetrack Dikes are two other areas occupied by terns, Newton Bend Dikes (RM 419.5) (nesting colony of 14 birds on the Mississippi side of the river) and across from Logo Landing (RM 418.3) (nesting colony of 58 birds on the Louisiana side of the river). It is estimated that these two tern nesting areas are approximately two miles from the Baxter-Wilson transmission line ROW. [USNRC 2006a, Section 2.7.1.2]

2.5.1.4 Red-Cockaded Woodpecker

The red-cockaded woodpecker is endemic to open, mature, and old growth pine ecosystems in the southeastern U.S. Red-cockaded woodpeckers are a cooperatively breeding species, living in family groups that typically consist of a breeding pair with or without one or two male helpers. In red-cockaded woodpeckers (and other cooperative breeders), a large pool of helpers is available to replace breeders when they die. Helpers do not disperse very far and typically occupy vacancies on their natal territory or a neighboring one. [USNRC 2006a, Section 2.7.1.2]

Red-cockaded woodpeckers require open pine woodlands and savannahs with large old pines for nesting and roosting habitat (clusters). Large old pines are required as cavity trees because the cavities are excavated completely within inactive heartwood and because of the higher incidence of heartwood decay that greatly facilitates excavation. Cavity trees must be in open stands with little or no hardwood midstory and few or no overstory hardwoods. Suitable foraging habitat consists of mature pines with an open canopy, low densities of small pines, little or no hardwood or pine midstory, few or no overstory hardwoods, and abundant native bunchgrass and forb groundcovers. [USNRC 2006a, Section 2.7.1.2]

The red-cockaded woodpecker is not known, either historically or currently, to occur in Claiborne and Warren counties. The red-cockaded woodpecker currently occurs in the Homochitto National Forest. Three counties (Franklin, Jefferson, and Lincoln) traversed by the Franklin transmission line ROW are crossed by the Homochitto National Forest. In Franklin County, a red-cockaded woodpecker Habitat Management Area (HMA) is situated within the Homochitto National Forest south and west of the intersection of U.S. Highways 84 and 98 at Meadville. The HMA is located approximately ten miles to the southwest of the Franklin transmission line ROW. There are forest management activities (e.g., prescribed burning and thinning) underway to restore old-age longleaf pine (*Pinus palustris*) stands across the Homochitto National Forest that could encourage the red-cockaded woodpeckers to inhabit restored old-age longleaf pine areas outside the HMA. [USNRC 2006a, Section 2.7.1.2]

2.5.1.5 Pallid Sturgeon

The pallid sturgeon has a range of more than 3,500 miles through the Missouri-Mississippi River drainage, including the LMR. The species was designated as endangered throughout its entire range in 1990. Pallid sturgeon have a long, uniformly grayish-white body, flattened, shovel-

shaped snout, with a long, slender completely armored caudal peduncle, and no spiracle. They are found in the main channels of large, highly turbid, free-flowing rivers with sand flats or gravel bars. Pallid sturgeon mainly feed on other fish. Little information is available on the spawning or migration habits of the pallid sturgeon except that they are likely to spawn in the spring and summer months, similar to other North American sturgeons. [USNRC 2006a, Section 2.7.2.2]

Pallid sturgeon have been collected in the region of GGNS. During the 1972 to 1973 preconstruction studies for the GGNS, a specimen was collected offshore of the site. In 2001, trawl surveys were conducted on the LMR in the Vicksburg area, approximately 38 miles upstream from GGNS. Several pallid sturgeon were caught in regions with moderate to strong currents, a sand or sand/gravel substrate, and areas with structure (for example, sand reefs, dunes, or secondary channel). [USNRC 2006a, Section 2.7.2.2] Spawning habitat may exist within 10 miles of the site. However, there is little information about the use of the reach by larvae or juvenile pallid sturgeon. [USNRC 2006a, Section 5.4.3.1]

2.5.1.6 Bayou Darter

The bayou darter is endemic to Bayou Pierre and its tributaries, which flow as close as 1.9 miles east of the GGNS site. Bayou darters are small 1.0 to 1.8 inches, the smallest representative of the subgenus, *Nothonotus*. The darters live in swift, shallow riffles or runs over coarse gravel and pebbles. Based on the known distribution of the bayou darter, the species is likely to inhabit the waters in the vicinity of the transmission line ROW. Loss of habitat through erosion of the tributaries has been a concern. [USNRC 2006a, Section 2.7.2.2]

2.5.1.7 Fat Pocketbook Mussel

The fat pocketbook mussel was historically found throughout the Mississippi River drainage from Minnesota to Louisiana. In 2003, the mussel was found near Vicksburg in the Mississippi River, as well as south of the GGNS site. The adult mussels are found in sand and mud, as well as in stable substrates of fast flowing rivers. Little information is available on the reproduction of the fat pocketbook mussel; however, they are thought to be similar to other freshwater mussels. [USNRC 2006a, Section 5.4.3.1]

The possible occurrence of the fat pocketbook mussel in the Mississippi River at the GGNS site was investigated by performing a mussel survey at the intake and discharge location on November 20, 2006. The survey found no native mussels of any species or live mussels of any exotic species. Dead zebra mussel and asiatic clam shells occurred on the river bank. The latter are introduced species common to the Mississippi River. Because the shells represented dead specimens, their origin is unknown except to note that they probably originated somewhere upriver and were carried to the site by river currents. [SERI 2008b, Section 2.4.2]

2.5.1.8 Rabbitsfoot Mussel

The rabbitsfoot mussel, a Candidate Species, is an historical resident of the Bear Creek, Big Sunflower River, and Big Black River watersheds. Population declines can be attributed to water-quality degradation, loss of stable substrates, sedimentation, channelization, gravel

milling, dredging, impoundments, and competition of exotic mussel species. [USFWS 2010b] The 2006 mussel survey, discussed above, found no native mussels of any species or live mussels of any exotic species.

2.5.2 State-Listed Species

As shown in Table 2.5-1, the MNHP has designated ten species as endangered and eight species as of special concern; while the LNHP has designated four species as either threatened or endangered. These species collectively include the Louisiana black bear, American black bear, bald eagle, wood stork, interior least tern, red-cockaded woodpecker, white ibis, Webster's salamander, pallid sturgeon, bayou darter, crystal darter, sicklefin chub, chestnut lamprey, black buffalo, paddlefish, blue sucker, fat pocketbook mussel, and robust baskettail. Below is a discussion of these species not already discussed above as it relates to their potential of being present on the GGNS site, within the vicinity of GGNS, and transmission line ROWs.

2.5.2.1 Bald Eagle

The bald eagle is a bird of aquatic ecosystems, frequenting major rivers, large lakes, reservoirs, estuaries, and some seacoast habitats. Fish are the major component of its diet, but waterfowl, seagulls, and carrion are also eaten. Bald eagles usually nest in large trees along shorelines in relatively remote areas that are free of disturbance. No critical habitat has been designated for this species. [USNRC 2006a, Section 2.7.1.2]

The bald eagle is known to inhabit Claiborne County and Warren County. In the region around the GGNS site, nest sites are usually in dominant living pine (*Pinus* spp.) or bald cypress trees (*Taxodium distichum*), and nesting activity usually occurs between September and January. Although a survey of the river shoreline at the site has not been conducted, it appears to lack such trees. Bald eagles have been known to frequent Yucatan Lake, located across the Mississippi River west of the site. However, there are currently no known bald eagle sightings within 10 miles of GGNS. Consequently, nesting onsite appears possible, though unlikely because of the apparent absence of suitable mature pine or cypress trees in the bottomland adjacent to the river. [USNRC 2006a, Section 2.7.1.2]

The only bald eagle nest site currently known in Warren County is at Halpine Lake, which is located along the Mississippi River north of Vicksburg about 25 miles from GGNS. There are no other bald eagle nest sites, roost sites, or feeding concentrations currently known of in Warren County. It is possible that eagles use the Mississippi River corridor elsewhere in Warren County for nesting, roosting, and/or foraging. [USNRC 2006a, Section 2.7.1.2]

2.5.2.2 White Ibis

The white ibis breeds coastally from Louisiana east along the Gulf Coast. They occur inland across Florida, and along the Atlantic coast as far north as the Carolinas. The non-breeding range extends further inland, north to Virginia, and west to eastern Texas. The main threats to the white ibis are human disturbance and habitat loss. Nesting adults are particularly sensitive to disturbance, and eggs and chicks left alone due to human intrusion are susceptible to predation.

Since the species nests in large groups, nest disturbance, even by well-meaning researchers, can have devastating effects on a colony. [Audubon]

2.5.2.3 Webster's Salamander

The Webster's salamander (*Plethodon websteri*) is a small salamander with variable coloration. Color morphs may include a striped form (wavy yellowish brown to orangish red dorsal stripe extends from the head to the end of the tail), an unstriped form that may have scattered red pigmentation on the dorsum, and individuals with intermediate coloration. All color morphs have tiny silvery white spots and brassy flecks that give the salamander a "frosted" appearance. It occurs disjunctly in five states of southeastern U.S. It is stable to possibly declining in different areas of the range, moderately threatened by loss and degradation of habitat due to urbanization and silvicultural practices, but persists in second growth forest in most parts of the range. It is a species of special concern in Mississippi. [NatureServe]

This salamander inhabits mesophytic forest (maple, hickory, oak, poplar, and elm) bordering rocky feeder streams and is usually found under logs, bark, and leaf litter on the forest floor and along rocky stream beds. It also occurs in moist forest on steep north-facing slopes with rock outcrops. The Webster's salamander is a terrestrial breeder, active in forest litter October–May. It is apparently inactive underground in other months, even after heavy rains. Courtship and insemination probably occur between January and March with eggs laid June or July that hatch between August and September. [NatureServe]

2.5.2.4 Crystal Darter

The crystal darter has a historical range throughout the Mississippi, Missouri, and Ohio Rivers. The crystal darter is a large, cigar-shaped fish, which is bi-colored with the lower half being white or silvery. These fish live in swift areas of sand and gravel raceways of large rivers. Crystal darters are found in the Bayou Pierre River and tributaries, which flow as close as 1.9 miles east of the GGNS site. [USNRC 2006a, Section 2.7.2.1]

2.5.2.5 Sicklefin Chub

The sicklefin chub is a member of the Cyprinidae or minnow family. The species is highly adapted for conditions found in large free-flowing rivers with relatively high levels of turbidity. Based on current understanding of this species, it is believed that the sicklefin chub historically occurred in approximately 85 miles of the Lower Yellowstone River, approximately 1,950 miles of the main stem of the Missouri River, and about 1,150 miles of the Mississippi River below the mouth of the Missouri River. Recent studies indicate that sicklefin chub are more widely distributed and more common than previously believed. The effectiveness of sampling techniques has dramatically improved with the use of benthic trawls that have been modified to collect small fish. Field studies conducted by the Missouri Department of Conservation since 1997 have documented viable populations of sicklefin chub in the Middle Mississippi River and in the Wolf Island area of the LMR. [66 FR 75] The sicklefin chub, an MNHP species of special concern, is listed as critically imperiled in Mississippi because of extreme rarity or some factors making it vulnerable to extirpation.

2.5.2.6 Chestnut Lamprey

The lampreys are eel-like fish which differ from true fish in the absence of jaws and paired fins and the presence of gill pockets rather than regular gills. The chestnut lamprey (*Ichthyomyzon castaneus*) has a round, sucking-disk mouth and a keel-like rayless fin along the back and around the tip of the tail. Growing to a length of 12 inches, chestnut lampreys are gray to greenish-gray in color with a pale belly. Adults live in medium and large rivers but may also occur in large reservoirs. In the vicinity of GGNS, chestnut lampreys may occur in the Mississippi, Big Black, and Bayou Pierre rivers. [NatureServe]

Adult lampreys are parasitic on various fishes, spend summer feeding, overwinter, spawn during the following summer and then die after spawning. Eggs are laid in a nest in the river bottom and may be covered with stones. Larvae burrow in bottom of smaller tributaries in areas of moderate current and later move into more densely vegetated areas with softer bottom. Larvae filter feed on desmids, diatoms, protozoans, and other minute plankton. The larval stage lasts about five to seven years, and metamorphose late in summer to winter. [NatureServe]

2.5.2.7 Black Buffalo

The black buffalo (*Ictiobus niger*) is a member of the Catostomidae family (suckers) found in North America. It is a species of special concern in Mississippi and may occur in Claiborne County along the Mississippi and lower Big Black rivers. Its habitat includes freshwater pools and backwaters of sloughs and small to large rivers, reservoirs, and river-margin lakes, although it is often also found in strong currents of large rivers. It eats planktonic and bottom organisms such as insects, mollusks, and vegetation. The black buffalo is sexually mature by age two and spawns in flooded areas in the spring. [NatureServe]

2.5.2.8 Paddlefish

The paddlefish (*Polyodon spathula*) is widespread in rivers in the eastern and central U.S., though less so than historically, and while populations are faring well in some areas, they are apparently declining or of unknown trend in much of the range. The paddlefish is a species of special concern in Mississippi and may occur in the lower Mississippi and lower Big Black rivers in Claiborne County. Paddlefish are being stocked in eleven states, largely to compensate for destruction or unavailability of spawning habitat. [NatureServe]

Paddlefish are threatened by siltation of spawning habitat, pollution, back-to-back impoundments, and, in some areas, exploitation by the caviar industry. They are reported to occur in slow-flowing water of large and medium-sized rivers, river-margin lakes, channels, oxbows, backwaters, and impoundments with access to spawning areas. Paddlefish prefer depths greater than 5 feet, seek deeper water in late fall and winter, and may congregate near human-made structures that create eddies and reduce current velocity. [NatureServe]

2.5.2.9 Blue Sucker

The blue sucker (*Cycleptus elongates*) is one of only a few species in the subfamily Cycleptinae (two in North America). There is wide distribution in large rivers in central North America, locally common in some areas, but greatly reduced in abundance in other parts of the range as a result of dam construction and reductions in water quality. It is a species of special concern in Mississippi and may occur in Claiborne County along the Mississippi, lower Big Black, and Bayou Pierre rivers. The blue sucker's habitat is reported to be in large rivers and lower parts of major tributaries, where it has been found in channels and flowing pools with moderate current (1.0-2.6 m/sec) and has also been found in some impoundments. Adults probably winter in deep pools. Young are believed to winter in shallower and less swift water than adults. [NatureServe]

The blue sucker is a bottom feeder that eats insects, crustaceans, and plant material, including algae and clams. Diet of adults and young often includes larvae and pupae of midges and caddisflies. The cited causes of decline include historical overfishing, depletion of surface water, poor water quality stemming from sewage effluent and agricultural runoff, siltation from poor farming practices, interruption of migrations by dams, and stranding in irrigation canals. Reductions in river velocity could also inhibit reproductive success. This fish can tolerate high turbidity if sufficient current prevents silt deposition. [NatureServe]

2.5.2.10 Robust Baskettail

The robust baskettail is a stout-bodied dragonfly that has a robust abdomen with a mild constriction at the base; the cerci are distinct with a protuberance dorsally (visible in the lateral view) and the cerci appear more or less parallel in dorsal view. Habitat information on the baskettail in Mississippi is limited, but it generally inhabits swamps with some water movement, boggy ponds, and lakes. [USGS 2006]

Table 2.5-1
Compilation of Federal- and State-Listed Species

Common Name	Scientific Name	Federal Status	MS Status	LA Status	On-Site	Vicinity (6-mi)	Transmission ROW
Mammals							
Louisiana Bear	*Ursus americanus luteolus*	T	E	T	Yes	Yes	Yes
American Black Bear	*Ursus americanus*	T (S/A)	E	–	Yes	Yes	Yes
Birds							
Bald Eagle	*Haliaeetus leucocephalus*	–	–	E	Yes	Yes	Yes
Wood Stork	*Mycteria americana*	E	E	–	Yes	Yes	No
Interior Least Tern	*Sterna antillarum athalassos*	E[a]	E[a]	E	No	Yes	Yes
Red-Cockaded Woodpecker	*Picoides borealis*	E	E	–	No	No	Yes
White Ibis	*Eudocimus albus*	–	S2, S3	–	Yes	Yes	–
Amphibians							
Webster's Salamander	*Plethodon websteri*	–	S3	–	Yes	Yes	–
Fish							
Pallid Sturgeon	*Scaphirhynchus albus*	E	E	E	Yes	Yes	No
Bayou Darter	*Etheostoma rubrum*	T	E	-	No	Yes	Yes
Crystal Darter	*Crystallaria asprella*	-	E	-	Yes	Yes	-
Sicklefin Chub	*Macrhybopsis meeki*	-	S1	-	Yes	Yes	-
Chestnut Lamprey	*Ichthyomyzon castaneus*	-	S3	-	Yes	Yes	-

Table 2.5-1 (Continued)
Compilation of Federal- and State-Listed Species

Common Name	Scientific Name	Federal Status	MS Status	LA Status	On-Site	Vicinity (6-mi)	Transmission ROW
Black Buffalo	*Ictiobus niger*	-	S3	-	Yes	Yes	-
Paddlefish	*Polyodon spathula*	-	S3	-	Yes	Yes	-
Blue Sucker	*Cycleptus elongates*	-	S3	-	Yes	Yes	-
Macroinvertebrate							
Fat Pocketbook Mussel	*Potamilus capax*	E	E	-	No	Yes	Yes
Rabbitsfoot Mussel	*Quadrula cylindrica*	CS	-	-	No	Yes	-
Insects							
Robust Baskettail	*Epitheca spinosa*	-	S1	-	Yes	Yes	-

T = Threatened
E = Endangered
CS = Candidate Species
S1 = Critically Imperiled in Mississippi
S2 = Imperiled in Mississippi;
S3 = Rare or uncommon in Mississippi
T (S/A) = Threatened by similarity of appearance

References:AAI; LWFD; MDWFP; USFWS 2010b; USFWS 2010c

a. Interior least terns belong to a subspecies of least terns and are protected Federally, and by the state of Mississippi under the species name. *Sterna antillarum athalassos* is the subspecies endemic to the GGNS region and is therefore specified above.

2.6 Regional Demography

2.6.1 Regional Population

NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), presents a population characterization method that is based on two factors: *sparseness* and *proximity* [USNRC 1996, Section C.1.4]. Sparseness measures population density and city size within 20 miles of a site and categorizes the demographic information as follows.

Demographic Categories Based on Sparseness

		Category
Most sparse	1.	Less than 40 persons per square mile and no community with 25,000 or more persons within 20 miles
	2.	40 to 60 persons per square mile and no community with 25,000 or more persons within 20 miles
	3.	60 to 120 persons per square mile or less than 60 persons per square mile with at least one community with 25,000 or more persons within 20 miles
Least sparse	4.	Greater than or equal to 120 persons per square mile within 20 miles

Reference: USNRC 1996

Proximity measures population density and city size within 50 miles and categorizes the demographic information as follows.

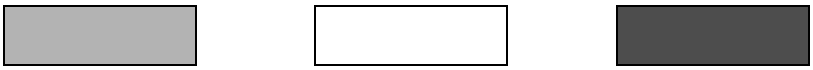
Demographic Categories Based on Proximity

		Category
Not in close proximity	1.	No city with 100,000 or more persons and less than 50 persons per square mile within 50 miles
	2.	No city with 100,000 or more persons and between 50 and 190 persons per square mile within 50 miles
	3.	One or more cities with 100,000 or more persons and less than 190 persons per square mile within 50 miles
In close proximity	4.	Greater than or equal to 190 persons per square mile within 50 miles

Reference: USNRC 1996

The GEIS then uses the following matrix to rank the population in the vicinity of the plant as low, medium, or high.

GEIS Sparseness and Proximity Matrix					
		Proximity			
		1	2	3	4
Sparseness	1	1.1	1.2	1.3	1.4
	2	2.1	2.2	2.3	2.4
	3	3.1	3.2	3.3	3.4
	4	4.1	4.2	4.3	4.4



Low Population Area | Medium Population Area | High Population Area

Reference: USNRC 1996

The U.S. Census Bureau (USCB) conducted a decennial census in 2010. The analysis that follows utilizes USCB data from the 2010 census, where available. However, population projection data based on the 2010 census data are not yet available from the Louisiana and Mississippi state sources. Generally, the 2010 census data reveal population counts for the region that are similar when compared to the 2000 projected population values found in the most recent state population projections.

The 2000 and 2010 census population data and TIGER/Line data from the USCB were used to determine demographic characteristics in the vicinity of the site [USCB 2010f; USCB 2011b]. The data were processed at the state, county/parish, and census block levels using ESRI ArcView® [ESRI 2007]. The census data also include people living in group quarters such as institutionalized and non-institutionalized populations. Examples of institutional populations living in group quarters are correctional institutions (i.e., prisons, jails, and detention centers), nursing homes, mental (psychiatric) hospitals, hospitals or wards for the chronically ill, and juvenile institutions. Examples of non-institutional populations living in group quarters are group homes, college dormitories, military quarters, soup kitchens, shelters for abused women (shelters against domestic violence or family crisis centers), and shelters for children who are runaways, neglected, or without conventional housing.

Based on 2010 census data, approximately 23,406 people were living within a 20-mile radius of the site, which equates to a population density of 19 persons per square mile [USCB 2011b]. There are no communities with 25,000 or more persons within a 20-mile radius of the site based on 2010 census data [USCB 2011a]. Therefore, according to the GEIS sparseness index, the site is classified as Category 1.

Based on 2010 census data, approximately 329,043 people were living within a 50-mile radius of the site, which equates to a population density of 42 persons per square mile [USCB 2011b]. Jackson, Mississippi, located 55 miles to the east-northeast, had a population of 173,514 in 2010 [USCB 2011a]. However, Jackson is not included in the proximity criteria since it is located greater than 50 miles from the site. Therefore, according to the GEIS proximity index, the site is classified as Category 1.

According to the GEIS matrix above, the combination of "sparseness" Category 1 and "proximity" Category 1 results in the conclusion that the site is located in a "low" population area.

The area within a 50-mile radius of the site includes twenty-five counties or parishes in Mississippi and Louisiana that are totally or partially included within the 50-mile radius (Table 2.6-1). According to the 2000 census, the total permanent population (not including transient populations) of these counties/parishes was approximately 831,332 [USCB 2010a]. Based on the 2010 census, the total permanent population (not including transient populations) of these counties grew to 857,401 [USCB 2011c].

By 2044, which is the end of the proposed license renewal period, the resident population (not including transient populations) of these whole counties/parishes is projected to be approximately 1,021,752 [Enercon 2011a]. The total population (including transient populations) of these whole counties and parishes within a 50-mile radius is projected to be approximately 1,073,137 [Enercon 2011a]. For the county and parish population that falls within the 50-mile radius, the total population (including transient populations) is projected to be 356,199 in 2044. Based on 2000–2044 population projections, an annual growth rate of approximately 0.40 percent is anticipated for the population in the 25 counties/parishes wholly or partially located within a 50-mile radius of the site. [Enercon 2011a]

Parish/county-level permanent population projections were obtained from the State of Louisiana Office of Electronic Services Division of Administration and the Mississippi Institutions of Higher Learning Office of Policy Research and Planning. Transient information was obtained from the Louisiana Office of Tourism and the Mississippi Development Authority Tourism Division. Louisiana and Mississippi transient populations are discussed in Section 2.10.4.

Table 2.6-1
County Population by State Totally or Partially Included in the 50-Mile Radius of GGNS

State and County[a]	2000 Population	2010 Population	2044 Projected Permanent Population[b]
Louisiana	126,052	119,561	120,419
Caldwell	10,560	10,132	10,990
Catahoula	10,920	10,407	10,407
Concordia	20,247	20,822	20,822
East Carroll	9,421	7,759	7,759
Franklin	21,263	20,767	20,767
Madison	13,728	12,093	12,093
Richland	20,981	20,725	20,725
Tensas	6,618	5,252	5,252
West Carroll	12,314	11,604	11,604
Mississippi	705,280	737,840	901,333
Adams	34,340	32,297	32,297
Amite	13,599	13,131	13,131
Claiborne	11,831	9,604	9,604
Copiah	28,757	29,449	32,942
Franklin	8,448	8,118	8,118
Hinds	250,800	245,285	245,285
Issaquena	2,274	1,406	1,406
Jefferson	9,740	7,726	7,726
Lincoln	33,166	34,869	42,554
Madison	74,674	95,203	165,995
Rankin	115,327	141,617	221,050
Sharkey	6,580	4,916	4,916
Simpson	27,639	27,503	28,961

Table 2.6-1 (Continued)
County Population by State Totally or Partially Included in the 50-Mile Radius of GGNS

State and County[a]	2000 Population	2010 Population	2044 Projected Permanent Population[b]
Warren	49,644	48,773	48,773
Wilkinson	10,312	9,878	10,510
Yazoo	28,149	28,065	28,065
TOTAL POPULATION	831,332	857,401	1,021,752

a. Three parish/counties (Caldwell, Simpson, and Wilkinson) have increasing population trends, according to state population projections, even though their 2010 population values declined. As such, the 2010 population values are less than the 2000 values and the projected 2044 values.
b. Projected population values are based on the population projection growth trend for the years reported by the states [LAOESDA; MSOPRP; Enercon 2011a]. To be conservative, for the counties/parishes that experienced a population in decline between 2000 to 2010, the 2010 census population count was retained for the year 2044 [USCB 2010a; USCB 2011c].

GGNS is located in rural Claiborne County, Mississippi. According to census data, the county had a 2000 population of 11,831 and a 2010 population of 9,604 [USCB 2010a; USCB 2011c]. The only incorporated town within the county is Port Gibson with a reported 2000 population of 1,840 people. According to 2010 census data, Port Gibson's population has dropped since 2000 by approximately 15 percent to 1,567 [USCB 2010b; USCB 2011a]. The cities and towns with boundaries falling totally or partially within the 50-mile region are listed in Table 2.6-3.

The site is located on the Mississippi River near the Louisiana state border. Based on census data, Tensas Parish, Louisiana, located on the west bank of the river across from the site, had a 2000 population of 6,618, and a 2010 population of 5,252 as shown in Table 2.6-1 [USCB 2010a; USCB 2011c]. Within Tensas Parish, the towns and cities include Newellton (2000 population of 1,482), Saint Joseph (2000 population of 1,340), and Waterproof (2000 population of 834). As indicated in Table 2.6-3, these city and town populations are also in decline according to the 2010 Census.

Estimated total projected populations and average annual growth rates for the seven counties and parishes included within the 20-mile radius of the site are shown in Table 2.6-2. These include Madison and Tensas Parishes in Louisiana, and Claiborne, Copiah, Hinds, Jefferson, and Warren Counties in Mississippi. These counties and parishes are of special significance in evaluation of demographic impacts because of their proximity to the site.

Of the seven counties/parishes, only Copiah County in Mississippi (located east, southeast of Claiborne County and the site) shows a consistent increase in projected population between the years 2000 and 2044. Hinds County has the largest urban center in Mississippi, Jackson. The

other six counties/parishes listed in Table 2.6-2 show an overall decline in projected population, which is expected to continue through 2044. [LAOESDA; MSOPRP]

Table 2.6-2
Madison and Tensas Parish (LA) and Claiborne, Copiah, Hinds, Jefferson, and Warren County (MS) Population Growth, 2000–2044

			2000	2010	2015	2020	2025	2044[a]
Louisiana	Madison	Population	13,728	12,903	12,903	12,903	12,903	12,903
		Average Annual Growth %	–	-1.26	0	0	0	–
	Tensas	Population	6,618	5,252	5,252	5,252	5,252	5,252
		Average Annual Growth %	–	-2.29	0	0	0	–
Mississippi	Claiborne	Population	11,831	9,604	9,604	9,604	9,604	9,604
		Average Annual Growth %	–	-2.06	0	0	0	–
	Copiah	Population	28,757	29,449	30,353	30,807	31,245	32,942
		Average Annual Growth %	–	0.24	0.61	0.3	0.28	0.28
	Hinds	Population	245,285	245,285	245,285	245,285	245,285	245,285
		Average Annual Growth %	–	-0.22	0	0	0	–
	Jefferson	Population	9,740	7,726	7,726	7,726	7,726	7,726
		Average Annual Growth %	–	-2.29	0	0	0	–
	Warren	Population	49,644	48,773	48,773	48,773	48,773	48,773
		Average Annual Growth %	–	-0.18	0	0	0	–

a. Projected population values are based on the population projection growth trend for the years reported by the states [LAOESDA; MSOPRP; Enercon 2011a]. To be conservative, for the counties/parishes projected to have a population in decline, the 2010 census population count was held constant through the year 2044 [USCB 2010a; USCB 2011c].

Table 2.6-3
Cities or Towns Located Totally or Partially Within a 50-Mile Radius of GGNS

City or Town	County/Parish	2000 Population Census	2010 Population Census	Direction and Distance[a] (mi) from GGNS
Louisiana Parishes				
Baskin	Franklin	188	254	WNW, 45
Clayton	Concordia	858	711	WSW, 35
Delhi	Richland	3,066	2,919	NW, 41
Delta	Madison	239	284	NNE, 23
Epps	West Carroll	1,153	854	NNW, 48
Ferriday	Concordia	3,723	3,511	SW, 40
Gilbert	Franklin	561	521	W, 36
Harrisonburg	Catahoula	746	348	WSW, 48
Mangham	Richland	595	672	WNW, 47
Mound	Madison	12	19	N, 23
Newellton	Tensas	1,482	1,187	WNW, 12
Richmond	Madison	499	577	NNW, 27
Ridgecrest	Concordia	801	694	SW, 40
Saint Joseph	Tensas	1,340	1,176	WSW, 12
Sicily Island	Catahoula	453	526	WSW, 37
Tallulah	Madison	9,189	7,335	NNW, 29
Vidalia	Concordia	4,543	4,299	SW, 38
Waterproof	Tensas	834	688	WSW, 24
Winnsboro	Franklin	5,344	4,910	WNW, 41
Wisner	Franklin	1,140	964	W, 36
Mississippi Counties				
Beauregard	Copiah	265	326	ESE, 44
Bolton	Hinds	629	567	ENE, 42
Brookhaven	Lincoln	9,861	12,513	SE, 46

Table 2.6-3 (Continued)
Cities or Towns Located Totally or Partially Within a 50-Mile Radius of GGNS

City or Town	County/Parish	2000 Population Census	2010 Population Census	Direction and Distance[a] (mi) from GGNS
Bude	Franklin	1,037	1,063	SSE, 39
Clinton	Hinds	23,347	25,216	ENE, 48
Crosby	Amite and Wilkinson	360	318	S, 50
Crystal Springs	Copiah	5,873	5,044	E, 41
Edwards	Hinds	1,347	1,034	NE, 34
Fayette	Jefferson	2,242	1,614	S, 20
Hazlehurst	Copiah	4,400	4,009	ESE, 40
Jackson	Hinds, Madison, and Rankin	184,256	173,514	ENE, 55
Learned	Hinds	50	94	ENE, 32
Meadville	Franklin	519	449	SSE, 38
Natchez	Adams	18,464	15,792	SW, 37
Port Gibson	Claiborne	1,840	1,567	SE, 5
Raymond	Hinds	1,664	1,933	ENE, 41
Roxie	Franklin	569	497	S, 35
Terry	Hinds	664	1,063	E, 45
Utica	Hinds	966	820	ENE, 26
Vicksburg	Warren	26,407	23,856	NNE, 25
Wesson	Copiah and Lincoln	1,693	1,925	ESE, 44

References: USCB 2010b; USCB 2011a; BTS

a. Distances are approximate and based on GGNS and National Transportation Atlas Database "National Populated Place" point data.

2.6.2 Minority and Low-Income Populations

2.6.2.1 Background

The USNRC performs environmental justice analyses utilizing a 50-mile radius around the plant as the environmental "impact area." The two states (Louisiana and Mississippi) included within the 50-mile radius, are used individually for comparative analysis and comprise the "geographic area." An alternative approach is also addressed which uses a combined geographic area of Mississippi and Louisiana. [USNRC 2004, pgs. D-4 and D-5] Both approaches were used for assessing minority and low-income population criteria.

USNRC guidance suggests using the most recent USCB decennial census data. The 2010 census population data and TIGER/Line data for Louisiana and Mississippi were obtained from the USCB web site and processed using ESRI ArcView® GIS software. Census population data were used to identify the minority and low-income populations within a 50-mile radius of the site. Minority populations in the geographic area were analyzed based on 2010 census block information [USCB 2011b]. A total of 23,582 census blocks were found in this area. Low-income populations in the geographic area were analyzed based on 2005–2009 census block group information. A total of 300 census block groups were found in the area [USCB 2011b; USCB 2011d]. The results were compiled and maps were produced showing the geographic location of minority and low-income populations in relation to the site. Information for both groups was then reviewed with respect to the Nuclear Reactor Regulation criteria for minority and low-income populations [USNRC 2004, pgs. D-8 and D-9].

2.6.2.2 Minority Populations

The USNRC Procedural Guidance for Performing Environmental Assessments and Considering Environmental Issues defines a "minority" population as American Indian or Alaskan Native, Asian, Native Hawaiian or Pacific Islander, Black, other, two or more races, the aggregate of all minority races, Hispanic ethnicity, and the aggregate of all minority races and Hispanic ethnicity [USNRC 2004, pg. D-8]. The guidance indicates that a minority population is considered to be present if either of the two following conditions exists:

(1) The minority population in the census block exceeds 50 percent, or

(2) The minority population percentage is more than 20 percentage points greater in the census block than the minority percentage of the geographic area chosen for the comparative analysis.

To establish minimum thresholds for each minority category, the non-white minority population total for each state was divided by the total population in the state. This process was repeated with the combined two-state total minority population and two-state total population. As described in the second criteria, 20 percent was added to the minority percentage values for each geographic area. The lower of the two USNRC conditions for a minority population (census block exceeds 50 percent or is more than 20 percent greater than the geographic area) was used as threshold values. Any census block with a percentage that exceeded this value was

considered to be a minority population. Minority percentages for Louisiana, Mississippi, and the two-state area, along with corresponding thresholds, are shown in Table 2.6-4.

The 2010 census indicates 37.44 percent of the population in Louisiana, 40.87 percent of the population in Mississippi, and 38.79 percent of the population for the two-state area were included in the minority category All Races Combined, as shown in Table 2.6-4. Using the second criteria listed above for identification of the presence of a minority population, when Mississippi is used as the geographic area, any census block with a combined minority population equal to or greater than 60.87 percent would be considered to be a "minority population." Since 60.87 percent exceeds the criteria of 50 percent, the first criteria (50 percent) would be used. When the two-state area is used as the geographic area, any census block with a combined minority population exceeding 50 percent would be considered a "minority population area."

For GGNS, the two-state area was evaluated for minority populations within census blocks because the area within a 50-mile radius of the site includes portions of Louisiana and Mississippi. Populations within each state were considered individually and as a two-state geographic area. A combined or aggregate population of the two-state area was calculated based on the state's populations. Finally, an additional evaluation was completed to identify the percentage of the population where all racial categories were combined and added to the Hispanic population counts for each state geographical area and for the two-state geographical area as a whole. Figures 2.6-1 through 2.6-18 reveal the areas within block groups inside the 50-mile radius that exceed the criteria percentages for race categories defined in Table 2.6-4.

Because Hispanic is not considered to be a race by the USCB, Hispanics are already represented in the census defined race categories. Because Hispanics can be represented in any race category, some white Hispanics not otherwise considered as minorities then become classified as a minority when categorized in the All Races Combined plus Hispanics category. Also, Hispanics that are of non-white racial background are included in both the racial group and the Hispanic group, and thereby doubly counted. The All Race Combined plus Hispanics category, however, results in the greatest chance of consideration of populations within a block group to be classified as minority.

The number of census blocks contributing to the minority population count was evaluated using the criteria shown in Table 2.6-4 and summarized in Table 2.6-5. The results of the evaluation are census blocks that are either flagged as not having a minority population or flagged as having a minority population(s). The resulting maps, Figures 2.6-1 through 2.6-18, depict the location of minority population census blocks flagged accordingly for each category.

The percentage of census blocks exceeding the All Races Combined minority population criteria was 18.7 percent when a two-state geographic area was used and 18.7 percent when each individual state was used as the geographic area. For the All Races Combined plus Hispanic category, 33.36 percent of the census blocks within the two-state geographic area contained a minority population, and 33.36 percent of the blocks within a 50-mile radius contained minority populations when each individual state was used. The minority population values of the blocks

were significantly reduced when races are analyzed individually. [USCB 2011b] There are 16 blocks that encompass or border the GGNS property. In Claiborne County, there are numerous minority census blocks that fall under the established criterion. Of the 16 blocks associated with GGNS, there are 11 blocks with no population, and the remaining five blocks contain a population count of less than 10 persons each, for a total population of 26. Using both geographic criterion, four of the five blocks were identified as having minority populations.

There are no Native American Indian reservations within the 50-mile region of GGNS (Section 2.1).

Table 2.6-4
Minority Populations Evaluated Against Criterion

Geographic Area	Louisiana			Mississippi			Two-State Area		
	Total Population			Total Population			Total Population		
	4,533,372			2,967,297			7,500,669		
	Count	%	Minority Threshold Criterion %	Count	%	Minority Threshold Criterion %	Count	%	Minority Threshold Criterion %
Black	1,452,396	32.04	50	1,098,385	37.02	50	2,550,781	34.01	50
American Indian/ Alaska Native	30,579	0.67	20.67	15,030	0.51	20.51	45,609	0.61	20.61
Asian	70,132	1.55	21.55	25,472	0.87	20.87	95,874	1.28	21.28
Native Hawaiian/ other Pacific Islander	1,963	0.04	20.04	1,187	0.04	20.04	3,150	0.04	20.04
Two or More Races	72,883	1.61	21.61	34,107	1.15	21.15	106,990	1.43	21.43
Other	69,227	1.53	21.53	38,162	1.29	21.29	107,389	1.43	21.43
All Races Combined	1,697,180	37.44	50	1,212,613	40.87	50	2,909,793	38.79	50
Hispanic	192,560	4.25	24.25	81,481	2.75	22.75	274,041	3.65	23.65
All Races Combined and Hispanic	1,889,740	41.69	50	1,294,094	43.61	50	3,183,834	42.45	50

Reference: USCB 2011b; USCB 2011e

Table 2.6-5
Minority Census Block Counts, 50-Mile Radius of GGNS

Geographic Area	Two-State Combined Method		Individual State Method	
	Number of Blocks with Identified Racial Category	% of Blocks within 50 miles	Number of Blocks with Identified Racial Category	% of Blocks within 50 miles
Black	4,219	17.89	4,219	17.89
American Indian/ Alaska Native	12	0.05	13	0.06
Asian	47	0.2	48	0.2
Native Hawaiian/ other Pacific Islander	3	0.01	3	0.01
Two or More Races	118	0.5	118	0.5
Other	77	0.33	79	0.34
All Races Combined	4,409	18.7	4,409	18.7
Hispanic	149	0.63	153	0.65
All Races Combined and Hispanic	7,868	33.36	7,868	33.36

References: USCB 2011b

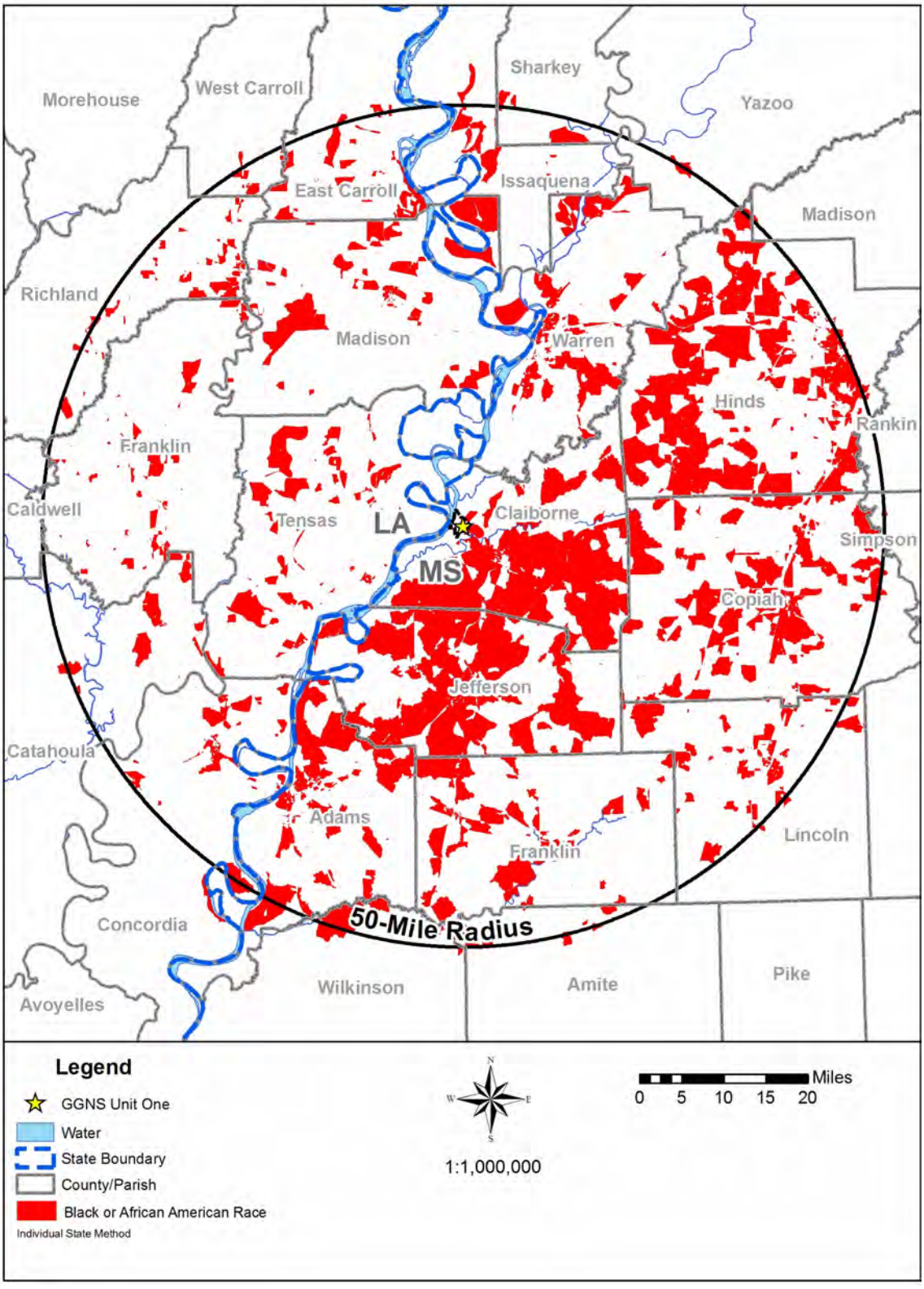


Figure 2.6-1
Census—Black or African American Minority (Individual States)

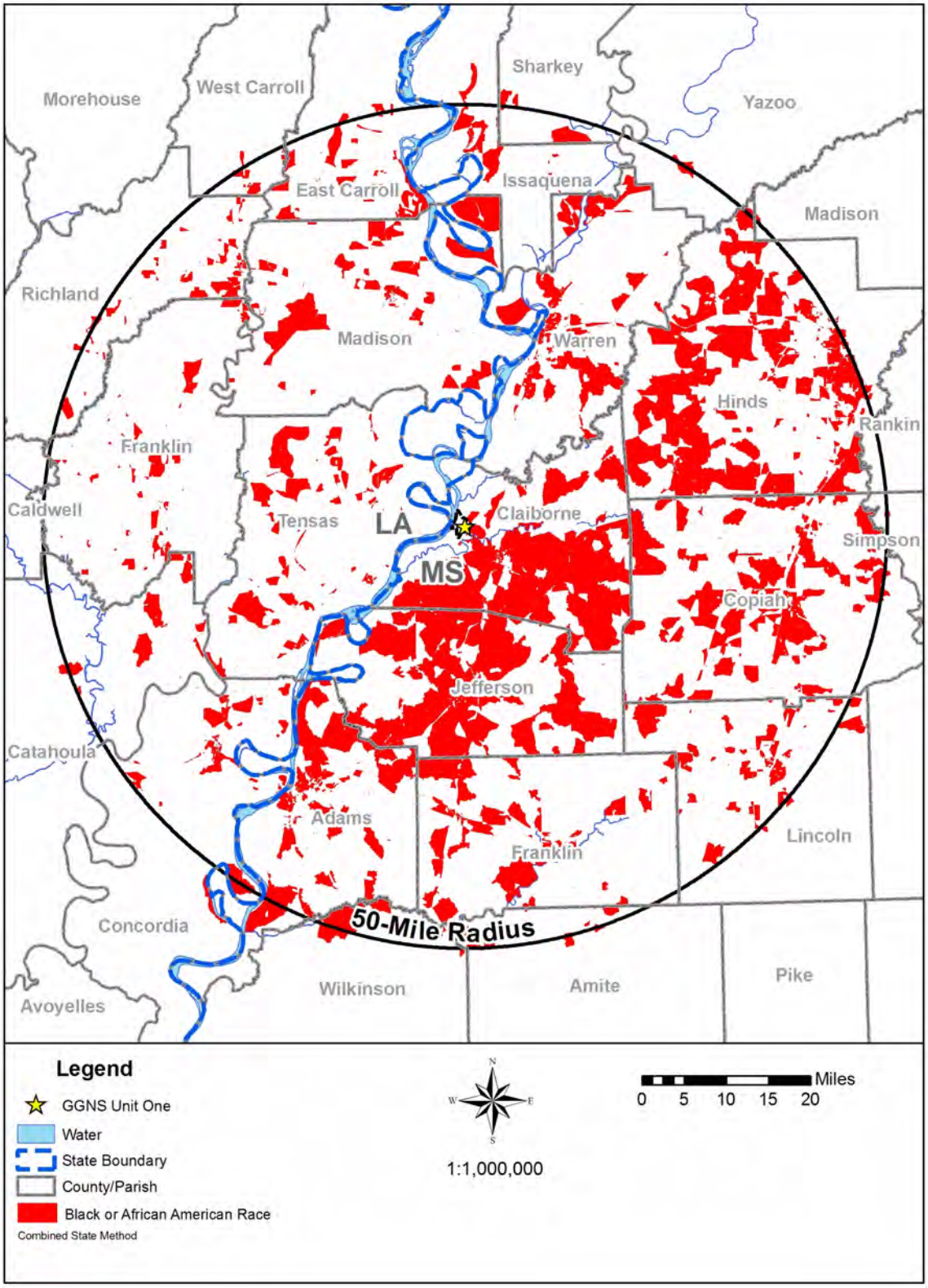


Figure 2.6-2
Census—Black or African American Minority (Combined States)

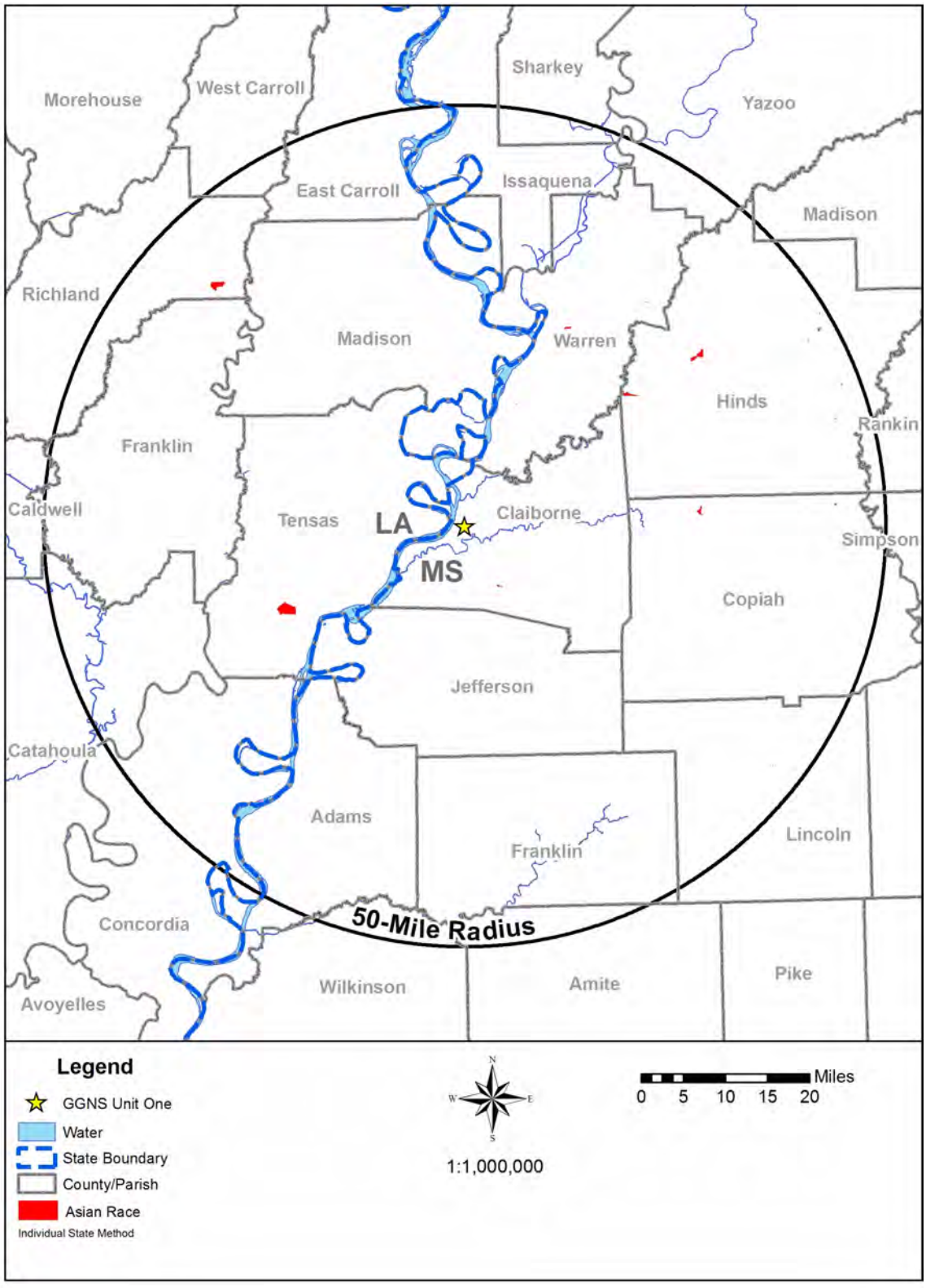


Figure 2.6-3
Census—Asian Minority (Individual States)

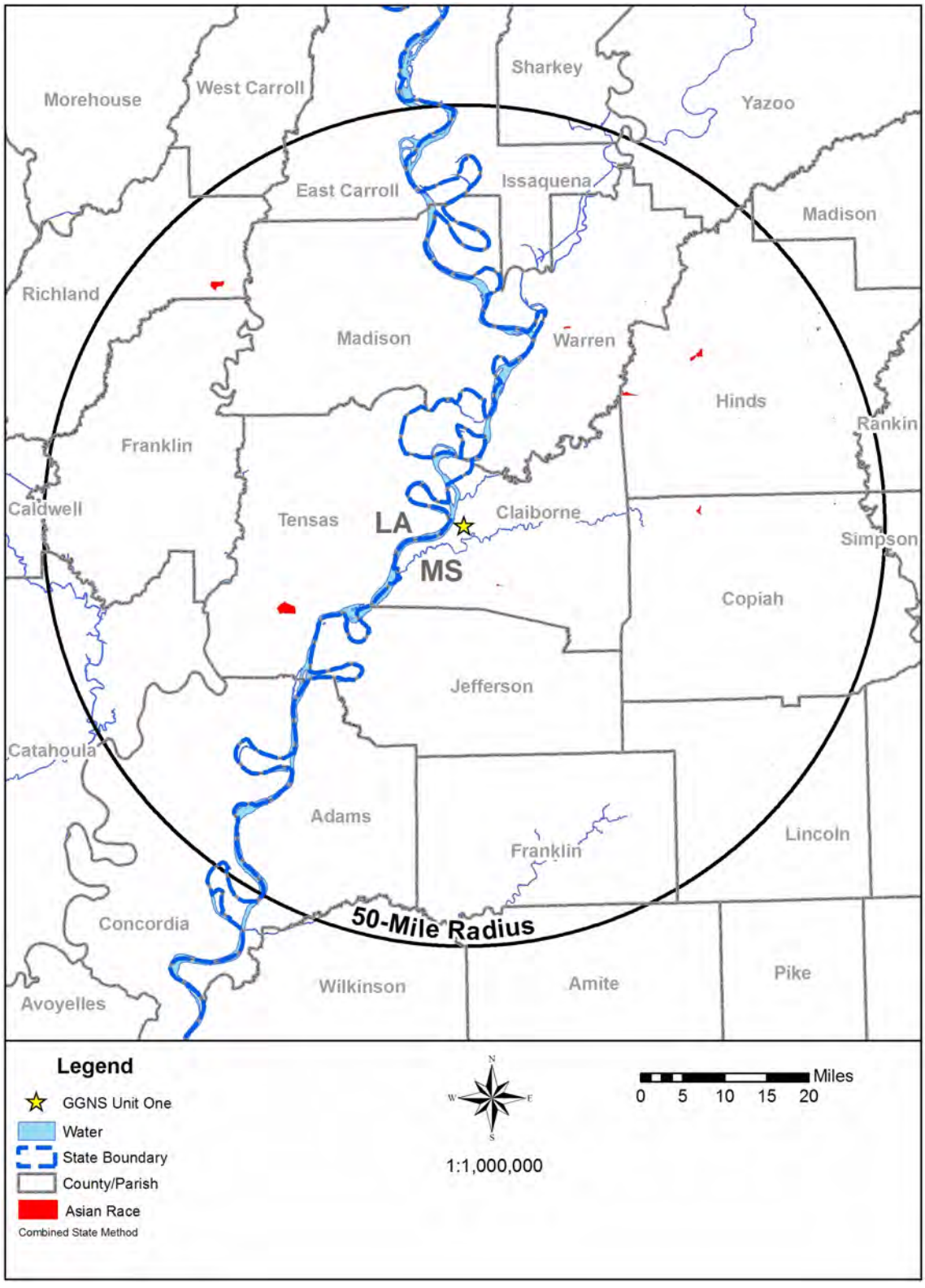


Figure 2.6-4
Census—Asian Minority (Combined States)

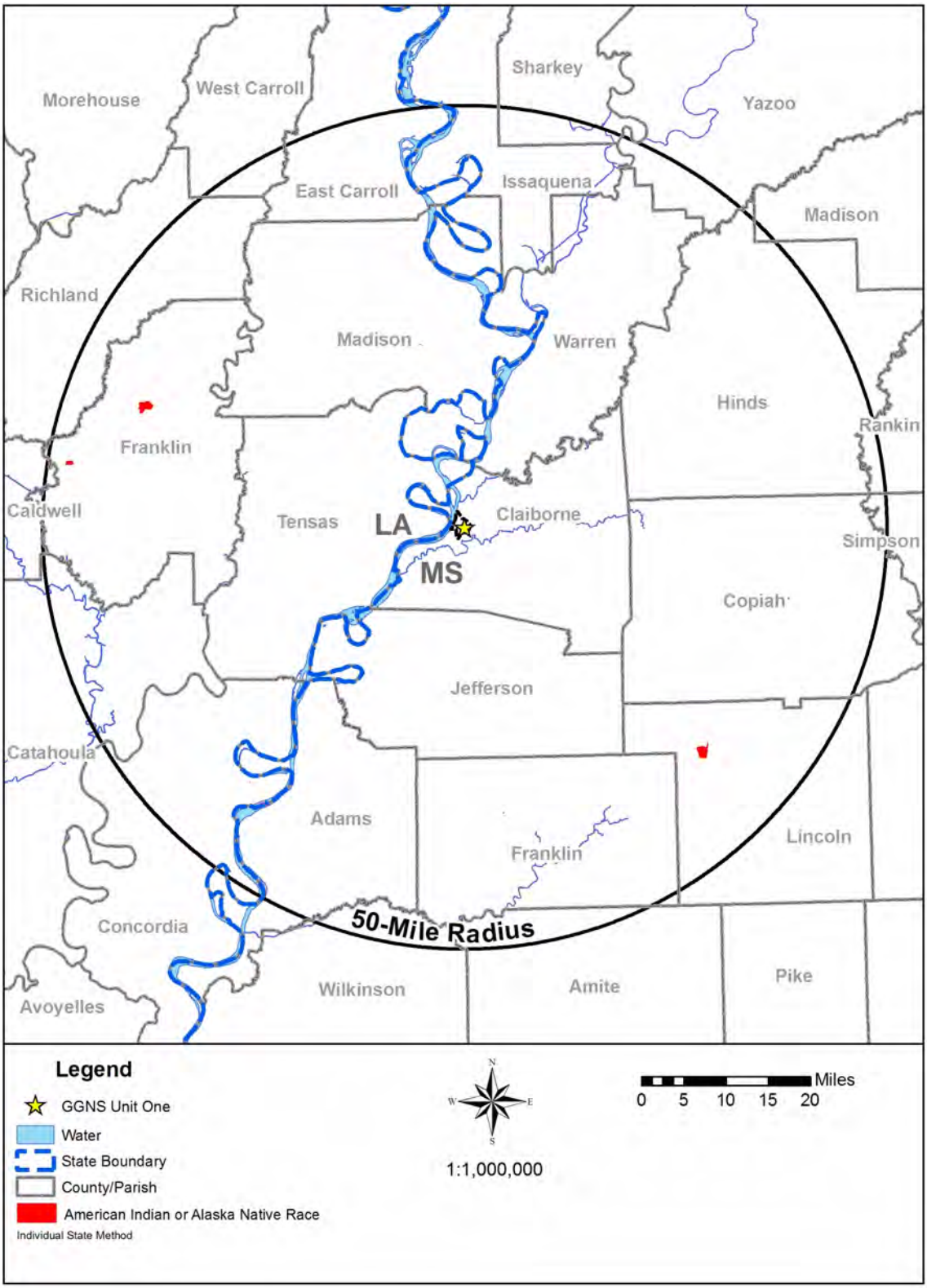


Figure 2.6-5
Census—American Indian or Alaska Native Minority (Individual States)

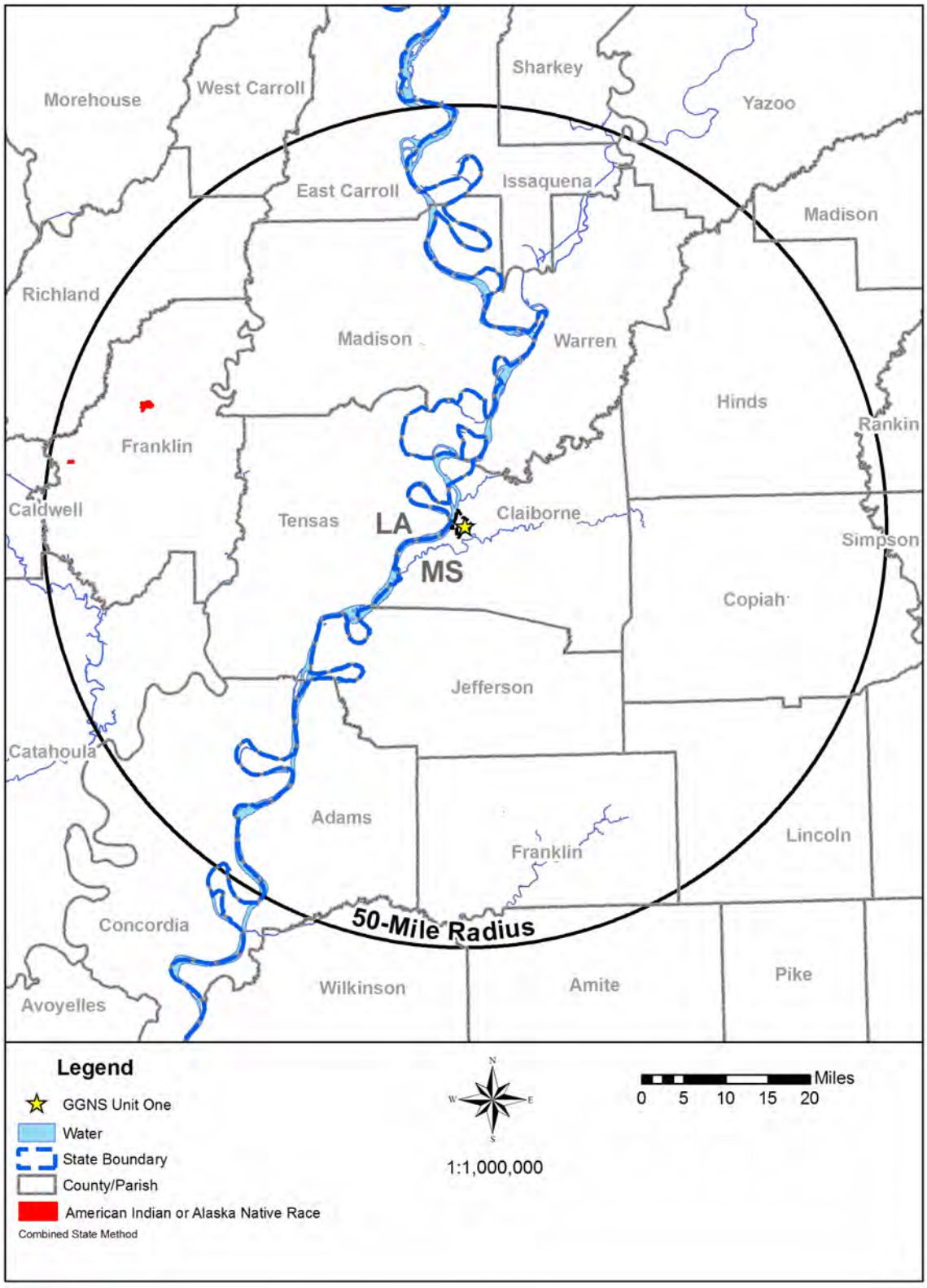


Figure 2.6-6
Census—American Indian or Alaska Native Minority (Combined States)

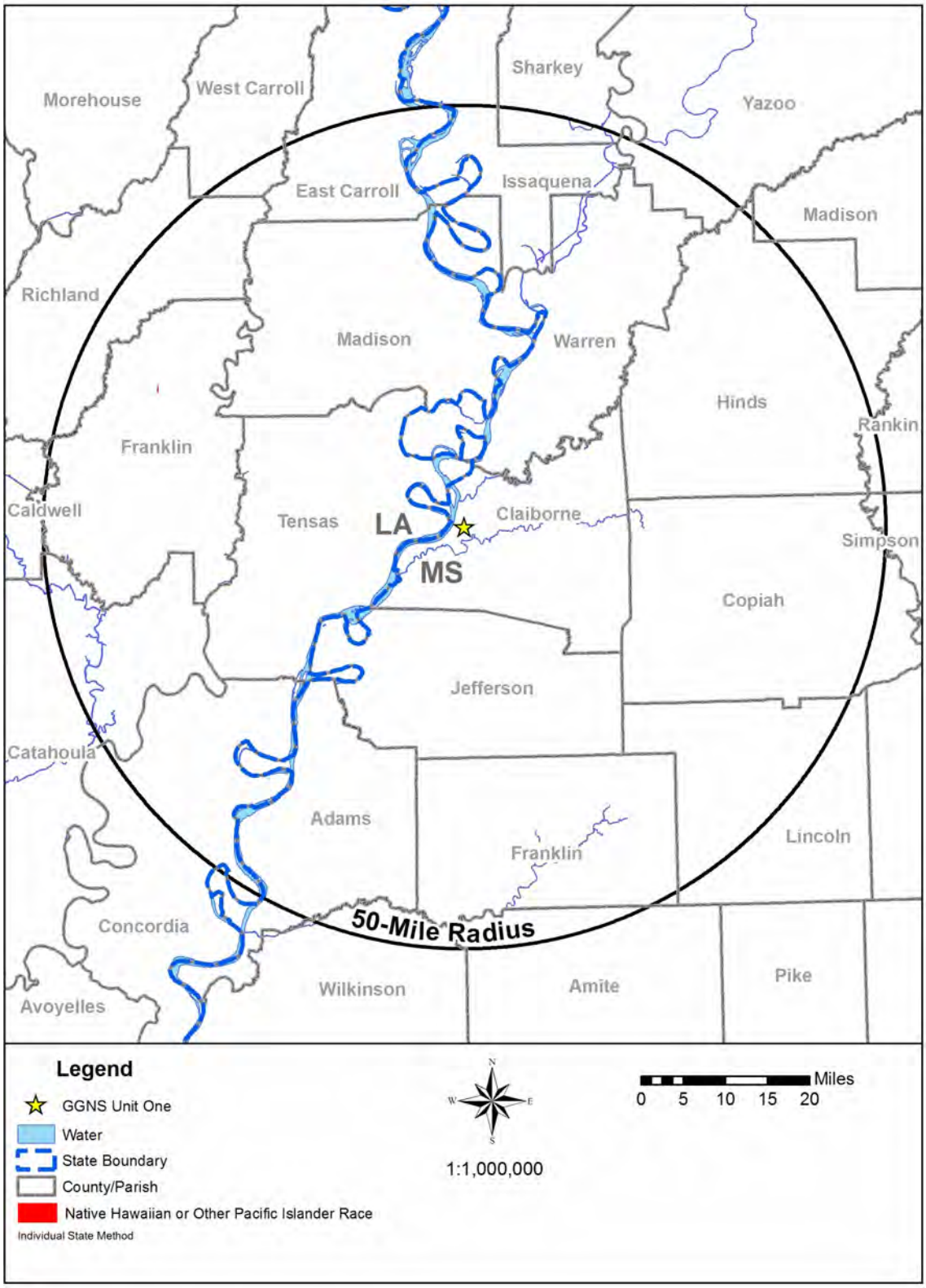


Figure 2.6-7
Census—Native Hawaiian or Other Pacific Islander Minority (Individual States)

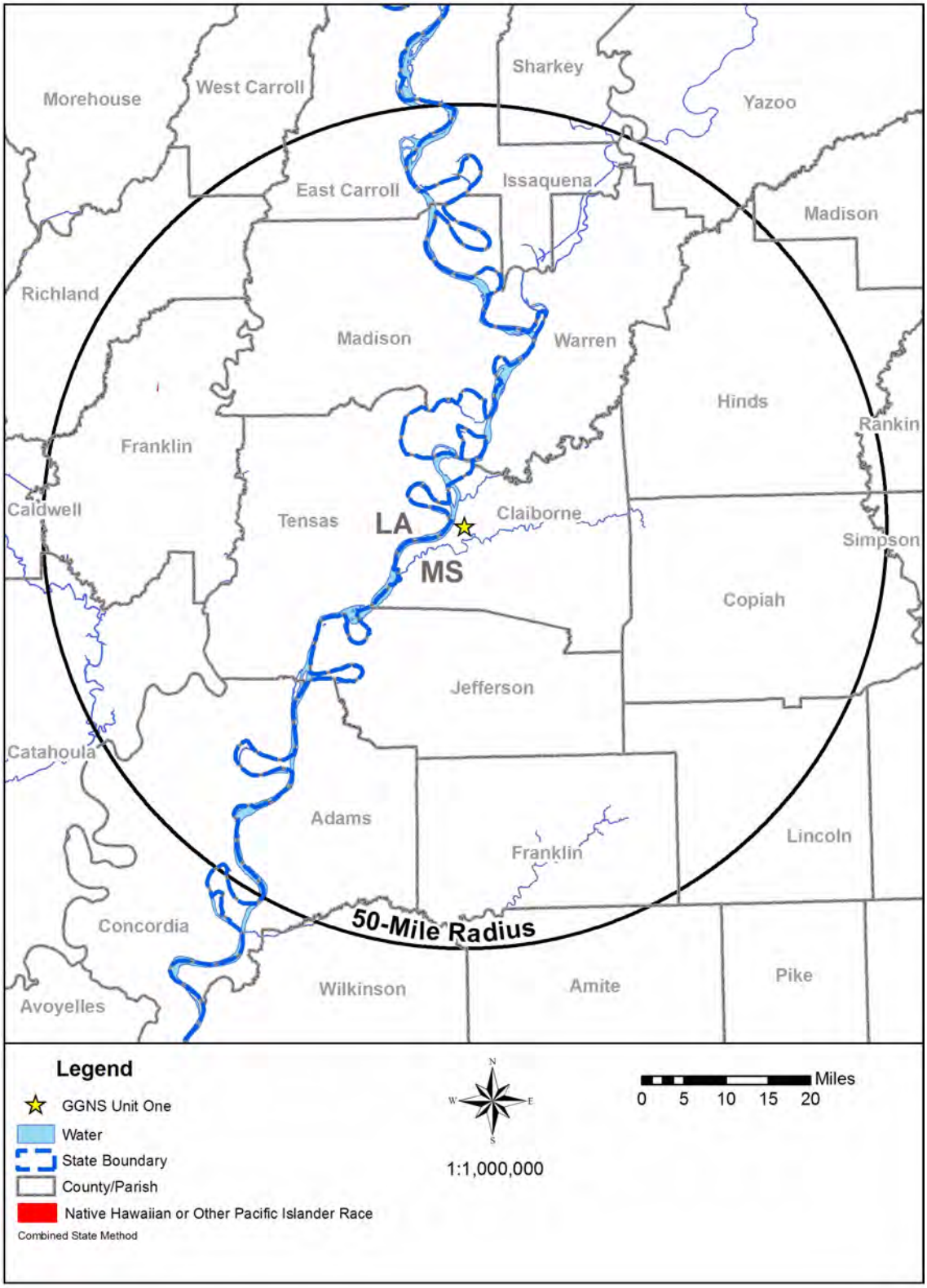


Figure 2.6-8
Census—Native Hawaiian or Other Pacific Islander Minority (Combined States)

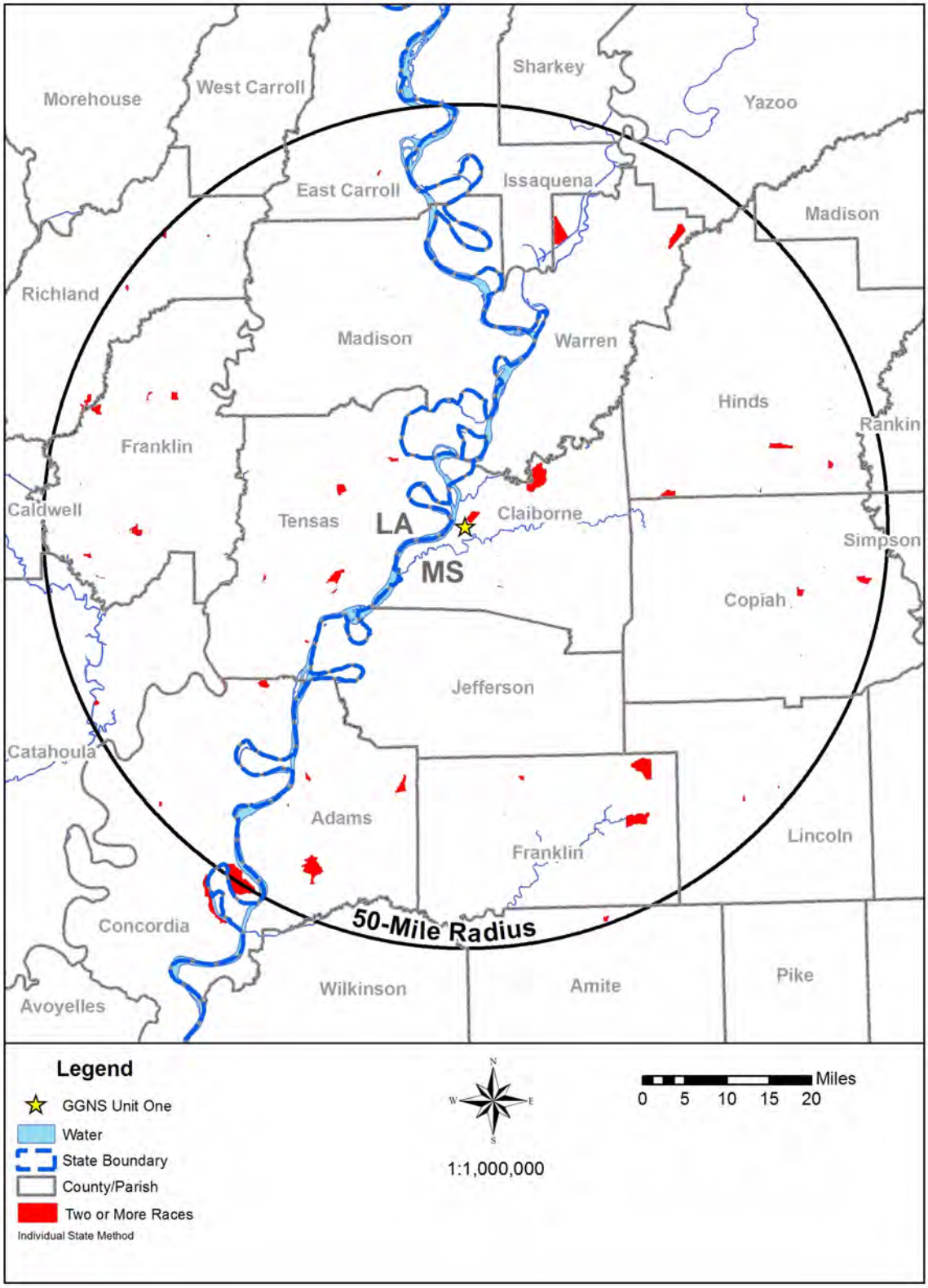


Figure 2.6-9
Census—Two or More Races (Individual States)

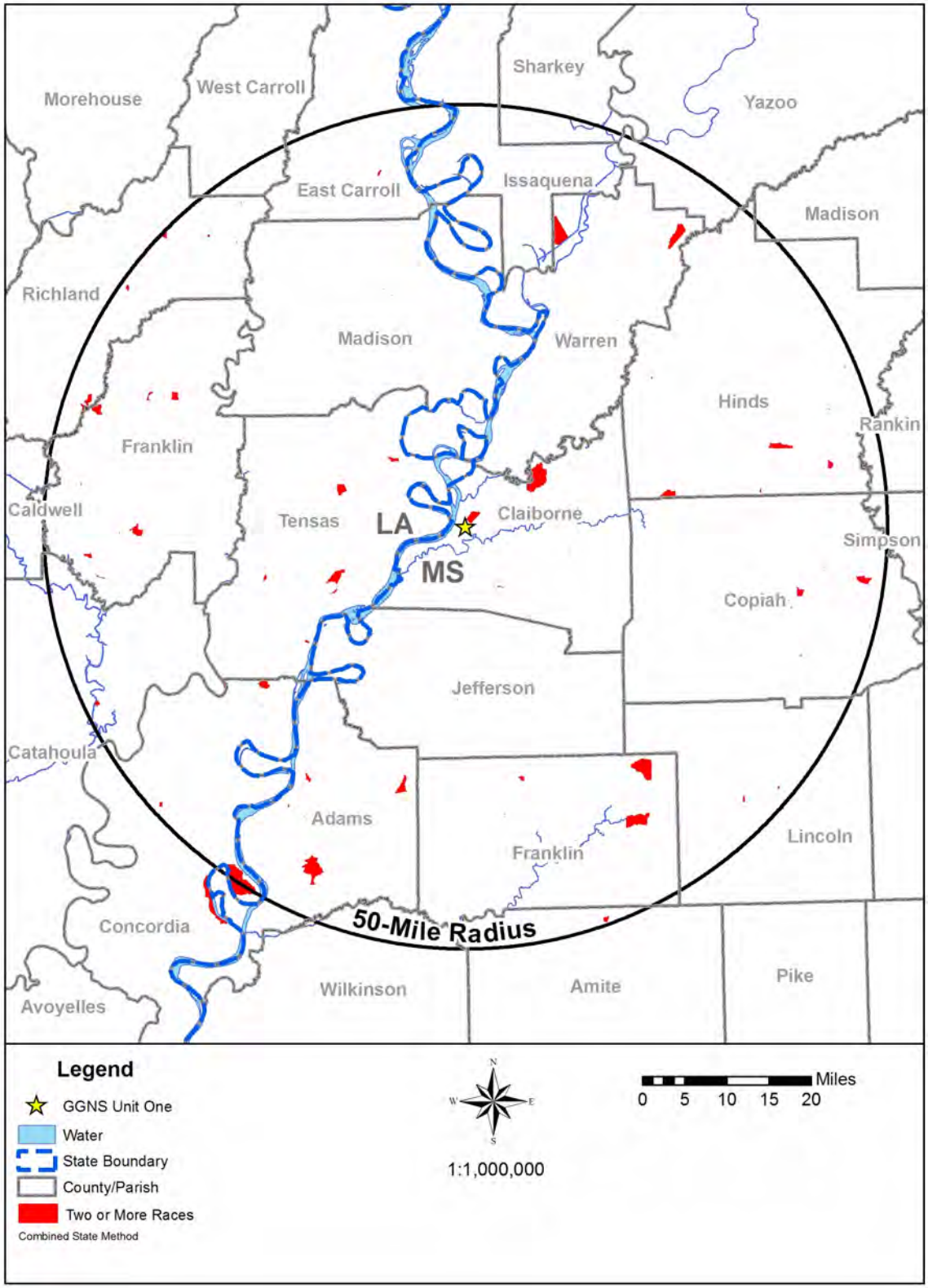


Figure 2.6-10
Census—Two or More Races (Combined States)

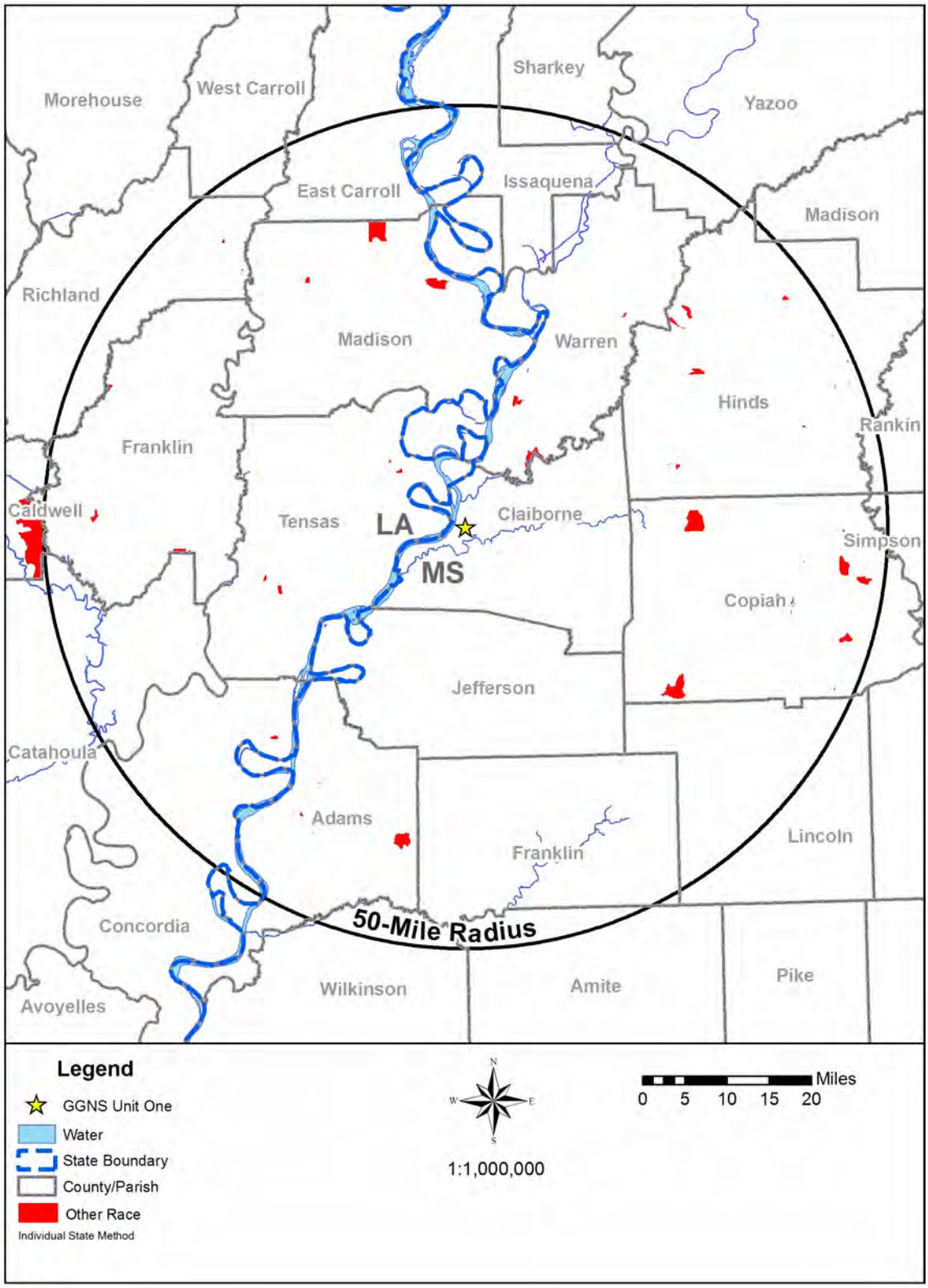


Figure 2.6-11
Census—Other Races (Individual States)

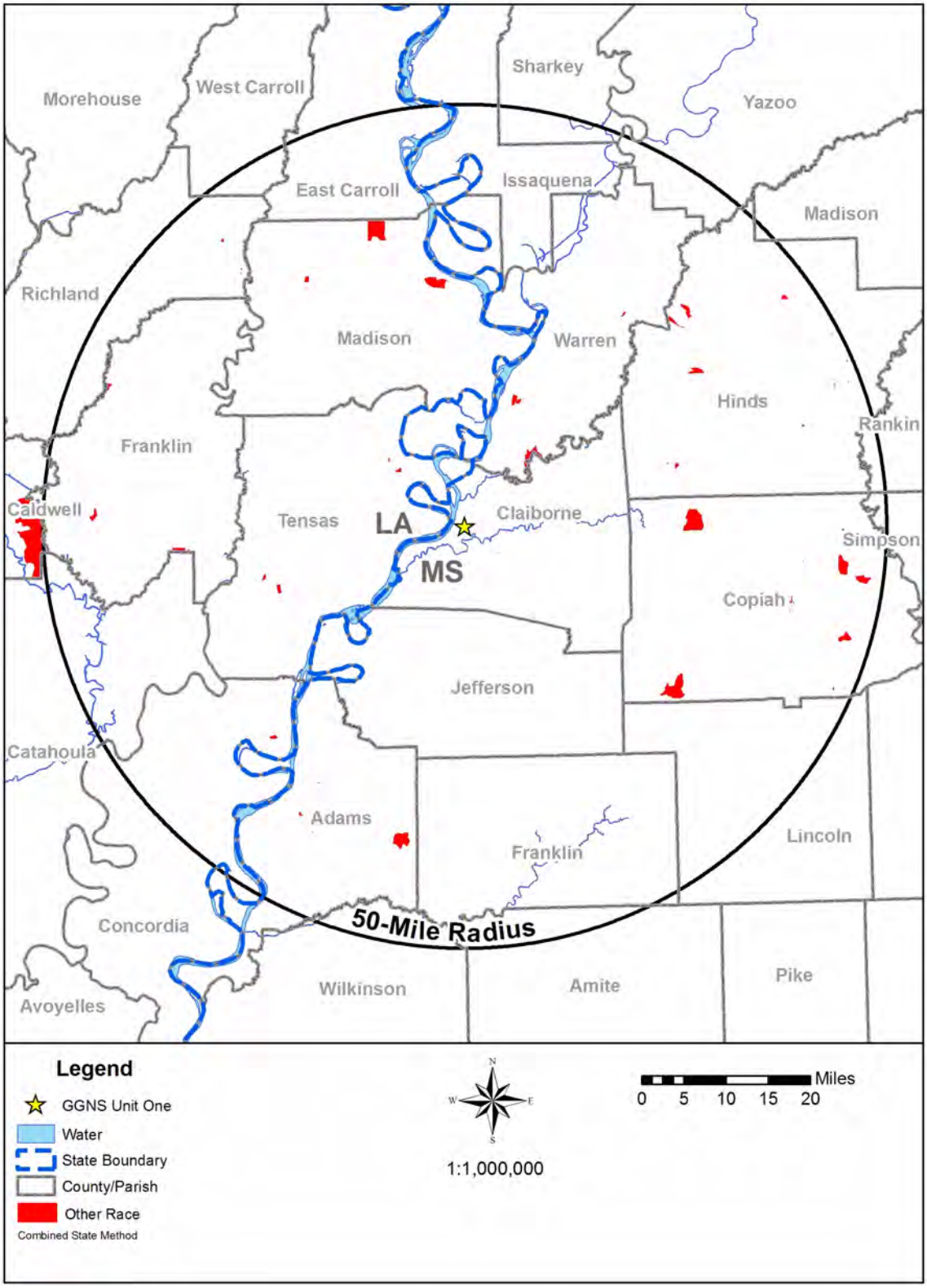


Figure 2.6-12
Census—Other Races (Combined States)

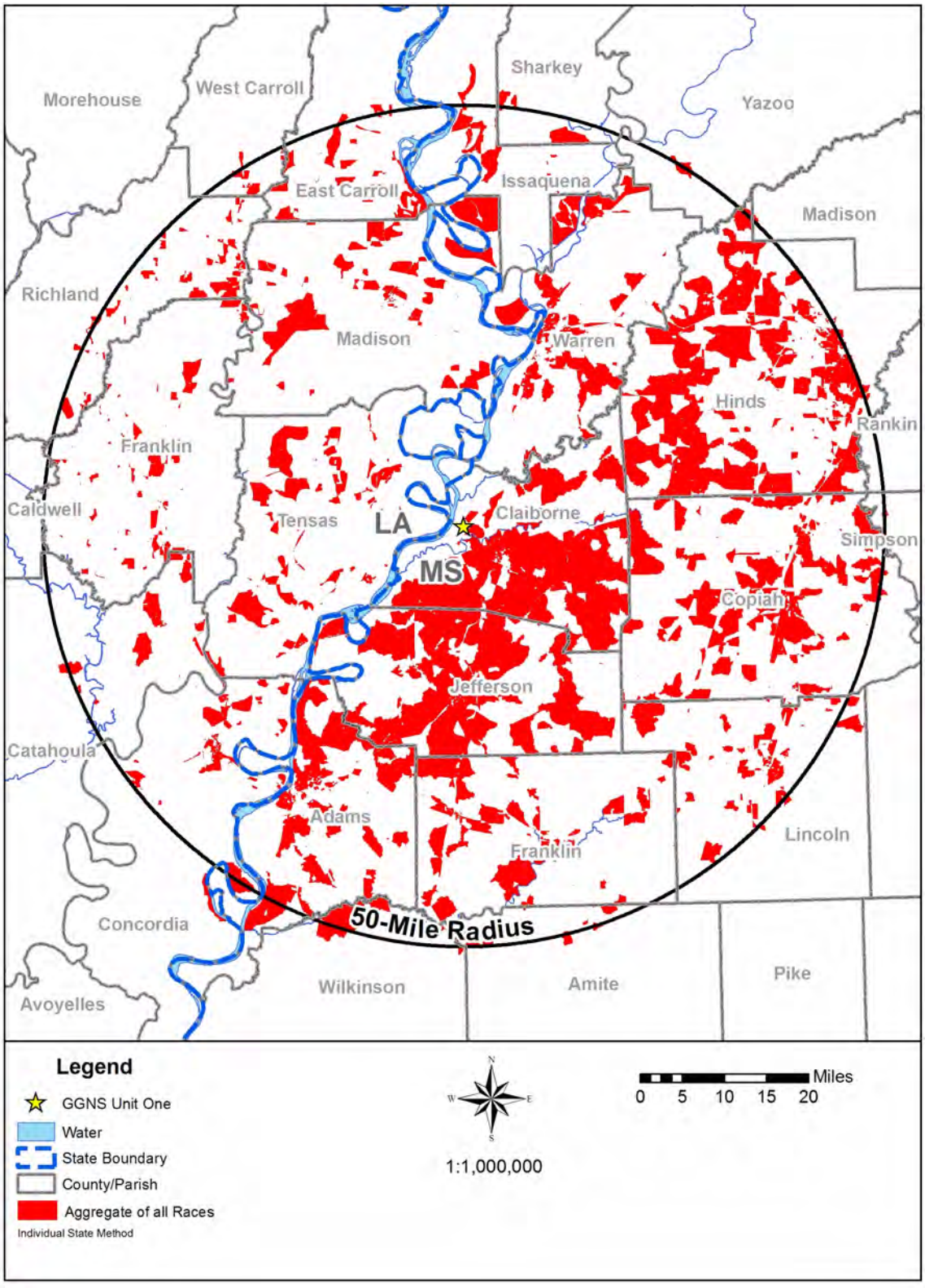


Figure 2.6-13
Census—Aggregate of All Races (Individual States)

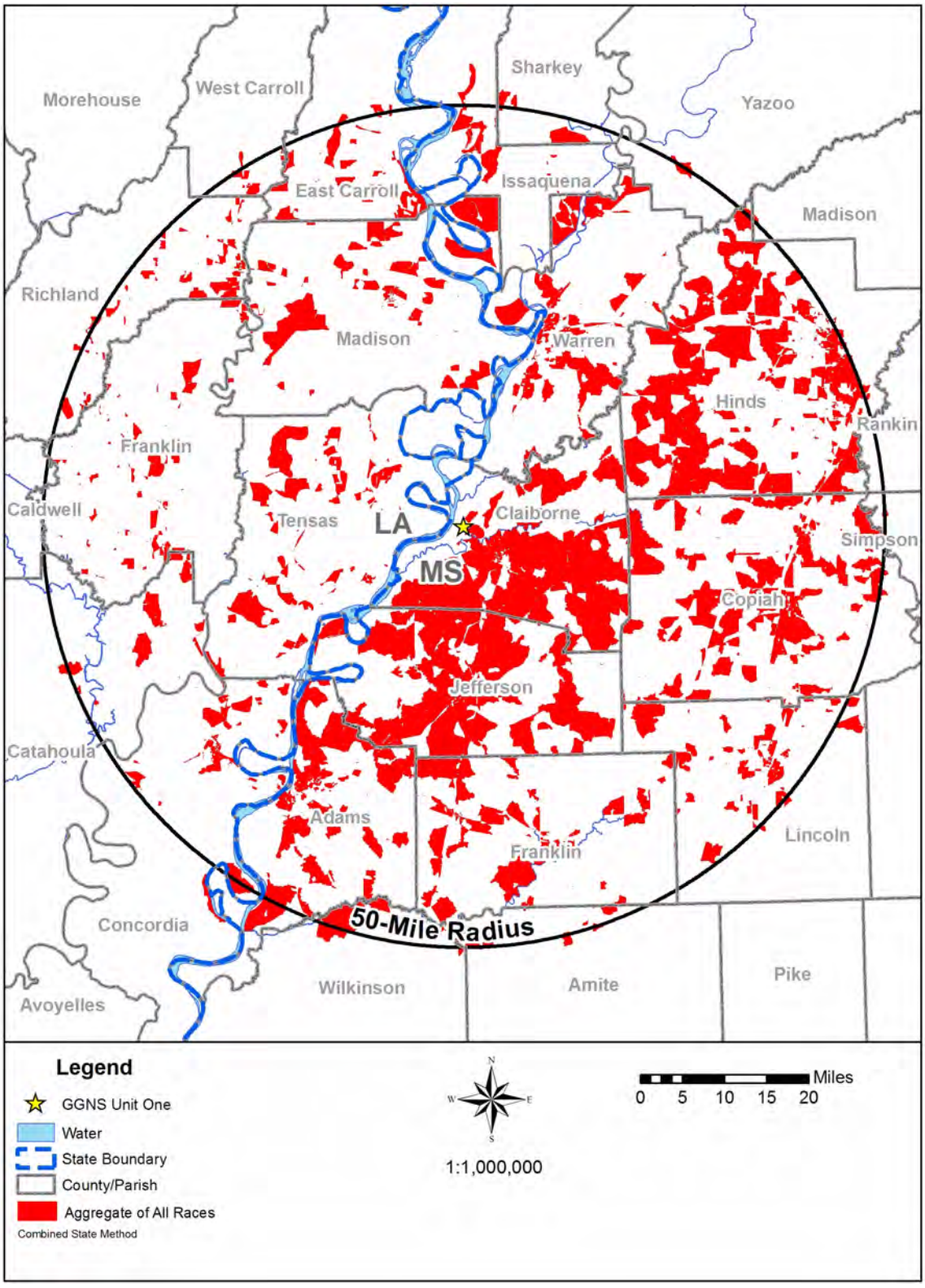


Figure 2.6-14
Census—Aggregate of All Races (Combined States)

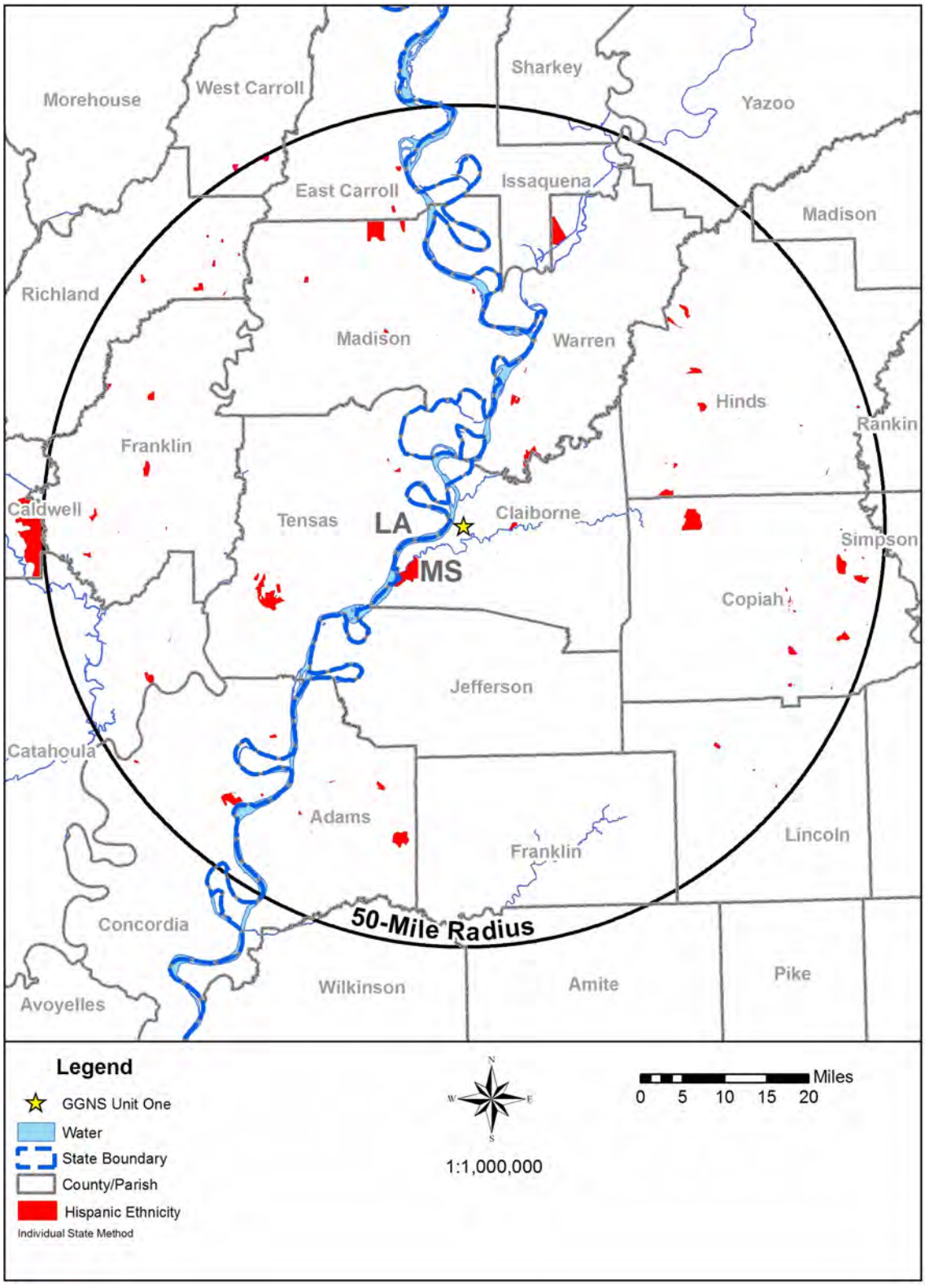


Figure 2.6-15
Census—Hispanic Minority (Individual States)

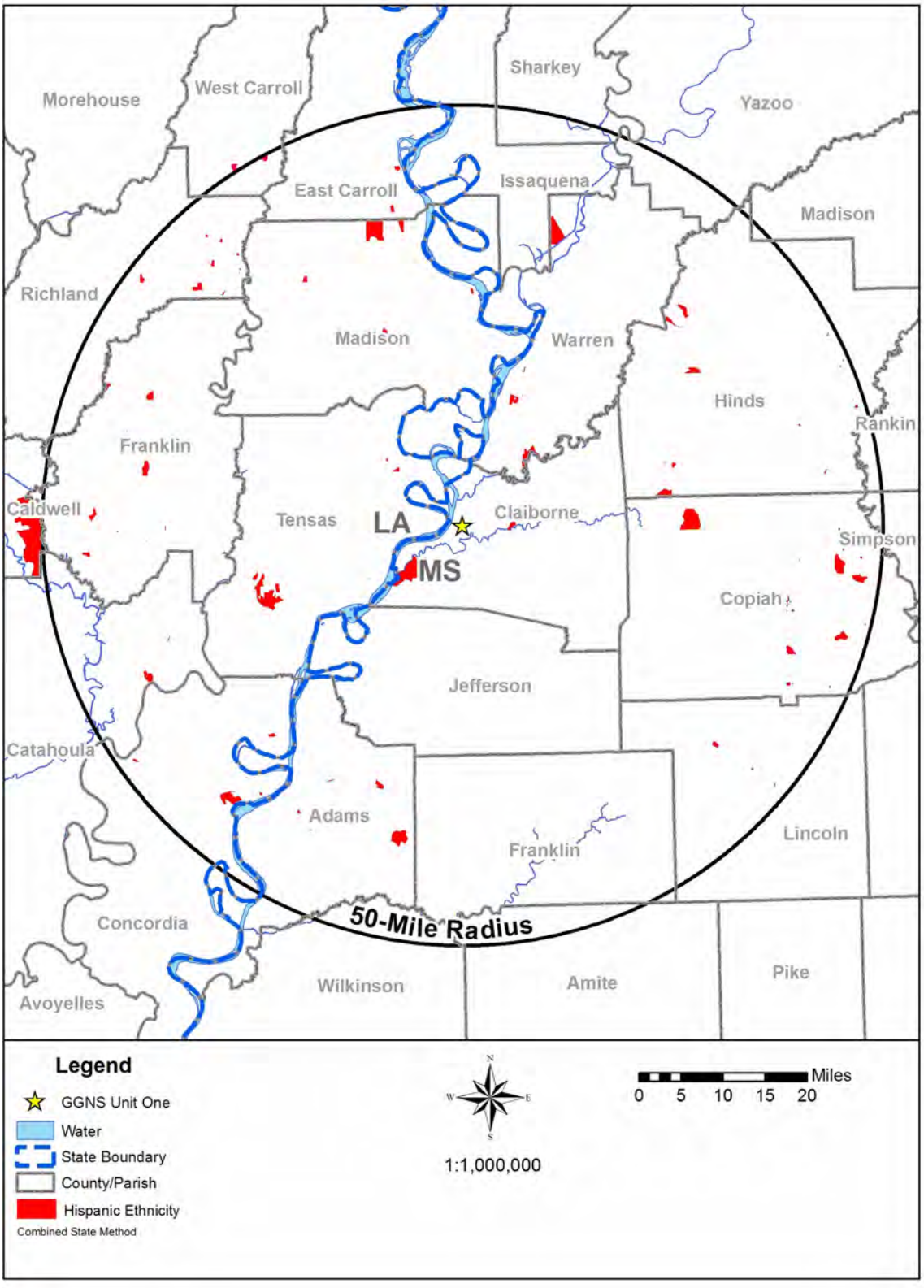


Figure 2.6-16
Census—Hispanic Minority (Combined States)

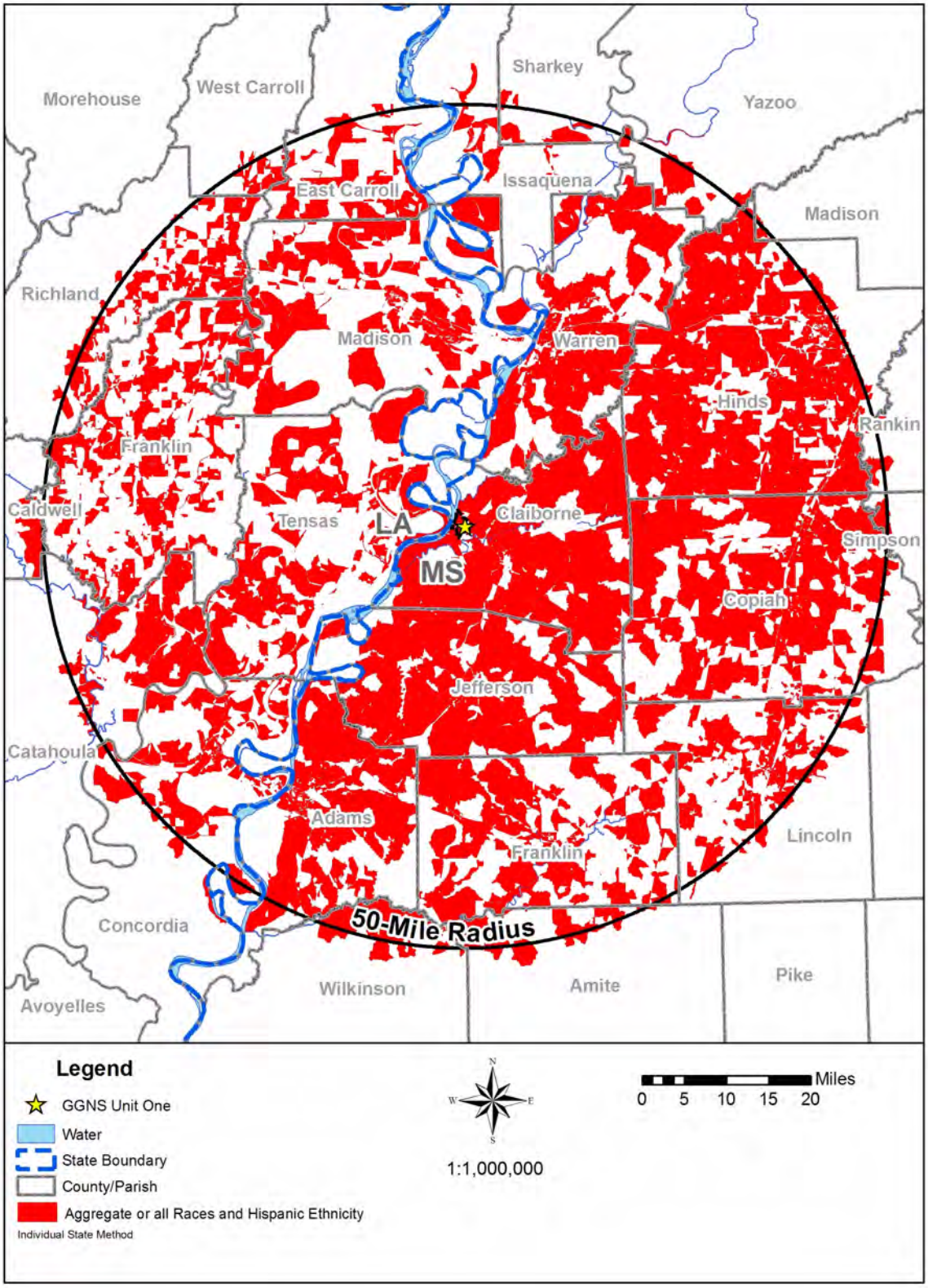


Figure 2.6-17
Census—Aggregate of All Races and Hispanic (Individual States)

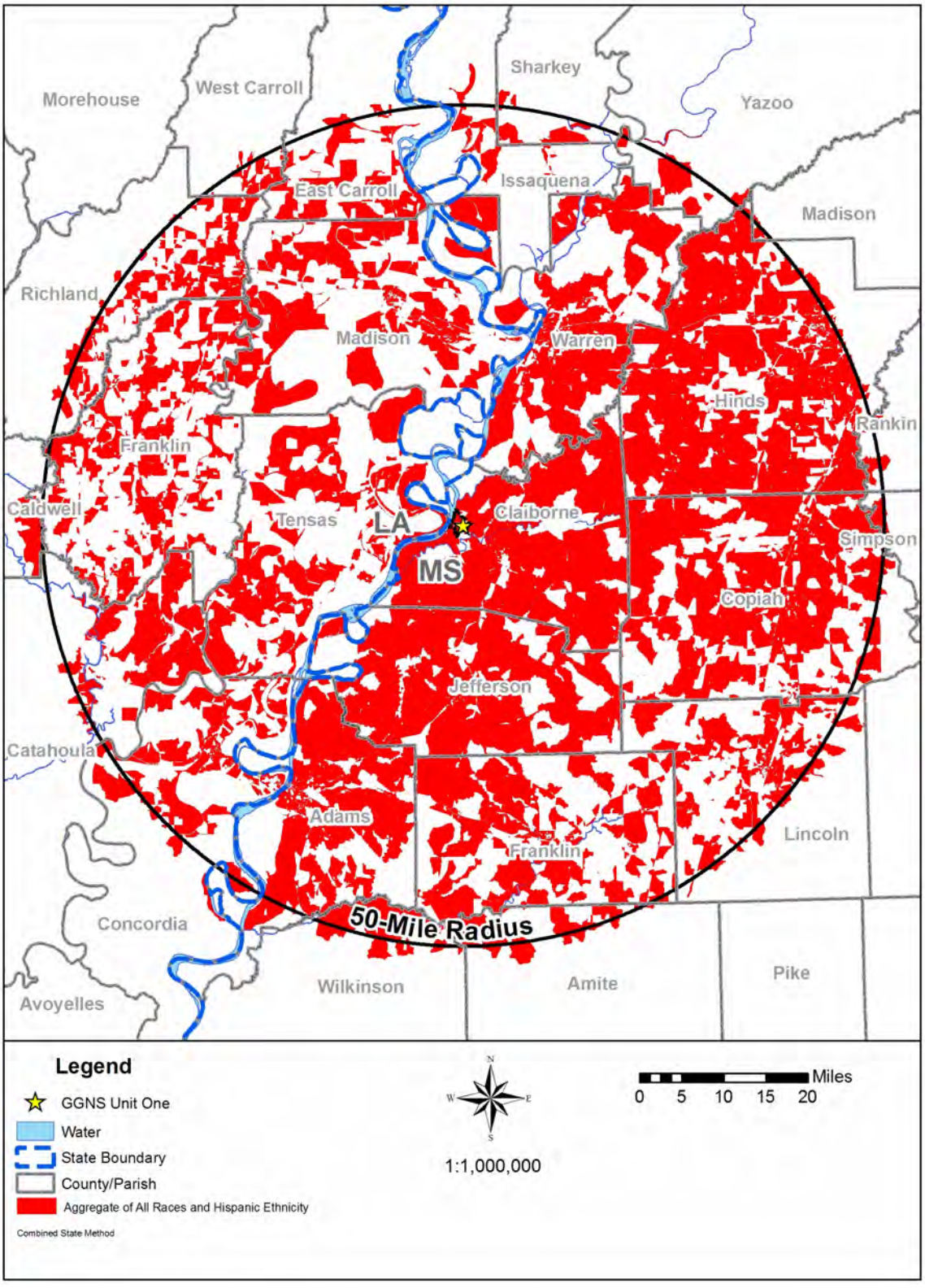


Figure 2.6-18
Census—Aggregate of All Races and Hispanic (Combined States)

2.6.2.3 Low-Income Populations

USNRC guidance defines "low-income" using USCB statistical poverty thresholds [USNRC 2004, pg. D-8]. As addressed above with minority populations, two alternative geographic areas (Louisiana and Mississippi individually and then both states combined) were used in this analysis.

The guidance indicates that a low-income population is considered to be present if either of the two following conditions exists:

(1) The low-income population in the census block group exceeds 50 percent, or.

(2) The percentage of households below the poverty level in a block group is significantly greater (typically at least 20 percentage points) than the low-income population percentage of the geographic area chosen for the comparative analysis (i.e., individual state and two-state combined average).

The 2005–2009 American Community Survey estimates indicate that 18.4 percent of the population of Louisiana, 21.4 percent of the population of Mississippi, and 19.6 percent of the population within the two-state area was composed of low-income individuals as shown in Table 2.6-6 [USCB 2011f]. When Mississippi is used as the geographic area, any census block group in Mississippi within a 50-mile radius of the site with low-income population equal to or greater than 41.4 percent of the total block group population would be considered a "low-income population." Using these criteria for each state, 47 of the 300 census block groups (15.7 percent) within a 50-mile radius of the site have low-income population percentages which meet or exceed the percentages in Table 2.6-6. These census block groups are illustrated in Figure 2.6-19. [USCB 2011f] The closest low-income census block group in Claiborne County (based on the individual state criterion) is located approximately five miles southeast of the site in Port Gibson, Mississippi. This block group contained a total population of 637 individuals.

When the two-state combined area is used as the geographic area, any census block group within a 50-mile radius of the site with low-income populations equal to or greater than 39.6 percent of the total block group population would be considered a "low-income population." Using these criteria, 50 of the 300 census block groups (16.7 percent) were identified within a 50-mile radius of the site, as shown in Figure 2.6-20. [USCB 2011f] There is one identified low-income block group that borders the GGNS property boundary to the northeast with a low-income population percentage that meets or exceeds the percentages listed in Table 2.6-6. It contained a total population of 1,328 individuals.

Table 2.6-6
Low-Income Population Criteria Using Two Geographic Areas

Geographic Area	Total Population	Number of Persons Below Poverty Level	Percentage of Persons Below Poverty Level	Percentage of Low-Income Criterion
Louisiana	4,285,810	789,634	18.4	38.4
Mississippi	2,821,414	604,204	21.4	41.4
Two-state area	7,107,224	1,393,838	19.6	39.6

Reference: USCB 2011f

2.6.2.4 Subsistence Living

NUREG-1817 determined that there were no known studies of subsistence hunting and fishing activities among minority and low-income individuals that directly relate to the nearest counties and to the Mississippi River. [USNRC 2006a, Section 2.10] However, consumption of groundwater, local food, fish, and wildlife does occur within the vicinity of GGNS. All of these pathway receptors are monitored as part of GGNS' REMP.

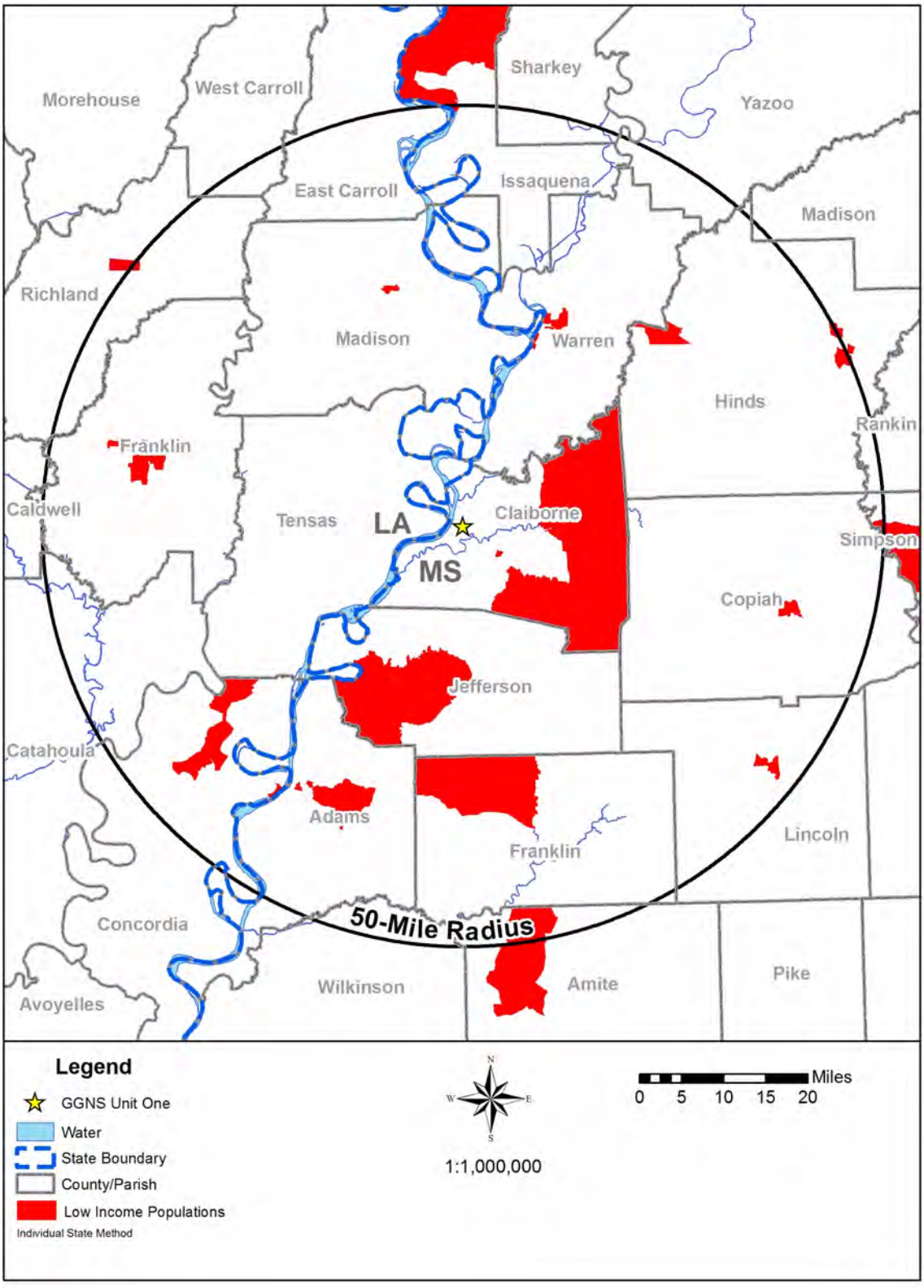


Figure 2.6-19
Census—Low Income (Individual States)

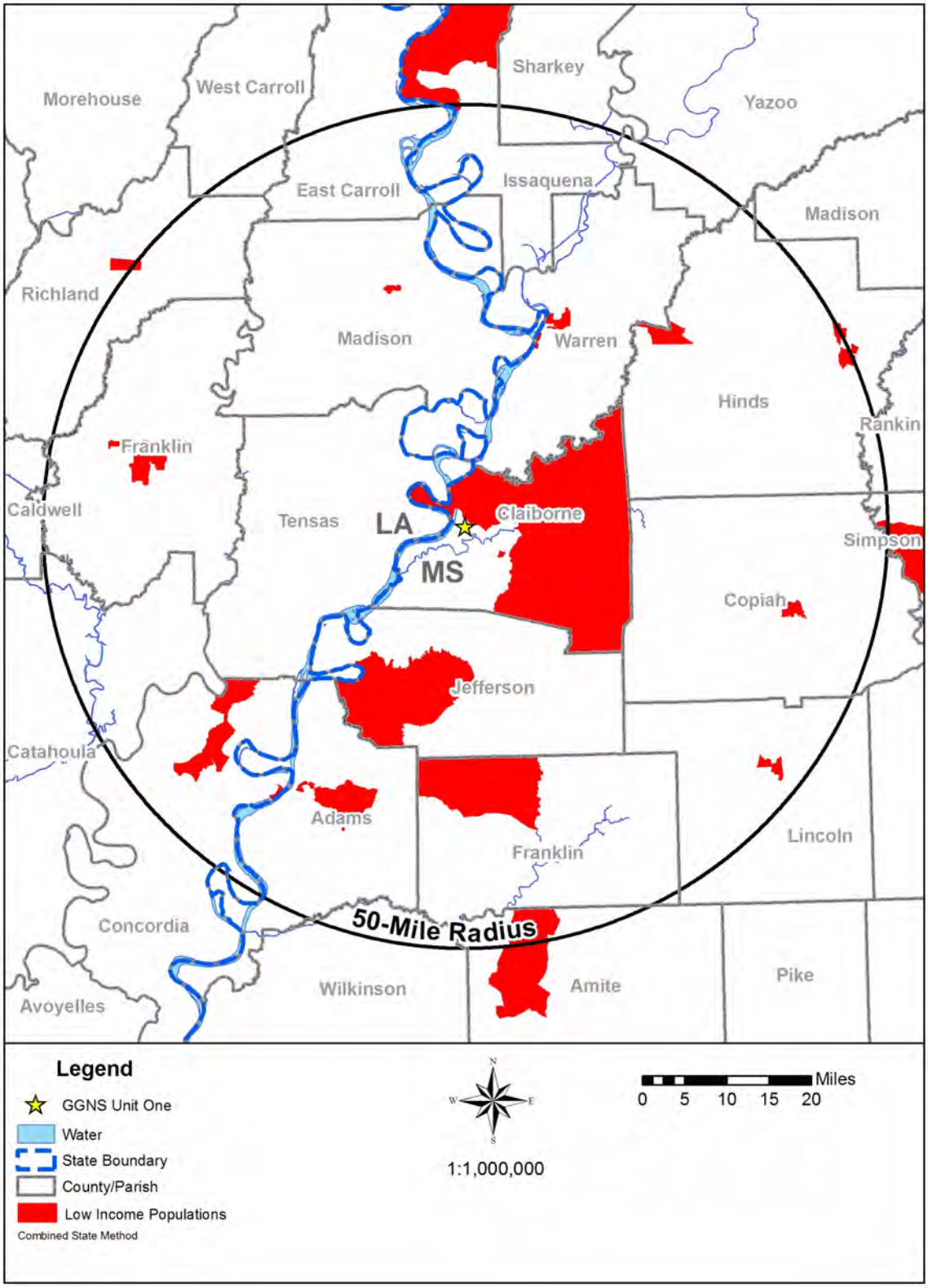


Figure 2.6-20
Census—Low Income (Combined States)

2.7 Taxes

GGNS is one of the largest employers in the region, and the largest single contributor, by far, to the local tax base. In addition, GGNS personnel have higher incomes than the area on average and contribute significantly to the local tax base by payment of sales taxes and property taxes. Many GGNS personnel are actively involved in volunteer work within the local community and contribute to local service agencies. All these activities have a positive impact on the local and regional economies. [GGNS 2010h, Attachment 4, Section 5.6]

GGNS currently employs approximately 690 people on a full-time basis (Table 3.5-1). This workforce is typically augmented by an additional 700–900 persons on average during regularly scheduled refueling outages. Employment at GGNS benefits local and regional economies as employee salaries flow through the communities purchasing goods and services and contributing income, sales, and personal property taxes. [GGNS 2010h, Attachment 4, Section 5.6.1]

Mississippi Code Title 27 addresses taxation of nuclear generating plants and the distribution of tax revenues from nuclear plants (Mississippi Tax Code 2003). This code states that any nuclear generating plant located in the State, which is owned or operated by a public utility rendering electric service within the State, 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 owner pays the Mississippi Department of Revenue (formerly the Mississippi State Tax Commission) a sum based on the assessed value of the nuclear generating plant. Based upon this assessment, the generating plant is taxed 2 percent of its assessed value, or $20,000,000, whichever is greater. GGNS currently pays $20,000,000 annually to the Department of Revenue. [Entergy 2010b; USNRC 2006a, Section 2.8.2.3]

The Department then distributes this revenue in accordance with the Mississippi Tax Code. At least $7.8 million of this revenue goes to Claiborne County, of which $3 million is allocated contingent upon Claiborne County upholding its commitment to the GGNS offsite emergency plan. The $7.8 million represents roughly 83 percent of all Claiborne County revenues. [Entergy 2010b; USNRC 2006a, Section 2.8.2.3]

The Department transfers $160,000 annually to the Town of Port Gibson provided that the city maintains its commitment to the GGNS offsite emergency plan. Ten percent of the remainder of the payment is dedicated to the General Fund of the State. The balance of the tax revenue from the GGNS site 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 20percent of the funds (Mississippi Tax Code 2003). This distribution, based on energy consumed, also includes Claiborne County. [Entergy 2010b; USNRC 2006a, Section 2.8.2.3]

2.8 Land Use Planning

Land use planning focuses on Claiborne, Hinds, Jefferson, and Warren counties in Mississippi since the operation of GGNS is important to the economy of these counties as a result of the 690 people employed at GGNS, of which 81 percent reside in these four counties.

2.8.1 Existing Land Use Trends

The four-county area near GGNS is generally rural in character and largely unincorporated. More than half of the population in Hinds County and almost half of the population in Warren County live in incorporated cities, while less than half of the population in Claiborne and Jefferson counties live in incorporated towns. According to Table 2.8-1, forested areas occupy most of the land area in the four-county area. In the counties of Claiborne, Jefferson, and Warren, land use areas identified as crops and grassland, along with open water and wetlands, comprise more of the three-county area than lands dedicated to development. In Hinds County, there are more areas identified as grass and cropland than areas identified as developed lands, but there are more developed land areas than identified water and wetlands (Table 2.8-1).

Claiborne County occupies approximately 487 square miles of land (311,489 acres) [USDA 2010a, Table 8; USCB 2010d]. Approximately 93,932 acres, or 30.2%, of the land in Claiborne County was used for agriculture in 2007. The county had 261 farms with most of the agricultural land devoted to woodland (54.77%), cropland (28.30%), and pasture (13.37%). Major agricultural crops produced in the county include corn for grain (7,147 acres, or 7.6%), forage (4,893 acres, or 5.2%), and soybeans for beans (1,300 acres, or 1.4%). Major livestock commodities are cattle and calves. [USDA 2010a; USDA 2010b] As reflected in Table 2.8-1, all developed land areas cover approximately 3.83% of the 311,489 acres in Claiborne County. [MRLCC]

Jefferson County occupies approximately 519 square miles of land (332,408 acres). [USDA 2010a, Table 8; USCB 2010d] Approximately 100,477 acres, or 30.2%, of the land in Jefferson County was used for agriculture in 2007. The county had 356 farms with most of the agricultural land devoted to woodland (46.89%), cropland (35.09%), and pasture (15.46%). Major agricultural crops produced in the county include cotton (7.090 acres, or 7.1%), forage (4,941 acres, or 4.9%), and corn for grain (3,897 acres, or 3.9%). Major livestock commodities are broilers and other meat type chickens, layers, and cattle and calves. [USDA 2010a; USDA 2010b] As reflected in Table 2.8-1, all developed land areas cover approximately 3.76% of the 332,408 acres in Jefferson County. [MRLCC]

Hinds County occupies approximately 869 square miles of land (556,238 acres). [USDA 2010a, Table 8; USCB 2010d] Approximately 260,096 acres, or 46.8%, of the land in Hinds County was used for agriculture in 2007. The county had 1071 farms with most of the agricultural land devoted to woodland (44.11%), cropland (28.81%), and pasture (17.95%). Major agricultural crops produced in the county include forage (16,136 acres, or 6.2%), corn for grain (14,471 acres, or 5.6%), cotton (7,990 acres, or 3.1%), and soybeans for beans (3,650 acres, or 1.4%). Major livestock commodities are layers and pullets for laying flock replacement, cattle and calves, and horses and ponies. [USDA 2010a; USDA 2010b] As reflected in Table 2.8-1, all

developed land areas cover approximately 13.32% of the 556,238 acres in Hinds County. [MRLCC]

Warren County occupies approximately 587 square miles of land (375,473 acres). [USDA 2010a, Table 8; USCB 2010d] Approximately 111,913 acres, or 29.8%, of the land in Warren County was used for agriculture in 2007. The county had 278 farms with most of the agricultural land devoted to woodland (50.19%), cropland (37.57%), and pasture (5.72%). Major agricultural crops produced in the county include corn for grain (12,454 acres, or 11.1%), soybeans for beans (10,384 acres, or 9.3%), cotton (4,642 acres, or 4.1%), forage (3,092 acres, or 2.8%), and wheat for grain (2,388 acres, or 2.1%). Major livestock commodities are cattle and calves, layers, and hogs and pigs. [USDA 2010a; USDA 2010b] As reflected in Table 2.8-1, all developed land areas cover approximately 6.48% of the 375,473 acres in Warren County [MRLCC].

Table 2.8-1
Land Use in Claiborne, Jefferson, Hinds, and Warren Counties, MS, 2010

Description	Claiborne	Jefferson	Hinds	Warren
Barren land (Rock/Sand/Clay)	0.20	0.10	0.12	0.27
Cultivated crops	3.20	4.80	7.90	13.80
Deciduous forest	46.14	36.38	23.23	37.73
Developed, high intensity	0.01	0.00	0.57	0.15
Developed, low intensity	0.29	0.22	3.89	1.00
Developed, medium intensity	0.07	0.03	1.53	0.45
Developed, open space	3.46	3.51	7.33	4.88
Emergent herbaceous wetland	0.36	0.21	0.21	0.62
Evergreen forest	6.29	12.57	5.90	0.32
Grassland/herbaceous	0.04	0.03	0.02	0.01
Mixed forest	8.67	15.53	7.91	1.86
Open Water	2.84	1.53	1.32	5.37
Pasture/hay	7.05	3.82	20.18	2.64
Scrub/shrub	9.90	13.75	12.38	3.72
Woody wetlands	11.47	7.51	7.53	27.20
Total Percent	**100**	**100**	**100**	**100**

Reference: MRLCC

As discussed in Section 2.6, Claiborne, Hinds, Jefferson, and Warren counties have all seen a steady decline in total population as more residents leave for other employment opportunities across the state and nation. Many of the towns located within a 50-mile radius of GGNS are small and located in a rural setting. The closest developed community to GGNS is the Town of Port Gibson, located approximately five miles southeast of the plant. The population of Port Gibson in 2010 was approximately 1,567 (Table 2.6-3). The town occupies 1.76 square miles (1,126.4 acres) and is residential in nature [City-Data]. The largest nearby city, Vicksburg, Mississippi, located 25 miles north of GGNS in Warren County, had a population of 23,856 in 2010 (Table 2.6-3). Vicksburg occupies 32 square miles (20,480 acres) and is located on Interstate 20 and the Mississippi River, with some industry and a river port that acts as a US customs port of entry (Section 2.10.2) [USCB 2010d]. Major land uses for the four-county area are shown in Table 2.8-1.

2.8.2 Future Land Use Trends

As previously discussed, Claiborne, Hinds, Jefferson, and Warren counties have all seen a steady decline in total population. Many of the town and city populations are also in decline and range from small (Fayette and Port Gibson) to larger urbanized areas (Vicksburg and Jackson). While a large percentage of the land in the four-county area is dedicated to agriculture, the largest employers in three of the four counties are associated with education, state government, medical, and industrial or manufacturing (Section 2.10.6). Population density in the fifty-mile region of GGNS is low.

The State of Mississippi zoning statutes are defined in the Mississippi Code of 1972, as amended. Chapter 1 of Title 17 empowers the governing authority of any municipality, and, with respect to the unincorporated part of any county, the governing authority of any county, in its discretion, to regulate, restrict, or prohibit the erection, construction, reconstruction, alteration, or use of nonfarm buildings or structures and the use, conditions of use, and/or occupancy of land. [MC] Mississippi counties and municipalities that wish to have a zoning ordinance and official zoning map are required by state law to prepare a comprehensive plan upon which they can base their zoning. [CMPDD] The purposes behind zoning regulations, as outlined in the Mississippi code, are to prevent the overcrowding of land; to avoid undue concentration of population; and to facilitate the adequate provision of transportation, water, sewerage, schools, parks, and other public requirements [MC].

Hinds County has well developed zoning and land use plans in place. Specifically, Hinds County has adopted land use planning regulations and zoning to manage future growth and development outside the municipal boundaries of various cities in Hinds [HC]. As of 2008, Hinds County consistently experienced a net loss of residents over a 15 year period, as compared to surrounding counties such as Rankin and Madison. Manufacturing, agriculture, and forestry only have a small influence on Hinds County's economy. Economic development strategies in Hinds County are currently focused on new business recruitment and expansion or retention of local firms. [HCEDD 2010a, pgs. 68 and 74] The City of Jackson also has its own zoning department regulating land use and development within city limits [JM].

To date, Claiborne County has no active county zoning in place, but the county recently prepared a comprehensive land use plan to prevent the overcrowding of land; to avoid undue concentration of population; and to facilitate the adequate provision of transportation, water, sewerage, schools, parks, and other public requirements [Enercon 2010a]. The Town of Port Gibson, located in Claiborne County, does have zoning and planning within its municipal boundaries [Enercon 2010b]. Jefferson County does not have a developed land use or zoning plan, but does have authority over the construction of cell phone towers in the county. The Town of Fayette, the only incorporated town in Jefferson County, does have some zoning regulations [Enercon 2010c]. The City of Vicksburg, located in Warren County, has an older comprehensive plan and does regulate zoning; however, Warren County does not currently have county-wide zoning, nor does it have an active comprehensive land use plan [Enercon 2010d; VM].

Each of the four counties are also members of regional economic development organizations, whose focus is to help bring new business into member counties. Hinds and Warren counties are members of the Central Mississippi Planning and Development District, and Claiborne and Jefferson counties are members of the Southwest Mississippi Partnership. [MDA 2010a] While actively pursuing economic development opportunities, no significant changes to future agricultural acreage, farm size, and land uses are anticipated for the four-county region.

2.9 Housing

As of November 2009, GGNS has a permanent staff of approximately 690 employees (Table 3.5-1). Approximately 81% of GGNS employees reside in Claiborne, Hinds, Jefferson, and Warren counties in Mississippi. Specifically, approximately 35% reside in Warren County, 21% in Claiborne County, 14% in Hinds County, and 12% in Jefferson County. The remaining employees live in outlying counties, with only a small number of employees living in Louisiana or other states.

Between 2000 and 2010, the total population for the four counties near the GGNS site has generally decreased (Table 2.6-1). The population decreased from 11,831 to 9,604 in Claiborne County, from 250,800 to 245,285 in Hinds County, from 9,740 to 7,726 in Jefferson County, and from 49,644 to 48,773 in Warren County. [USCB 2010a; USCB 2011c]

Available housing in the four-county area generally increased between 2000 and 2010, as shown in Table 2.9-1, although the 2010 census data show small available housing declines in Claiborne and Jefferson counties [USCB 2010e; USCB 2011g]. Between the years 2000 and 2010, the housing vacancy rates in Hinds County, which contains a portion of the City of Jackson, grew by 2.4% to an overall 11.7%. For this same time period, the vacancy rate in Warren County, where the City of Vicksburg is located, grew by 3.7% to an overall 13.5%. [USCB 2010e; USCB 2011g] Claiborne County, where Port Gibson is located, had a 13.3% vacancy rate in 2000 that increased to an overall 18.5% vacancy rate in 2010, and Jefferson County's (City of Fayette) vacancy rate increased by 6.9% to an overall 20.3% vacancy rate in 2010. [USCB 2010e; USCB 2011g]

The USCB has not released 2010 updates for median home values and monthly rental fees. Based on 2005–2009 estimates, the median home values for all four counties grew between

2000 and the 2005–2009 time period. Median home values increased 39.8% in Hinds County and are valued at $102,200. Median home values increased by 22.5% to $96,900 in Warren County. Median home values increased by 37.8% and are valued at $67,100 in Jefferson County. The least growth in median home value was in Claiborne County, which only saw an increase of 8.9%, to a median value of $52,500. Between 2000 and 2005–2009, median monthly rents grew in Hinds County by 45.7% to $733, 35% in Warren County to $629; and 40.6% in Jefferson County to $388. The largest growth in median rent was in Claiborne County, with a 65.7% increase to $517. [USCB 2010e; USCB 2011h]

Between 2000 and 2010, the amount of available housing has increased in all four counties, although each has also seen a population decline. The rural counties, Jefferson and Claiborne, saw the greatest increase in their available vacant housing. Home values have increased in the four counties, but Claiborne County increased the least and Hinds increased the most. Monthly rental fees have also increased in each of the four counties, with Claiborne showing the greatest percent change. Overall, this would indicate adequate housing is available to county residents.

Table 2.9-1
Claiborne, Hinds, Jefferson, and Warren Counties, MS, Housing Statistics, 2000–2009

	2000[a]	2005–2009[b]	2000 to 2005–2009 % Change	2010[c]	2000–2010 % Change
Claiborne					
Total Housing Units	4,252	4,485	5.5	4,223	-0.7
Occupied Units	3,685	3,634	-1.4	3,440	-6.6
Vacant Units	567	851	50.1	783	38.1
Vacancy Rate (%)	13.3	19.0	5.6	18.5	5.2
Median House Value ($)	48,200	52,500	8.9	NA	NA
Median Rent ($/month)	312	517	65.7	NA	NA
Hinds					
Total Housing Units	100,287	105,916	5.6	103,421	3.1
Occupied Units	91,030	91,222	0.2	91,351	0.4
Vacant Units	9,257	14,694	58.7	12,070	30.4
Vacancy Rate (%)	9.2	13.9	4.6	11.7	2.4
Median House Value ($)	73,100	102,200	39.8	NA	NA
Median Rent ($/month)	503	733	45.7	NA	NA

Table 2.9-1 (Continued)
Claiborne, Hinds, Jefferson, and Warren Counties, MS, Housing Statistics, 2000–2009

	2000[a]	2005–2009[b]	2000 to 2005–2009 % Change	2010[c]	2000–2010 % Change
Jefferson					
Total Housing Units	3,819	4,058	6.3	3,673	-3.8
Occupied Units	3,308	3,162	-4.4	2,929	-11.5
Vacant Units	511	896	75.3	744	45.6
Vacancy Rate (%)	13.4	22.1	8.7	20.3	6.9
Median House Value ($)	48,700	67,100	37.8	NA	NA
Median Rent ($/month)	276	388	40.6	NA	NA
Warren					
Total Housing Units	20,789	21,466	3.3	21,896	5.3
Occupied Units	18,756	19,272	2.8	18,941	1.0
Vacant Units	2,033	2,194	7.9	2,955	45.4
Vacancy Rate (%)	9.8	10.2	0.4	13.5	3.7
Median House Value ($)	79,100	96,900	22.5	NA	NA
Median Rent ($/month)	466	629	35.0	NA	NA

NA: Updated housing data not available.

a. Reference: USCB 2010e
b. Reference: USCB 2011h
c. Reference: USCB 2011g

2.10 Social Services and Public Facilities

2.10.1 Public Water Supply

GGNS utilizes an onsite non-transient non-community public water system for the majority of the plant's potable water. With the exception of the four onsite areas served by the CS&I Water Association #1 discussed in Section 2.3.4.3, GGNS' potable water needs are supplied by onsite groundwater wells. As indicated in Section 2.3.4 and Table 2.3-3, three wells are currently installed near the bluff in the Upland Complex terrace deposits for GGNS potable water supply. The North and South Drinking Water Wells, and the North Construction Well, identified as Construction Wells 1, 3, and 4 in Table 9.1-1, respectively, are used for potable water, once-

through cooling for plant air conditioners, and for regenerating the water softeners at the Energy Services Center (Figure 2.3-7). As shown in Table 2.3-3, average annual pumping from all three of these wells combined would be less than 100 gpm.

Only public water systems in Claiborne County within a 10-mile radius of GGNS are discussed in this section, as no GGNS employees reside within a 10-mile radius of the site in Louisiana. Public water supply wells in Claiborne County (excluding GGNS) are supplied by the Catahoula Formation or Miocene aquifer with well depths ranging from 166 to 960 feet. Active public water supply systems located in Claiborne County as of May 2009, not including GGNS, are shown in Table 2.10-1.

Information was solicited from the MDH Bureau of Public Supply for public water systems within Claiborne County within 10 miles from the GGNS site (Table 2.10-1). MDH maintains records on the current capacity and demand of each public water supply based on calculations of the maximum capacity of each system and its current actual connections.

Residents within the vicinity of GGNS are served by CS&I Water Association #1. CS&I Water Association #1 has three wells approximately six miles to the east-northeast of GGNS that withdraw groundwater from the Miocene aquifer [MDEQ 2009a]. These wells supply a population of approximately 1,100 and have an average depth of just over 400 feet [USEPA 2010; MDEQ 2009a]. MDH shows CS&I Water Association #1 has a maximum pumping capacity of 288 gpm and a capacity of 576 connections; system demand is currently at 64.1% of its capacity [MDH].

Port Gibson is the only incorporated town in Claiborne County. Port Gibson's public water supply comes from five wells that withdraw groundwater from the Catahoula Aquifer [MDEQ 2009a]. These wells supply a population of approximately 4,263 and have depths ranging between 166 and 205 feet [USEPA 2010; MDEQ 2009a]. MDH shows Port Gibson has a maximum pumping capacity of 850 gpm and a capacity of 2,000 connections; system demand is currently at 69% of its capacity [MDH].

Other residents within 10 miles are served by the Hermanville Water Association, Pattison Water Association, Ramola Water Association, or the Alcorn State University (ASU) public water systems as shown in Table 2.10-1 [MDEQ 2009a].

ASU's community water system, serving a reported population of 3,824, is supplied by four wells with depths ranging from 182 to 205 feet that withdraw groundwater from the Catahoula Aquifer [MDEQ 2009a; USEPA 2010]. MDH records shows ASU's system has a maximum pumping capacity of 1,136 gpm and a capacity of 1,442 connections; system demand is currently at 56.9% of its capacity. [MDH]

The Hermanville Water Association community water system, serving a reported population of 1231, is supplied by three wells with depths ranging from 465 to 480 feet that withdraw water from the Catahoula and Miocene aquifers [MDEQ 2009a; USEPA 2010]. MDH shows Hermanville has a maximum pumping capacity of 552 gpm and a capacity of 1,052 connections; system demand is currently at 28.9% of its capacity. [MDH]

The Pattison Water Association community water system, serving a reported population of 2,900, is supplied by four wells with depths ranging from 260 to 960 feet that withdraw water from the Catahoula Aquifer [MDEQ 2009a; USEPA 2010]. MDH records shows Pattison has a maximum pumping capacity of 982 gpm and a capacity of 1,832 connections; system demand is currently at 39.6% of its capacity. [MDH]

The Ramola Water Association community water system, serving a reported population of 681, is supplied by two wells with depths of 450 and 472 feet that withdraw groundwater from the Miocene aquifer [MDEQ 2009a; USEPA 2010]. MDH records shows Ramola has a maximum pumping capacity of 556 gpm and a capacity of 1,056 connections; system demand is currently at 27.8% of its capacity. [MDH]

The Reedtown Water Association community water system, serving a reported population of 504, is supplied by a single well with screen base of 408 feet that withdraws groundwater from the Catahoula Aquifer [MDEQ 2009a; USEPA 2010]. MDH records shows Reedtown has a maximum pumping capacity of 243 gpm and a capacity of 349 connections; system demand is currently at 14.6% of its capacity. [MDH]

As previously discussed in Section 2.3.4, water in the vicinity satisfies a variety of purposes including domestic, industrial, and agricultural uses with groundwater withdrawn from the various aquifers and surface water withdrawn from the Mississippi River. In NUREG-1817, the USNRC staff used 2000 data from the USGS and found that the total estimated water use in Claiborne County was 34.3 mgd. Groundwater comprises that entire total except 0.4 mgd of surface water. [USNRC 2006a, Section 2.6.2]

In summary, groundwater is the primary source of both community and non-community water supply systems and serves virtually the entire population in the area. Since GGNS groundwater withdrawals at the site rely on different aquifers than that of Port Gibson and county water systems, and only a small portion of the plant's water is supplied by a community water system, the capacities of public water resources should remain stable.

Table 2.10-1
Claiborne County Community Water Systems, 10-Mile Radius of GGNS

Water System	Source	Aquifer	Number of Wells	Connections Capacity[a]	Capacity (gpm)	Demand (% of Design)
Non-Transient Non-Community Water System						
Entergy Operations, Inc.	Groundwater	Terrace Deposits (Upland Complex)[b]	3	1,496	1,335	16.7
Community Water Systems						
CS&1 Water Association #1	Groundwater	Miocene	3	576	288	64.1
Town of Port Gibson	Groundwater	Catahoula	5	2,000	850	69
Alcorn State University	Groundwater	Catahoula	4	1,442	1,136	56.9
Reedtown Water Association	Groundwater	Catahoula	1	349	243	14.6
Hermanville Water Association	Groundwater	Catahoula and Miocene	3	1,052	552	28.9
Pattison Water Association - West	Groundwater	Catahoula	4	1,832	982	39.6
Ramola Water Association	Groundwater	Miocene	2	1,056	556	27.8

References: MDH; MDEQ 2009a

a. Calculated connections capacity based on MDH criteria.
b. MDEQ records currently show Catahoula as aquifer source; however, records have not been updated to reflect permit source revisions dated October 7, 2007 [MDEQ 2007].

2.10.2 Transportation

Primary transportation corridors within the region surrounding GGNS include Interstate 20 across the northern portion, Interstate 55 along the eastern portion, and U.S. 61 on the east side of the Mississippi River and U.S. 65 on the west side of the river. Figure 2.1-2 shows the area within a 50-mile radius of GGNS. Interstate 20 passes approximately 20 miles north of GGNS connecting Vicksburg and Jackson, Mississippi, with towns to the east and west. Interstate 55 passes approximately 36 miles east of GGNS, connecting Jackson, Mississippi, and New Orleans, Louisiana. U.S. 65 runs north and south in Louisiana and lies approximately 11 miles to the west of GGNS. U.S. 61 runs north-south approximately bisecting the region and connecting Vicksburg to the north and Natchez to the south in Mississippi. U.S. Highway 84 runs east and west, connecting U.S. 65 and Interstate 55, and passes within about 31 miles to the south of the site. Figure 2.1-1 shows the locations of federal highways and railroads in the site vicinity. The Mississippi River, which passes along the west border of the site and approximately one mile west of GGNS, provides another route for river transportation. The nearest river port facility is Port Claiborne at RM 404.8. A larger river port facility, which is also a U.S. Customs port of entry, lies north of the site near RM 437 in Vicksburg. [USNRC 2006a, Section 2.2.3]

Transportation routes are limited in the vicinity of GGNS and all road access to the plant falls within Claiborne County, Mississippi. The major highway in Claiborne County is U.S. 61, which passes by the site to the east-southeast and runs parallel to the Mississippi River from New Orleans, Louisiana, to St. Louis, Missouri. A two-lane portion of the four-lane highway passes through Port Gibson and is approximately 4.5 miles from GGNS at the closest point. From the Town of Port Gibson, U.S. 61 runs north to Vicksburg, Mississippi and southwest to Natchez, Mississippi. U.S. 61 connects Claiborne, Jefferson, and Warren Counties, three of the counties in which most of GGNS' workers reside. The Natchez Trace Parkway lies east of Port Gibson and runs southeast to Natchez and northeast to Clinton, Mississippi. State Highway 18 runs east from Port Gibson to Jackson. A number of county and rural roads are in the vicinity of the site. Normal access to the site is by paved Grand Gulf Road and Bald Hill Road located north and east of the site, respectively. [USNRC 2006a, Sections 2.1 and 2.8.2.2]

In 2011, the Mississippi Department of Transportation (MDOT) scheduled an upgrade of roads in the Town of Port Gibson. Various other future MDOT road projects include an upgrade of the Grand Gulf Access Road between U.S. 61 to the Port of Claiborne and an extension of the U.S. 61 four-lane portion of the highway through Port Gibson to where it becomes a four-lane south of the Natchez Trace Parkway. [MDOT 2009]

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. No rail line serves Claiborne County or the GGNS site directly. An active spur line from the Kansas City Southern line runs south from Vicksburg about seven miles. [USNRC 2006a, Section 2.8.2.2]

2.10.2.1 Traffic Counts

Table 2.10-2 shows the estimated average daily traffic count on roads in the vicinity of the GGNS site.

Table 2.10-2
Traffic Counts Near GGNS, 2000–2008

Route	Location	2000	2006	2008
SR 18	Between Natchez Trace and U.S. 61	3,700	4,600	4,300
SR 547	Between Natchez Trace and U.S. 61	4,700	5,100	4,900
SR 462	East of U.S. 61	800	480	620
Rodney Road	West of U.S. 61	990	930	890
U.S. 61	Between SR 18 and SR 462	6,200	7,000	6,500
U.S. 61	Between Natchez Trace and SR 547	6,600	7,100	6,600
U.S. 61 (Church St)	Port Gibson: between SR 18 and Fair Street	10,000	13,000	13,000
U.S. 61 (Church St)	Port Gibson: between SR 547 and Fair Street	10,000	12,000	11,000
Old Mill Road	Bald Hill and Grand Gulf Road	1,400	850	860
Old Mill Road	U.S. 61 and Bald Hill	2,200	1,900	2,500
Grand Gulf Rd	Between U.S. 61 and Old Mill	1,100	1,000	980
Grand Gulf Rd	Between Old Mill Rd and Grand Gulf Park	940	1,700	1,600

References: USNRC 2006a, Figure 2-10; MDOT 2008; MDOT 2010

2.10.2.2 Level of Service

The U.S. Transportation Research Board has developed a commonly used indicator, called level of service (LOS), to measure roadway traffic volume. LOS is a qualitative assessment of traffic flow and how much delay the average vehicle might encounter during peak hours. Table 2.10-3 presents the LOS definitions used by local and state agencies, as well as by the USNRC in the GEIS. [USNRC 1996, Section 3.7.4.2]

.

Table 2.10-3
Level of Service Definitions

Level of Service	Conditions
A	Free flow of the traffic stream; users are unaffected by the presence of others.
B	Stable flow in which the freedom to select speed is unaffected, but the freedom to maneuver is slightly diminished.
C	Stable flow that marks the beginning of the range of flow in which the operation of individual users is significantly affected by interactions with the traffic stream.
D	High-density, stable flow in which speed and freedom to maneuver are severely restricted; small increases in traffic will generally cause operational problems.
E	Operating conditions at or near capacity level causing low, but uniform, speeds and extremely difficult maneuvering that is accomplished by forcing another vehicle to give way; small increases in flow or minor perturbations will cause breakdowns.
F	Defines forced or breakdown flow that occurs wherever the amount of traffic approaching a point exceeds the amount that can traverse the point. This situation causes the formation of queues characterized by stop-and-go waves and extreme instability.

Reference: USNRC 1996, Section 3.7.4.2.

The MDOT estimates that currently much of U.S. 61 in the GGNS vicinity has an LOS designation of A. Traffic becomes dense where the four-lane turns into a two-lane north of Port Gibson, and again along the two-lane where traffic enters Port Gibson from the south. These portions of U.S. 61 currently have an LOS designation of D. Within the community of Port Gibson, the road set has an LOS designation of A, as do the roads leading to the plant. With plans to expand all of U.S. 61 to four-lane, MDOT projects that by 2020 the entire length of U.S. 61 in Claiborne County will better accommodate traffic loads and achieve an LOS assignment of A. The LOS designations for Port Gibson road sets and roads leading to the plant would continue to have an A or B designation. [Enercon 2008]

2.10.3 Education

The State of Mississippi is divided into several public school districts. The public school districts closest to GGNS are listed in Table 2.10-4. Claiborne County, where GGNS is located, has a single unified school district with four public schools. All four schools are located in Port Gibson, and have a total student population of 1,761. The other counties where a majority of GGNS employees reside include Hinds County with three school districts and 11 schools, Jefferson

County with one school district and six schools, and Warren County with one school district and 16 schools. [NCES]

Claiborne County has two private educational institutions. Claiborne Educational Foundation is a primary education facility, and has approximately 48 students and a 1:7 teacher/student ratio [PSR]. Chamberlain-Hunt Academy is a military boarding school that offers a secondary education. The academy has 23 teachers and additional staff who serve the needs of the 120 cadets. [CHA]

The State of Mississippi has 15 public community colleges, eight private colleges, and nine public universities [MSG]. Claiborne, Hinds, and Warren counties are served by Hinds Community College, which has six locations throughout the area. The Vicksburg/Warren campus is the closest branch to GGNS. [HCC] Claiborne County is the home of ASU, seventeen miles southwest of Port Gibson. Approximately 3,252 full- and part-time undergraduate and graduate students attend ASU. [ASU] There are a number of private and public two and four year colleges located in Hinds County. In the Jackson area, this includes nine institutions of higher learning, with a combined enrollment of approximately 38,000 students, and 12,300 staff and faculty. [HCEDD 2010b]

Table 2.10-4
Mississippi School Districts Closest to GGNS

School District	Number of Schools	County	Total General Revenue (2007–08)	Total Expenditures (2007–08)	Total Students (2008–09)	Student/ Teacher Ratio (District) (2008–09)
Claiborne County	4	Claiborne	16,555,000	16,017,000	1,761	16.9
Clinton Public	9	Hinds	37,497,000	39,483,000	4,729	17.5
Hinds County	11	Hinds	56,624,000	53,831,000	6,697	14.3
Jackson Public	61	Hinds	271,497,000	282,929,000	30,587	16.0
Jefferson County	6	Jefferson	12,712,000	12,703,000	1,474	14.1
Vicksburg Warren	16	Warren	77,050,000	73,628,000	9,058	15.9

Reference: NCES

2.10.4 Transient Population

Fine geographical-level tourism (transient) data are not collected by the states for the area within the 50-mile radius of GGNS. Instead, Louisiana and Mississippi collect these data at the state level only. The websites for the state tourism agencies were accessed to obtain recent tourist

information, which is shown in Table 2.10-5. These state tourism numbers were then used to develop an estimate of county-level transient populations. Assuming an even distribution of transients across each state based on this data, a transient to permanent population ratio was developed. State tourist numbers, estimated at the county level population, were developed by multiplying the permanent county population by this ratio. The ratio was then used to estimate current transient population numbers in Table 2.10-6 for the four counties where the majority of GGNS employees reside.

Table 2.10-5
State Tourism Offices and Reported Visitor Numbers

Department	Louisiana Tourism 2008 Data	Mississippi Tourism 2009 Data
Reported Annual Visitor Numbers (Visits in a Year)	15,600,000	19,000,000
Average Stay (Days per Visit)	3.1	3
Annual Visitor Day (Person-days in a Year)	48,360,000	57,000,000
Transient Population (Person Days)	132,493	156,164
Permanent Population	4,451,513	2,951,996
Transient/Permanent Ratio	0.03	0.053

References: TNS; MDATD; USCB 2010a

Table 2.10-6
2009 Transient/Permanent Ratio for Claiborne, Hinds, Jefferson, and Warren Counties

County	2009 Estimated Population	2009 Person Visits (per day)	Transient/Permanent Ratio (per day)
Claiborne	10,755	570	0.053
Hinds	247,631	13,124	0.053
Jefferson	8,928	473	0.053
Warren	48,175	2,553	0.053

References: MDATD; USCB 2010a

2.10.5 Migrant Farm Labor

Migrant farm labor was reviewed using the USDA National Agricultural Statistics Service (NASS) data for 2007. According to the USDA, a migrant farm worker is a farm worker whose employment required travel that prevented the worker from returning to his/her permanent place of residence the same day. While actual migrant worker numbers are not directly reported, county-level data on hired farm labor are available. For Claiborne County, NASS reported that 59 out of a total of 261 farms employed farm labor. Only three of those farms reported employing migrant farm workers. In Hinds County, 177 of 1,071 farms hired farm labor, and of those, seven employed hired or contract workers who were considered migrant labor and two farms employed only contract labor consisting of migrants. Of the 356 farms in Jefferson County, 66 hired farm labor, and none reported hiring migrant farm workers. In Warren County, 59 of 278 farms employed farm labor, and only two of those 59 hired migrant farm workers. [USDA 2010a]

In all four counties, a total of 1,135 farm laborers were hired, of which 820 were reported to work fewer than 150 days per year. The largest use of hired farm labor was in Hinds County, with 516 total workers hired, of which 344 worked fewer than 150 days per year. Claiborne County had a total of 212 workers hired, of which 176 worked fewer than 150 days per year. For Jefferson County, a total of 201 workers were hired, of which 143 worked fewer than 150 days per year. Similarly, in Warren County, 206 workers were hired, 157 of which worked fewer than 150 days per year. [USDA 2010a]

The census data do not provide a reasonable means of interpolating the number of migrant farm labor workers, but based on available data, over half the hired farm laborers worked fewer than 150 days per year. Claiborne County had only three of the 14 farms that reported hiring migrant workers. [USDA 2010a]

2.10.6 Employment

The four counties most influenced by GGNS operations—Claiborne, Hinds, Jefferson, and Warren—are where the majority of employees reside. As noted in Section 2.6, the populations of these counties are generally in decline. This population decline has a significant impact on the local economies. Generally, the annual 2010 unemployment rate in the four counties ranged between 9.5% and 16.8%, but that may be affected by eligible labor emigrating from the area [BLS].

The estimated employed population in Claiborne County in 2005–2009 was 3,879, with no particular occupation sector showing employment dominance. The leading occupation was the sales and office occupations sector, with 24.7% or approximately 959 persons employed. This was closely followed by the management, professional, and related occupations sector with 23.8%, or 923 persons employed. The service occupations category had 20.1%, or 780 persons employed. The production, transportation, and material moving category had 18.9%, or 735 people employed. [USCB 2011i] The largest employer in the county was ASU, with approximately 750 employees [MDA 2010b]. As described in Section 3.5, GGNS has 690 employees and would be the second largest employer in the county. The annual payroll in Claiborne County was reported to be approximately $108 million in 2009 [USCB 2011j]. In 2009,

per capita personal income was $23,781 and annual unemployment increased from 15.9% in 2009 to approximately 16.3% in 2010. [BEA; BLS]

The estimated employed population in Hinds County in 2005–2009 was 109,813 with management, professional, and related occupations leading total employment in the county at 32.5%, or approximately 35,741 people, employed. This was closely followed by the sales and office occupations with 27.8%, or 30,475 persons, employed. Service occupations had 19.6%, or 21,562 persons employed. Production, transportation, and material moving occupations had 11.5%, or 12,670 persons, employed. [USCB 2011i] The largest employer in Hinds County was the State of Mississippi with 31,556 employees. After the State, the largest employers in Hinds County are the University of Mississippi Medical Center (8,000 employees), the United States Government (5,500 employees), Jackson Public School District (4,814 employees), Baptist Health System (2,875 employees), and the City of Jackson (2,323 employees). [MDA 2010b] The annual payroll in Hinds County was $3.8 billion in 2009 [USCB 2011j]. In 2009, per capita personal income was $35,865 and annual unemployment increased from 8.4% to approximately 9.5% in 2010. [BEA; BLS]

The estimated employed population in Jefferson County in 2005–2009 was 2,838 people with no occupation category showing clear dominance. The management, professional, and related occupations led employment with 27.8%, or 788 persons employed. Production, transportation, and material moving occupations followed with 20.9%, or 593 persons, employed. The service occupations had 19.6%, or 555 persons, employed. The construction, extraction, maintenance, and repair occupations had 15.1%, or 429 persons, employed. [USCB 2011i] A listing of the largest employers was unavailable for Jefferson County. The annual payroll in Jefferson County was reported to be approximately $17.0 million in 2009 [USCB 2011j]. In 2009, per capita personal income was $20,316 and annual unemployment decreased from 17.0% to 16.8% in 2010. [BEA; BLS]

The estimated employed population in Warren County in 2005–2009 was 21,388 with management, professional, and related occupations dominating total employment in the county at 30.2%, or approximately 6,454 persons, employed. Sales and office occupations followed with 21.6%, or 4,610 persons, employed. The service occupations had 21.3%, or 4,557 persons, employed. The production, transportation, and material moving occupations had 16.3% or 3,481 persons, employed. [USCB 2011i] The largest employers in Warren County included a transportation equipment manufacturer, LeTourneau, Inc. (1,100 employees), followed by Cooper Lighting HID (700 employees), and Tyson Foods, Inc.–Vicksburg (678 employees) [MDA 2010b]. The annual payroll in Warren County was reported to be approximately $625 million in 2009 [USCB 2011j]. In 2009, per capita personal income was $35,288 and annual unemployment increased from 10.0% in 2009 to 11.1% in 2010. [BEA; BLS].

2.11 Meteorology and Air Quality

2.11.1 Climate

GGNS, which is located on the east bank of the Mississippi River in southwestern Mississippi, is approximately 150 miles from the coast of the Gulf of Mexico. The dominant air mass in the

region during most of the year is a maritime tropical air mass originating in the Gulf of Mexico. As a result, the climate of the region is humid most of the year. The winters are relatively short and mild with occasional brief cold periods associated with outbreaks of continental polar air. These cold periods rarely last more than three or four days. Summers are long and warm; however, temperatures above 100°F are infrequent and long periods of very hot weather are rare. During these summer months, the weather at the site is dominated by the western edge of the Bermuda High. [USNRC 2006a, Section 2.3.1]

Mississippi is south of the general track of winter cyclones. This location, in combination with the dominant influence of the Bermuda High in the summer, results in a limited wind resource in the area. Wind energy resource maps prepared for the United States Department of Energy (USDOE) indicate that Mississippi wind resources fall into Wind Power Class 1, the lowest of seven classes used to rate the resource. USDOE does not list commercial wind power projects in Mississippi. [USNRC 2006a, Section 2.3.1]

On average, about 60% of the sky at Jackson, Mississippi, is covered by clouds. However, cloudiness varies seasonally and diurnally. Daytime cloudiness at Jackson covers more than 50% of the sky during the winter, with maximum sky cover of about 80% in December and January. The rest of the year, the average daytime sky cover is 50% or less, with minimum sky cover of about 30% during September. The USDOE estimates the annual average solar resource in the vicinity of the Grand Gulf ESP site to be 4.5 to 5.0 kWh/m^2 per day for flat-panel collectors, and 4.0 to 4.5 kWh/m^2 per day for concentrating collectors. The USDOE lists two photovoltaic energy projects with a total installed capacity of 44.2 kW in Mississippi. [USNRC 2006a, Section 2.3.1]

Winds at the site are relatively light with the most prevalent wind direction being from the northeast. Winds from the northeast and southeast quadrants are far more frequent than winds from the southwest and northwest quadrants. The highest wind speeds tend to have a southerly component. [USNRC 2006a, Section 2.3.1.1]

The long-term (95-year) annual average temperature in Jackson is 65.2°F, with monthly average temperatures ranging from 47.2°F in January to 81.9°F in July. During the year, the normal (based on data for 1971 through 2000) number of days with minimum temperatures of 32°F and below is 46, while the normal number of days with maximum temperatures of 32°F and below is less than 2. Temperatures below 0°F have been observed in the area. In contrast, the normal number of days with maximum temperatures of 90°F and above is 84, and the highest temperature on record is 107°F. [USNRC 2006a, Section 2.3.1.3]

Precipitation averages about 56 inches per year and is uniformly distributed throughout the year. The months of January, March, April, November, and December average more than five inches of precipitation, while the months of June, August, September, and October average less than four inches. The maximum precipitation in a 24-hour period was 8.5 inches in April 2003. On average, about one third of the days each month experience measurable precipitation. Typically, snow falls almost every year, but only about four years in ten have measurable snowfall. The maximum snowfall in a 24-hour period, six inches, occurred in January 1982. On occasion, the

24-hour snowfall in the vicinity of Jackson has exceeded six inches. In January 1940, 10.6 inches was recorded, and in February 1960, 9.1 inches was recorded. [USNRC 2006a, Section 2.3.1.4]

The 30-year normal relative humidity at Jackson, Mississippi, has an annual average of about 75% with a diurnal variation in the annual average value from about 91% at 6:00 a.m. to about 58% at noon. Seasonal variation of relative humidity is small. The 6:00 a.m. monthly average relative humidities range from a minimum of 87% in March to a maximum of 95% in August. The noon monthly average humidities range from a minimum of 53% in April to a maximum of 65% in January. Relative humidities for Vicksburg, Mississippi, are consistent with those for Jackson, Mississippi. [USNRC 2006a, Section 2.3.1.4]

When the relative humidity is near 100%, small water droplets (fog) form in the atmosphere and reduce visibility. Records for Jackson indicate that heavy fog, which reduces the visibility to 0.25 miles or less, can occur in any month. On average, heavy fog occurs on more than 22 days per year with three days in December and January, and less than one day in June. Vicksburg, Mississippi, averages approximately 92 hours per year of fog, with fog defined as reduction of visibility to less than 5/8 mile. [USNRC 2006a, Section 2.3.1.4]

GGNS can experience severe weather in the form of thunderstorms, snow, ice, tornadoes, and hurricanes. Other significant weather can be associated with these events. For example, lightning, hail, and high winds frequently occur with thunderstorms, and tornadoes can occur with both thunderstorms and hurricanes. [USNRC 2006a, Section 2.3.1.5]

Thunderstorms can be expected on about 68 days per year. Thunderstorms are most frequent in summer. The months of June, July, and August average nine or more thunderstorm days per year. Months from October through February average fewer than three thunderstorm days per year. National Climatic Data Center Storm Data list 23 hail events with hail 0.75 inches or greater in diameter in Claiborne County since 1971. However, this number is incomplete because no events were listed from 1972 through 1982. [USNRC 2006a, Section 2.3.1.5]

On average, hurricanes strike the Gulf Coast along the Louisiana and Mississippi coastlines several times a decade. However, GGNS is sufficiently far inland that the strength of storms generally diminishes to less than hurricane strength by the time they reach the vicinity of the site. [USNRC 2006a, Section 2.3.1.5]

NUREG-1817 conducted an assessment of the probability of a tornado striking the GGNS site using National Climatic Data Center data for 1950 through August 2003. For this time period, there were 592 tornado events within the two-degree box centered on the GGNS site. Given the distribution of areas associated with the events, it was estimated that the expected probability of a tornado striking the site is approximately 7.4×10^{-4} yr with 95% confidence that the strike probability is less than 9.4×10^{-4} yr. A tornado struck the GGNS site on April 17, 1978, and detailed reports of this event are included in the GGNS UFSAR. [USNRC 2006a, Section 2.3.1.5]

2.11.2 Air Quality

The GGNS site is in Claiborne County, Mississippi, which is on the western edge of the Mobile, Alabama-Pensacola, Florida-Panama City, Florida-Southern Mississippi Interstate air quality control region. The area across the Mississippi River from the site is in the Monroe, Louisiana-El Dorado, Arkansas, Interstate air quality control region. None of the counties in these air quality control regions have been designated as in nonattainment of the National Ambient Air Quality Standards (40 CFR 81.319; 40 CFR 81.325). There are no mandatory Class 1 Federal Areas where visibility is an important value within 100 miles of the GGNS site. [USNRC 2006a, Section 2.3.2] The State of Mississippi is both in attainment with national primary and secondary air quality standards for all criteria air pollutants. Based on the most current available records, the nearest non-attainment areas to GGNS are Baton Rouge, Louisiana, approximately 105 miles south of Port Gibson, and the Beaumont-Port Arthur, Texas, area (Orange County), approximately 200 miles southwest. Baton Rouge is currently listed as being in non-attainment for the 8-hour ozone criteria and the Beaumont-Port Arthur in non-attainment for the 1-hour ozone criteria [USEPA 2011a]. However, EPA is proposing to approve the state of Louisiana's request to redesignate the Baton Rouge area to attainment of the 1997 8-hour ozone standard [USEPA 2011b]. In addition, EPA is also approving a determination that the Beaumont-Port Arthur area is meeting the 1-hour ozone standard, although still being cited as being in non-attainment in the EPA Green Book [75 FR 64675]. Therefore, the next nearest non-attainment area is Jefferson County, Alabama (Birmingham, Alabama area), approximately 230 miles to the northeast of GGNS, which is listed as being in non-attainment for the PM-2.5 standard [USEPA 2011a].

2.11.3 Greenhouse Gases

Several studies provide qualitative discussions of the potential for nuclear power to ameliorate greenhouse gas (GHG) emissions. Examples of these studies include Hagen et al.; IAEA; Keepin; MIT; NEA; NIRS/WISE; and Schneider. While these studies sometimes reference and critique the rationale contained in the existing quantitative estimates of GHGs produced by the nuclear fuel cycle, their conclusions are generally based on other factors such as safety, cost, waste generation, and political acceptability. Therefore, these studies are not directly applicable to the evaluation of the GHG emissions associated with license renewal. [USNRC 2010, Section 6.2.1.1]

A number of studies provide technical lifecycle analyses and quantitative estimates of the amount of GHGs generated by nuclear and other power generation technologies. Examples of these studies include AEA; Andseta et al.; Dones; Fritsche; Fthenakis and Kim; Mortimer; POST; Spadaro et al.; Storm van Leeuwen and Smith; and Weisser. Comparison of these quantitative studies is difficult because the assumptions and components of the lifecycles (i.e., reactor types, energy sources used in mining and processing fuel, capacity factors, fuel quality) included within each study vary widely. Also, these studies are inconsistent in how they define the lifecycle: some include plant construction, decommissioning, and resource extraction (uranium ore, fossil fuel), while others include one or two of these activities. Similarly, the scope of these studies is inconsistent with license renewal because license renewal does not include construction or

decommissioning. For example, Storm van Leeuwen and Smith present comparisons of GHG emissions from nuclear versus natural gas that incorporate GHG emissions associated with nuclear plant construction and decommissioning in the values used for comparison. License renewal would not involve GHG emissions associated with construction because the facility already exists, nor would it involve additional GHG emissions associated with facility decommissioning, because decommissioning must occur whether the facility license is renewed or not. In many of these studies, the contribution of GHG emissions from facility construction and decommissioning cannot be separated from the other lifecycle GHG emissions that would be associated with license renewal. Therefore, these studies overestimate the GHG emissions that would be attributable to renewal of an operating license. [USNRC 2010, Section 6.2.1.2]

The estimates and projections of the carbon footprint of the nuclear power lifecycle provided in the various studies vary widely, and considerable debate exists regarding the relative impacts on GHG emissions of nuclear and other electricity-generating technologies. Nevertheless, the studies indicate a consensus that nuclear power produces fewer GHG emissions than fossil-fuel-based electricity-generating technologies. Based on the literature review, lifecycle GHG emissions from the complete nuclear fuel cycle currently range from 2.5 to 55 grams (g) of carbon equivalents per kilowatt hour (Ceq/kWh). The comparable lifecycle GHG emissions from the use of coal range from 264 to 1,250 g Ceq/kWh, and GHG emissions from the use of natural gas range from 120 to 780 g Ceq/kWh. The studies also provided estimates of GHG emissions from five renewable energy sources, based on current technology. These estimates included solar-photovoltaic (17 to 125 g Ceq/kWh), hydroelectric (1 to 64.6 g Ceq/kWh), biomass (8.4 to 99 g Ceq/kWh), wind (2.5 to 30 g Ceq/kWh), and tidal (25 to 50 g Ceq/kWh). The range of these estimates is very wide, but the general conclusion is that the GHG emissions from the nuclear fuel cycle are of the same order of magnitude as those for renewable energy sources. [USNRC 2010, Section 6.2.2]

Therefore, GHG emissions associated with renewal of an operating license would be similar to the lifecycle GHG emissions from renewable energy sources and lower than those associated with fossil fuel-based energy sources.

2.12 Historic and Archaeological Resources

The Mississippi and Louisiana State Historic Preservation Offices (SHPO) environmental review programs are a planning process that helps protect Mississippi and Louisiana historic and cultural resources from the potential impacts of projects that are funded, licensed, or approved by state or federal agencies. Under Section 106 of the National Historic Preservation Act, the SHPO's role in the review process is to ensure that effects or impacts on eligible or listed properties are considered and avoided or mitigated during the project planning process. The Mississippi Department of Archives and History (MDAH) and the Louisiana Office of Cultural Development are the primary contacts for the historic registers that track Mississippi's and Louisiana's historic resources, respectively, while the National Register of Historic Places (NRHP) is the official federal listing of significant historic, architectural, and archaeological resources. During development of the ER, Entergy consulted with both the Mississippi and

Louisiana SHPOs who identified no concerns associated with GGNS license renewal (Attachment B).

2.12.1 Prehistoric Era

2.12.1.1 First Arrivals

GGNS is situated on the eastern edge of the lower Mississippi River Valley. The area is a broad valley between Loess bluffs with extremely deep sediments of Holocene and Pleistocene age. At some point near the end of the Pleistocene, the first people began filtering into the region. Who these people were or where they came from remains unknown. There is, however, a growing body of evidence for identifying a "First Arrivals" archeological period preceding the Paleo-Indian period. A handful of sites across America appear to date between about 13,000 to 17,000 years ago. Most of these sites have circumstantial evidence for human occupation. There is, however, no generally accepted consensus or conclusive evidence for human occupation in the Americas before about 12,000 years ago. A human pelvis found, in association with extinct mega fauna remains, below the loess deposits near Natchez in 1846 was later tested for fluorine content and proved to contain the same content as the mega fauna remains. The relative stratigraphic position of the find was estimated at between 18,000 and 22,000 years ago. No additional human or cultural material has been found in the area since the original find. [Enercon 2010e, Section 5.1]

2.12.1.2 Paleo-Indian Period

The Clovis Culture, around 11,500 years ago, is the earliest dated and accepted group in the New World. The culture is the oldest of the Paleo-Indian or Big Game Hunters Period which existed at the end of the last Ice Age. Conditions at the time were colder and wetter than today and the Mississippi River flowed in a braided channel through deciduous forest covering the Eastern Lowlands. Small nomadic bands, probably extended family groups of a dozen or less, followed the large herds and subsisted off the occasional kill of a mammoth or other large animal and foraging for local plant and smaller game resources. Distinctive point styles and variations in other tool types define the Pre-Fluted (ca. 12,500 to 11,500 years ago), Fluted (ca. 11,500 to 10,000 years ago), and Unfluted Lanceolate (ca. 11,000 to 9,000 years ago) Point Horizons. Period camp and kill sites are generally found in areas where deposits of the right age are exposed. No early sites are known from the Mississippi Valley in the GGNS area, but such resources may exist as deeply buried deposits along relic terraces. An Agate Basin-Like Horizon (ca. 10,500 to 10,000 years ago) has been tentatively identified along the Mississippi River in Arkansas as a possible early intrusion of Plains cultures into the Eastern Woodlands. Enercon 2010e, Section 5.1]

2.12.1.3 Archaic Period

Around 8,000 years ago, the Paleo-Indian period is replaced by the Archaic Period. The Archaic began as a slow transition from nomadic wandering to a more systematic exploitation of particular localized areas. The climate during the period was trending to a warmer and dryer nature. The Southern Pine Forest was expanding northward and the Mississippi River was

becoming a down-cutting meandering stream. The Dalton Culture (circa 8,500 to 7,500 years ago) is seen by many as the last of the Paleo-Indian peoples and by others as the first of the Archaic peoples. Some earlier Paleo-Indian influences appear to have come from the Plains to the west, whereas Dalton influence appears to have originated in the Woodlands to the east, marking a transition between the two cultures/periods. [Enercon 2010e, Section 5.1]

The Archaic period is subdivided into the Early Archaic Early Corner-Notched Point Horizon (circa 9,500 to 9,000 years ago), Early Stemmed Point Horizon (circa 9,000 to 8,000 years ago), and Late Archaic (circa 4,500 to 2,500 years ago). Archaic foragers appear to have begun exploiting a wider range of more localized resources with a wider range of tool forms. By about 3,700 years ago populations along the lower Mississippi River had increased to the point where regional differences are recognizable, particularly in the Piedmont region to the east. The first mounds and vestiges of permanent settlements appear. Early ceremonialism is typified by the Poverty Point Site and complex, a massive earthworks and mound center in northeast Louisiana. [Enercon 2010e, Section 5.1]

By 3,000 years ago, conditions had ameliorated from the earlier dry and warm Altithermal Period, and more permanent villages had begun to expand up the Mississippi Valley. Larger semi-permanent warm weather villages were located along the higher terraces along the valley margins. Winter encampments were located along smaller order streams in the uplands. Fiber tempered pottery is found at some sites showing clear influences from the developing Woodland cultures to the south and east. Period sites identified in the area are generally lithic scatters with various dart points or, lacking diagnostics, often identified by the recording archeologists as "Archaic." The Poverty Point Culture (relatively dated from ca. 3,700 to 2,500 years ago) was a transition between the earlier Archaic and later Woodland cultures. [Enercon 2010e, Section 5.1]

Late Archaic settlements are much more widespread across the Southeast than the preceding Middle Archaic. Concentrations of sites occur in southern, central, and northern Mississippi, particularly near smaller river drainages (such as the Big Black, Pascagoula, and Pearl) and the nearby uplands, although the Mississippi Delta is nearly devoid of these sites. It is possible that people during this time period preferred upland settings, although survey bias and erosion are also possible explanations for the absence of these sites. The mound building that began in the Middle Archaic continued during the Late Archaic. The largest and best known site is Poverty Point in Louisiana, which consists of five mounds and six concentric earthworks. Several Archaic sites have been recorded in the Mississippi state site files within a 2-mile radius of GGNS; however, these were not identified by sub-period (e.g., Early, Middle, Late). [Enercon 2010e, Section 5.1]

2.12.1.4 Woodland or Early Ceramic Period

The Woodland or Early Ceramic period (circa 2,500 to 1,300 years ago) is heavily influenced by the developing cultures to the south and east. The Woodland period sees the first signs of sedentary villages, the bow and arrow technology, and elaborate ceremonialism with status burials and later mounds. The Tchefuncte Culture (ca. 2,700 to 2,100 years ago) was named for a site excavated in the lower Yazoo Basin in the 1940s. Numerous phases are recognized in the

lower Mississippi Valley. Villages occupied between the spring and fall seasons are common along the bluff line/river valley wall and on higher terraces along older meanders of the river. Information from Coastal Alabama and Florida suggest that the culture appears to have started along the Gulf Coast and spread inland sometime around 2,700 years ago. [Enercon 2010e, Section 5.1]

Indigenous groups saw a population increase and developed during the Middle Woodland period (circa 2,100 to 1,600 years ago) into the Marksville Culture. The Middle Woodland Period is generally defined as beginning around 2,000 years ago but the Marksville appears to have begun earlier. The Middle Woodland Period is hallmarked by year-round permanent villages, some association with the Hopewell Culture and elaborate burial mounds. A number of Middle Woodland sites have been archeologically investigated in the region, including the Grand Gulf Mound (22CB522) on the GGNS property. The Grand Gulf Mound was identified by Clarence Moore in 1911, revisited by the Peabody Museum in the 1940s and Brookes and Inmon in 1972, and excavated in 1973. [Enercon 2010e, Section 5.1]

The Late Woodland Period (from ca. 1,600 to 1,300 years ago) is associated in the lower valley with the Baytown Culture. It is during this period when evidence of domestication of certain plants becomes evident and local cultures begin sharing in the larger Hopewell network. Baytown is defined on the basis of primarily plain surface, cordmarked, and red filmed ceramics. Baytown was originally divided into three phases (Marksville, Baytown, and Coles Creek) with the Baytown phase having a Troyville variant for the region below the Yazoo basin, again based primarily on ceramic types. [Enercon 2010e, Section 5.1]

New archaeological sites and isolated finds identified in 2007 at GGNS suggest that the ridge tops throughout the study area were utilized at least during the Woodland period and probably considerably longer. The majority of the sites discovered were small artifact scatters representative of short-term occupations or utilization of the uplands. [Enercon 2010e, Section 5.1] However, only two sites (22CB522 and 22CB528), as discussed in Section 2.12.4 below, were determined to be potentially eligible for listing in the NHRP.

2.12.1.5 Mississippian Period

The Woodland Period is replaced by the Emergent Mississippian Period around 1,300 years ago with the Coles Creek Culture. Coles Creek (again partially defined on ceramic evidence) was a time of larger populations living in small villages, the development of larger regional ceremonial temple mound centers, and a heavier reliance on agriculture. Coles Creek may have been a religious/political manifestation that spread as far west as the emerging Caddoan area along the Red River. Sherds of Coles Creek ceramics are found in Fourche Maline and early Caddoan sites as far west as Texas and Oklahoma. Along the Tensas River Basin, the culture is divided into the (earliest) Sundown (ca. 1,300 to 1,200 years ago), (following) Ballina (ca. 1,200 to 1,150 years ago) and Balmoral (ca. 1,150 to 1,000 years ago), and (latest) Preston (ca. 1,000 to 900 years ago) phases. In the Natchez vicinity, the Gordon phase is identified instead of the Preston phase. [Enercon 2010e, Section 5.1]

By about 1,300 years ago, groups in the Middle Mississippian Valley began coalescing towards the development of a truly Mississippian hierarchical society. The Florescence of the Mississippian culture took place in the American Bottoms (near modern-day St. Louis) around 1,200 years ago and by 800 or 900 years ago had spread to the Lower and Coastal Mississippi areas. The local expression of the Period is the Plaquemine Culture, more closely related to the earlier Coles Creek than to the true Mississippian culture to the north. In simplified terms, the Mississippian Period is a time of larger settlements around mound/ceremonial complexes, extensive trade networks, smaller outlier villages and hamlets and intensive agriculture along the bottoms. In the Grand Gulf region, period settlements are known in Tensas Parish to the west, along the Natchez Bluffs to the south, and in the delta bottoms north of Vicksburg. [Enercon 2010e, Section 5.1]

2.12.2 Historic Era

2.12.2.1 Early Louisiana Period

By the time European explorers reached the area, the nature of native settlement had changed. There were still large, elaborate towns such as the Grand Village of the Natchez, but by and large settlement had become much more dispersed. Groups such as the Choctaw and Chickasaw are the likely descendants of Mississippian people in the region, but in the immediate vicinity of Grand Gulf, little is known about the intervening years between about AD 1500 and the coming of the first European explorers. The Hernando de Soto expedition traveled extensively throughout the Southeast and went down the Mississippi River past the study area in 1543. Diseases spread by the expedition had a disastrous impact on native groups, completely or nearly completely decimating many population centers. [Enercon 2010e, Section 5.2]

La Salle had claimed the river and all that it drained for France in 1682. As a colony founder, La Salle failed miserably (after founding a colony in Spanish Texas) and it was 1699 before the first true colony was established at Biloxi Bay by Iberville. Several Native American groups are known to have occupied the region, including the Choctaw, Taensa, Natchez, and Yazoo. There are no known records of specific occupation of the GGNS property, although the Taensa occupied a village on Lake Bruin, about 12 miles southwest of the property, and the Natchez occupied a major village at modern-day Natchez, about 40 miles to the southwest. The French first occupied the area in 1716, building Fort Rosalie near the Grand Village of the Natchez. The settlements in the lower Mississippi Valley were named Louisiana in honor of the French king, Louis XIV. [Enercon 2010e, Section 5.2]

European Americans also became familiar with the area as river traffic opened up with New Orleans after its founding as the territorial capitol in 1717. Occupation of the region during this period appears to have been temporary and most likely would have been small short-term encampments adjacent to the river, or similar hunting camps along the bluff and in the uplands east of the river. Makeshift riverboats were floated down river as far as Natchez or New Orleans where the cargo was sold. The boats were sold as lumber and the crews returned north along an ancient trail running between Natchez and modern-day Nashville. The trail became known as

the Natchez Trace and remained in use well into the nineteenth century. [Enercon 2010e, Section 5.2]

2.12.2.2 American Antebellum Period

The first European settlement along this portion of the Mississippi was Pierre Joffrion, sometime before 1742. The extent and nature of his holdings are unknown, but a later grant from Spain to Samuel Gibson in 1788 places the Gibson Grant on the south side of Bayou Pierre. By the 1790s, C.D. Hamilton owned a tract of land in the vicinity of the GGNS, with Gibson to the south and Grand Gulf to the north according to a series of maps on file at the Louisiana Archeological Survey. [Enercon 2010e, Section 5.2]

Grand Gulf takes its name from a large whirlpool and bend of the Mississippi River that was described by early travelers as wide enough to engulf large vessels. The river has since shifted course slightly. Grand Gulf is located along high ground above the active floodplain, but included boat landings along the river channel that were active during the first half of the nineteenth century. Port Gibson grew as a community around the original Samuel Gibson Plantation on Bayou Pierre. Gibson had received a grant of land from Spanish Louisiana in 1788, where he established a farm and boat landing (also known as Gibson's Landing and Gibson's Port). Claiborne County, Mississippi Territory was organized in 1802, and the name of the County Seat was changed to Port Gibson in 1803. [Enercon 2010e, Section 5.2]

Claiborne County saw its first large-scale "American" settlements shortly after 1798, when the Louisiana Territory was returned by the Spanish to the French. For the most part, settlement remained low and consisted of widely scattered farmstead plantations and loosely organized communities, generally on the highlands east of the river. Tensas Parish was not extensively occupied until after 1803 and consisted of a number of small holdings granted by the Spanish (ca. 1781 to 1798) to Americans migrating from the east. The Grand Gulf and Port Gibson Railroad was established in 1840, running about 7.5 miles between the two communities. [Enercon 2010e, Section 5.2]

Prior to the Civil War, Claiborne County and Tensas Parish were primarily rural agricultural areas dependent upon lumber and produce from the back country, shipped to New Orleans through the port facilities at Grand Gulf and Port Gibson. [Enercon 2010e, Section 5.2]

2.12.2.3 Civil War Period

Control of the Mississippi River was a vital issue to both the Union and Confederate governments. A Union blockade of the Confederate ports forced European powers to transport supplies and arms through Mexico and loss of the Mississippi meant cutting off the main avenue of supplies and men from west of the river. Taking the river was considered by most in the North as the greatest psychological blow that could be made against the South. The Confederacy made the effort to strengthen a number of points to deny the river to the North. Vicksburg commanded the key strategic point on the river and was supported by fortifications at Grand Gulf. General Grant (commanding the Army of the Mississippi Campaign) and Admiral Farragut (commanding the Navy) tried a number of unsuccessful maneuvers during 1862 before retiring

for the winter. In May of 1862, fire from local troops at Grand Gulf led to the Union forces burning the town but taking no further advantage of the landings. Grant wintered at Hard Times Landing in Tensas Parish, allowing the construction of considerable fortifications at Grand Gulf. [Enercon 2010e, Section 5.2]

On April 29, 1863, Farragut's armada began a barrage on the fortifications at Grand Gulf with the hopes of taking the landing for Grant's troops. Farragut was able to silence the lower battery placed in the town site (burned the previous year) but was unable to silence the upper battery on the heights above the town site. On the night of April 30, Farragut began ferrying Grant's troops across the river at Bruinsburg, about 14 miles below Grand Gulf. The landing on the night of April 30–May 1 was the largest marine assault in history up to that point. Two major roadways, Bruinsburg Road and Rodney Road, led from Bruinsburg to the Natchez Trace via Port Gibson. The first elements of the Union force encountered a hastily prepared defense shortly after midnight at the Shaifer House on the Rodney Road near Port Gibson. The Battle of Port Gibson consisted of countless skirmishes around key points on the Bruinsburg and Rodney Roads and numerous smaller fights in the surrounding country side. Fighting lasted the entire day and ended with withdrawal of the Confederate forces across Bayou Pierre and on to Grand Gulf on the morning of May 2. Grand Gulf became untenable and was abandoned on May 3, 1863. Instead of pursuing the Confederate force, Grant's force continued to the northeast, taking Jackson on May 15. After destroying Confederate stores and burning the town, Grant turned west for the assault on Vicksburg from the landward side. Vicksburg fell on July 4, 1863, after a protracted siege. [Enercon 2010e, Section 5.2]

The GGNS tract is located between the Grand Gulf and Port Gibson Battlefields and certainly saw troop movements across the property. The Grand Gulf Battlefield includes an artillery duel between Union gunboats and Confederate earthworks at the town site of Grand Gulf. Observation posts and small earthworks could have existed on the GGNS property but have not been identified in historical records (or physically on the ground). [Enercon 2010e, Section 5.2]

The Port Gibson Battlefield generally occurred south of Bayou Pierre, where the organized ranks of troops faced each other. A series of smaller units and individuals fought a running withdrawal from the main portion of the battlefield and some skirmishing may have occurred on the property. A Union soldier from a Pennsylvania Shaker community was wounded and captured somewhere near Grand Gulf. After the war, the soldier gave a rocking chair (of unique Shaker design) to the Grand Gulf community, in gratitude for his care and treatment as a prisoner of war. The chair has detailed maps painted on the seat and back. The maps depict the town site and surrounding areas, suggesting the soldier had familiarity with the area, either during or after the Port Gibson battle. [Enercon 2010e, Section 5.2]

2.12.2.4 Later Nineteenth Century Period

One of the main features of reconstruction after the Civil War was the introduction of the sharecropper system. Prior to the Civil War, slaves outnumbered whites in Mississippi eight to one, and were concentrated in proximity to plantation improvements. After the war, a system of small parcels of land were essentially leased to former slaves (later joined by poor European

Americans), often referred to as the "Forty Acres and A Mule" system. Individual families took up residence on each of the leased tracts, generally on the edge of flatter croplands in the loess uplands and floodplain bottoms. Possible evidence of sharecropper farmsteads was located in 2006 at sites 22CB824, 22CB827, and a site along the bluff top on GGNS property. As historical archaeological resources, these types of sites are seldom addressed and are not considered significant unless associated with historically prominent persons or events. [Enercon 2010e, Section 5.2]

Portable steam-powered saw mills arrived about the same time as the sharecroppers, a necessity born out of a need for ready cash after the Civil War and more available cropland for sharecroppers. The Port Gibson and Grand Gulf Railroad was completed in 1840 and served as a major link for freighting lumber and other farm produce. Portable sawmill sites are generally ephemeral localities and typically go unnoticed in the archaeological literature. No such sites have been identified on the GGNS property. A segment of the Port Gibson and Grand Gulf Railroad crosses the property along the floodplain just east of the bluff line and along the uplands on the north edge of the property. The rails along the line no longer exist, but segments of the railway bed and bridges over area streams remain relatively intact. [Enercon 2010e, Section 5.2]

By the end of the nineteenth century, the majority of the African-American sharecroppers began resettling in small segregated communities and nearby towns. None of these localities are located on GGNS property. The area remained rural farmland until acquired by GGNS in the 1970s. [Enercon 2010e, Section 5.2]

2.12.3 History of Grand Gulf

GGNS was named for the nearby historic community of Grand Gulf located on the eastern banks of the Mississippi River and adjacent to the Civil War battlefield preserved today by the GGMP. During the 1800s, a significant community grew at the historic Grand Gulf town site during the boom days of "King Cotton." At one point the town had over 1,100 residents and was briefly considered as a potential site for the state capital. A series of disasters, however, brought the promising city to ruin. A yellow fever epidemic struck the community in 1843, followed ten years later by a massive tornado. Then between 1855 and 1860, the Mississippi River eroded away the business district, destroying 55 blocks of the original city. By the time of the Civil War, fewer than 200 people still lived at Grand Gulf. [Enercon 2010e, Section 5.3]

Control of the Mississippi River was a vital issue to both the Union and Confederate governments. Vicksburg commanded the key strategic point on the river and was supported by fortifications at Grand Gulf. General Grant (commanding the Army of the Mississippi Campaign) and Admiral Farragut (commanding the Navy) tried a number of unsuccessful maneuvers during 1862 before retiring for the winter. On April 29, 1863, Admiral Farragut's armada began a barrage on the fortifications at Grand Gulf with the hopes of taking the landing for General Grant's troops. Farragut was able to silence the lower battery placed in the town site (burned the previous year) but was unable to silence the upper battery on the heights above the town site. On the night of April 30, Farragut ferried Grant's troops across the river at Bruinsburg, about 14 miles below Grand Gulf. The first elements of the Union force encountered a hastily prepared

defense shortly after midnight at the Shaifer House on Rodney Road near Port Gibson. Fighting lasted the entire day and ended with withdrawal of the Confederate forces across Bayou Pierre and on to Grand Gulf on the morning of May 2. Grand Gulf became untenable and was abandoned on May 3, 1863. After destroying Confederate stores and burning the town, Grant turned west for the assault on Vicksburg from the landward side. Vicksburg fell on July 4, 1863, after a protracted siege. [Enercon 2010e, Section 5.2]

The property now occupied by GGNS was mainly forest and farmland prior to site construction activities that began in early 1974. At the time, it was the largest construction project in Mississippi state history as well as one of the largest undertaken by private industry in the nation. [Enercon 2010e, Section 5.3] Prior to construction activities, the only structure of any architectural interest on or immediately adjacent to the GGNS site, with exception of the structures in the GGMP, was an antebellum house known locally as the Callendar House, which no longer exists today (Section 2.12.4). In June 1974, MP&L transferred a 164-acre tract of land, which included the bulk of the remaining portion of the old Grand Gulf town site, to the Grand Gulf Military Monument Commission.

2.12.4 Previous Archaeological Studies

The GGNS site has been the focus of several archaeological studies and consultations with the Mississippi SHPO since the early 1970s due to construction of power generating and transmission facilities there. MP&L contracted with the MDAH in June 1972 to perform an archaeological, architectural, and historical survey of the GGNS site, perimeter area, and transmission line routes. A total of eight sites were recorded by archaeologists during these investigations. Seven of the sites (designated 22CB523 through 22CB529) were scatters of lithic and ceramic debris and were not considered important enough for inclusion in the NRHP at the time of the 1972 survey. [Enercon 2010e, Section 4.1]

The Grand Gulf Mound (22CB522), located on the terrace on the bluffs overlooking the Mississippi River on the north part of the property, was considered important enough for potential listing. However, it was damaged by artifact collectors and other activities by the time MDAH archaeologists visited it in 1972. MDAH excavated the Grand Gulf Mound in 1973. Because the mound was excavated, the site was no longer considered eligible for listing in the NRHP. [Enercon 2010e, Section 4.1]

MP&L also commissioned a survey of the existing architectural resources of Claiborne County. One resource, the Callendar House, a mid-19th century simple Greek Revival style house (unique to the county), was located on the eastern portion of the GGNS property. Built by C.D. and Lizzie Hamilton in about 1866, it was later owned by the Maxwell brothers and finally the Callendar Family. By the early 1970s, the Callendar House was in poor condition and now no longer exists. [Enercon 2010e, Section 4.1]

The pre-construction resource assessment also documented a portion of the Grand Gulf town ruins. At the request of the state legislature and the SHPO, MP&L donated 150 acres of land that contained the bulk of the Grand Gulf town ruins to the Grand Gulf Military Monument Commission for its preservation. This land is now part of the GGMP, a former civil war

battleground located immediately north of the GGNS site. The remains of the U.S.S. Rattler, a Federal tin-clad gunboat, were believed to be located just north of this 150-acre tract of land and therefore were not expected to be affected by plant operations or future construction. [Enercon 2010e, Section 4.1]

MP&L also conducted an archaeological survey for the Ray Braswell Transmission Line. The report of that survey was reviewed by the SHPO and the USNRC, who agreed that no historic properties eligible for listing on the NRHP would be affected by construction of the transmission line. The SHPO stated that the burial mound was the only nonexpendable archaeological site within the GGNS site property boundary and associated transmission line routes. [Enercon 2010e, Section 4.1]

In recent years, a portion of the GGNS site has been considered for construction of new nuclear units, with additional archeological assessments conducted in conjunction with the project. An ESP was granted by the USNRC in 2006 for up to two additional nuclear reactor units and their associated support facilities within the boundaries of the GGNS site property. Enercon submitted Section 106 consultation letters dated August 12, 2002, to the MDAH and the Archaeology & Ethnography Program within the National Park Service. The Vicksburg National Military Park and others were also contacted. MDAH, in a letter dated December 12, 2002, requested a cultural resources survey of two noncontiguous onsite areas referred to as "proposed alternate construction space" and "construction space with construction support buildings." [Enercon 2010e, Section 4.1]

A decision was made to defer the survey to an anticipated future site characterization for development of a COLA, which was initiated in 2006. Additional consultations were again initiated at the beginning of the development of the GGNS Unit 3 COLA. The Choctaw Nation responded with a determination that it was unlikely the proposed project would result in adverse effect, but stated that should construction expose artifacts, the Tribal Historic Preservation Office (THPO) should be contacted. MDAH reaffirmed its request that select areas within the site considered for the potential new nuclear reactors and supporting facilities should be surveyed when the GGNS Unit 3 COLA development got underway. Scoping for the survey was submitted to MDAH in January 2007 and approved by MDAH in February 2007. Based on a scoping review, MDAH indicated a portion of the potential construction areas already disturbed would not need to be surveyed. [Enercon 2010e, Section 4.1]

On Entergy's behalf, Enercon contracted with the Archaeological Research Laboratory of the University of Tennessee for a Phase 1 survey of the areas selected in the scoping. Two previously recorded sites (22CB524 and 22CB528) were resurveyed and nine newly discovered sites (22CB820, 22CB821, 22CB822, 22CB823, 22CB824, 22CB825, 22CB826, 22CB827, and 22CB828) were identified by the Archaeological Research Laboratory. With the exception of 22CB528, all of these sites were determined to be ineligible for listing in the NRHP and no further testing of those sites is required. It was determined that Site 22CB528 is potentially eligible for listing in the NRHP and should be avoided or tested further to determine eligibility. [Enercon 2010e, Section 4.1]

Finally, a 300-foot segment of an important 19th century historic railroad, known as the Grand Gulf and Port Gibson Railroad, still exists within the site boundary and was inspected by USNRC staff on April 13, 2004. The steel rails are gone, but the railroad bed and berm exists in good condition. USNRC discussions with MDAH personnel indicate this would not be the best representative portion of the railroad to preserve and, therefore, no mitigation would likely be required should this portion be affected during facility construction. [Enercon 2010e, Section 4.1]

Recently, an additional consultation with the Mississippi SHPO was initiated by Entergy related to construction of a new radial well in the floodplain adjacent to the Mississippi River. The area of construction for Radial Well #6 is in the same area as the proposed intake structure and associated piping included in the archaeological scoping review performed as part of the GGNS Unit 3 COLA. After review, MDAH concluded further archaeological surveys in this area are not required, based on previous investigations and disturbances. [Enercon 2010e, Section 4.1]

2.12.5 Protection of Cultural Resources

As shown in Table 2.12-1, there have been 18 archaeological sites identified on the GGNS property, of which only one has been classified as potentially eligible for listing on the NRHP (Site CB528). The 2010 Phase 1A analysis noted that although the Grand Gulf Mound (Site CB522) was previously excavated and is considered by MDAH to be no longer eligible for NRHP listing, such mounds were typical of larger village sites, and the area surrounding the Mound could hold resources significant enough for listing. [Enercon 2010e, Section 6.1] However, there are no historic sites eligible for listing on or already listed on the NRHP at the GGNS site (Table 2.12-2). Historic sites are areas of land that usually contain aboveground historic structures and objects such as old homes, barns, churches, cemeteries, business districts, and residential districts.

In conjunction with the Phase 1A Literature Review and Archeological Sensitivity Assessment conducted on the GGNS site in August 2010, pre-historic and historic documentary sources were reviewed at the Claiborne County and Tensas County Historical Societies and Libraries, Mississippi and Louisiana Historic Preservation Offices, Mississippi Department of Archives and History, Louisiana State Archeological Survey, Western History Collection in Norman, Oklahoma, and Arkansas Archeological Survey in Fayetteville, Arkansas. In addition, databases at the Mississippi and Louisiana SHPO were reviewed for up-to-date information on previously recorded historical properties and prehistoric sites within a 10-mile radius of GGNS. As a result of this review, archaeological and historical sites identified within a 10-mile radius of the GGNS site are summarized in Tables 2.12-1 and 2.12-2.

During the 2010 assessment, a preliminary grounds walkover at targeted points on the GGNS property was conducted to confirm that certain areas of the property have the potential for containing significant cultural resources. Sufficient reconnaissance was made to determine that the property has undergone some changes, but retains much of its earlier nineteenth and twentieth century farmland character. Based on literature reviews and the site walkover, there is a potential to locate cultural resources on the GGNS site.

The proposed action upon which this ER is based is for the renewal of the GGNS OL. As discussed in Chapter 3, Entergy does not foresee a need for refurbishment during the license

renewal period, nor is any major construction planned that will result in significant land disturbance.

Entergy also does not have plans for further development of property areas in association with the application for license renewal. However, a nuclear fleet procedure is in place for management of cultural resources ahead of any future ground-disturbing activities at the plant. This procedure, which requires reviews, investigations, and consultations as needed, ensures that existing or potentially existing cultural resources are adequately protected and assists Entergy in meeting state and federal expectations. [Entergy 2008d]

Table 2.12-1
Archeological Sites Within a 10-mile Radius of GGNS

Site	County/Parish	Quad	NRHP
CB501	Claiborne	Willows	PE
CB504	Claiborne	Grand Gulf	OR
CB507	Claiborne	Willows	UNK
CB508	Claiborne	Widows Creek	OR
CB519	Claiborne	Willows	PE
CB520	Claiborne	Port Gibson	PE
CB522[a]	Claiborne	Grand Gulf	UNK
CB523[a]	Claiborne	Grand Gulf	NE
CB524[a]	Claiborne	Grand Gulf	NE
CB525[a]	Claiborne	Grand Gulf	UNK
CB526[a]	Claiborne	Grand Gulf	UNK
CB527[a]	Claiborne	Grand Gulf	UNK
CB528[a]	Claiborne	Grand Gulf	PE
CB529[a]	Claiborne	Grand Gulf	UNK
CB530	Claiborne	Widows Creek	UNK
CB531	Claiborne	Widows Creek	NE
CB532	Claiborne	Grand Gulf	UNK
CB534	Claiborne	Widows Creek	OR
CB535	Claiborne	Widows Creek	PE
CB537	Claiborne	Widows Creek	OR
CB538	Claiborne	Widows Creek	UNK
CB539	Claiborne	Widows Creek	UNK
CB540	Claiborne	Widows Creek	UNK
CB541	Claiborne	Grand Gulf	UNK
CB542	Claiborne	Willows	PE

Table 2.12-1 (Continued)
Archeological Sites Within a 10-mile Radius of GGNS

Site	County/Parish	Quad	NRHP
CB543	Claiborne	Grand Gulf	PE
CB544	Claiborne	Grand Gulf	UNK
CB547	Claiborne	Widows Creek	UNK
CB548	Claiborne	Widows Creek	UNK
CB549	Claiborne	Grand Gulf	NE
CB551	Claiborne	Willows	UNK
CB552	Claiborne	Willows	UNK
CB558	Claiborne	Widows Creek	UNK
CB559	Claiborne	Willows	PE
CB560	Claiborne	Willows	UNK
CB561	Claiborne	Willows	UNK
CB562	Claiborne	Willows	UNK
CB564	Claiborne	Widows Creek	UNK
CB568	Claiborne	Widows Creek	PE
CB571	Claiborne	Port Gibson	PE
CB573	Claiborne	Willows	NE
CB575	Claiborne	Port Gibson	NE
CB576	Claiborne	Widows Creek	PE
CB581	Claiborne	Port Gibson	PE
CB582	Claiborne	Port Gibson	PE
CB583	Claiborne	Widows Creek	PE
CB584	Claiborne	Port Gibson	OR
CB586	Claiborne	Willows	PE
CB587	Claiborne	Widows Creek	UNK
CB592	Claiborne	Grand Gulf	UNK
CB593	Claiborne	Willows	UNK

Table 2.12-1 (Continued)
Archeological Sites Within a 10-mile Radius of GGNS

Site	County/Parish	Quad	NRHP
CB594	Claiborne	Willows	UNK
CB595	Claiborne	Willows	UNK
CB596	Claiborne	Willows	UNK
CB597	Claiborne	Willows	UNK
CB598	Claiborne	Willows	UNK
CB599	Claiborne	Grand Gulf	UNK
CB600	Claiborne	Port Gibson	UNK
CB601	Claiborne	Widows Creek	OR
CB609	Claiborne	Willows	PE
CB610	Claiborne	Willows	UNK
CB611	Claiborne	Port Gibson	UNK
CB612	Claiborne	Port Gibson	UNK
CB615	Claiborne	Port Gibson	UNK
CB618	Claiborne	Grand Gulf	UNK
CB620	Claiborne	Port Gibson	UNK
CB621	Claiborne	Port Gibson	UNK
CB622	Claiborne	Port Gibson	PE
CB624	Claiborne	Widows Creek	PE
CB625	Claiborne	Widows Creek	PE
CB626	Claiborne	Widows Creek	PE
CB627	Claiborne	Widows Creek	PE
CB632	Claiborne	Widows Creek	UNK
CB633	Claiborne	Widows Creek	NE?[b]
CB634	Claiborne	Widows Creek	NE
CB635	Claiborne	Widows Creek	NE
CB636	Claiborne	Widows Creek	UNK

Table 2.12-1 (Continued)
Archeological Sites Within a 10-mile Radius of GGNS

Site	County/Parish	Quad	NRHP
CB637	Claiborne	Widows Creek	PE
CB638	Claiborne	Widows Creek	NE
CB639	Claiborne	Widows Creek	NE
CB640	Claiborne	Widows Creek	UNK
CB641	Claiborne	Widows Creek	UNK
CB642	Claiborne	Widows Creek	UNK
CB643	Claiborne	Widows Creek	NE?[b]
CB644	Claiborne	Widows Creek	PE
CB645	Claiborne	Port Gibson	UNK
CB646	Claiborne	Port Gibson	NE
CB647	Claiborne	Port Gibson	PE
CB648	Claiborne	Port Gibson	NE
CB649	Claiborne	Port Gibson	UNK
CB650	Claiborne	Port Gibson	UNK
CB651	Claiborne	Port Gibson	NE
CB652	Claiborne	Port Gibson	PE
CB653	Claiborne	Port Gibson	NE
CB654	Claiborne	Port Gibson	NE
CB655	Claiborne	Port Gibson	UNK
CB656	Claiborne	Port Gibson	NE
CB673	Claiborne	Port Gibson	UNK
CB674	Claiborne	Port Gibson	UNK
CB675	Claiborne	Willows	UNK
CB676	Claiborne	Willows	UNK
CB677	Claiborne	Willows	UNK
CB678	Claiborne	Willows	UNK

Table 2.12-1 (Continued)
Archeological Sites Within a 10-mile Radius of GGNS

Site	County/Parish	Quad	NRHP
CB679	Claiborne	Willows	UNK
CB680	Claiborne	Willows	UNK
CB681	Claiborne	Willows	UNK
CB682	Claiborne	Willows	UNK
CB683	Claiborne	Willows	UNK
CB684	Claiborne	Willows	UNK
CB685	Claiborne	Willows	UNK
CB686	Claiborne	Willows	UNK
CB687	Claiborne	Willows	UNK
CB688	Claiborne	Willows	UNK
CB689	Claiborne	Willows	UNK
CB690	Claiborne	Willows	UNK
CB691	Claiborne	Willows	UNK
CB692	Claiborne	Willows	UNK
CB693	Claiborne	Willows	UNK
CB694	Claiborne	Widows Creek	UNK
CB695	Claiborne	Widows Creek	PE
CB696	Claiborne	Widows Creek	UNK
CB697	Claiborne	Widows Creek	PE
CB698	Claiborne	Widows Creek	UNK
CB699	Claiborne	Port Gibson	UNK
CB699	Claiborne	Widows Creek	UNK
CB700	Claiborne	Widows Creek	UNK
CB709	Claiborne	Widows Creek	UNK
CB710	Claiborne	Widows Creek	UNK
CB714	Claiborne	Widows Creek	PE

Table 2.12-1 (Continued)
Archeological Sites Within a 10-mile Radius of GGNS

Site	County/Parish	Quad	NRHP
CB715	Claiborne	Widows Creek	OR
CB716	Claiborne	Widows Creek	OR
CB717	Claiborne	Widows Creek	OR
CB720	Claiborne	Port Gibson	UNK
CB722	Claiborne	Port Gibson	UNK
CB723	Claiborne	Port Gibson	UNK
CB724	Claiborne	Port Gibson	UNK
CB725	Claiborne	Port Gibson	UNK
CB726	Claiborne	Port Gibson	UNK
CB727	Claiborne	Port Gibson	UNK
CB728	Claiborne	Port Gibson	UNK
CB729	Claiborne	Port Gibson	UNK
CB730	Claiborne	Port Gibson	UNK
CB731	Claiborne	Port Gibson	UNK
CB732	Claiborne	Port Gibson	UNK
CB733	Claiborne	Port Gibson	UNK
CB734	Claiborne	Port Gibson	UNK
CB735	Claiborne	Port Gibson	UNK
CB736	Claiborne	Port Gibson	UNK
CB738	Claiborne	Port Gibson	UNK
CB739	Claiborne	Port Gibson	UNK
CB740	Claiborne	Port Gibson	UNK
CB741	Claiborne	Port Gibson	UNK
CB742	Claiborne	Port Gibson	UNK
CB743	Claiborne	Port Gibson	UNK
CB749	Claiborne	Port Gibson	UNK

Table 2.12-1 (Continued)
Archeological Sites Within a 10-mile Radius of GGNS

Site	County/Parish	Quad	NRHP
CB750	Claiborne	Port Gibson	UNK
CB751	Claiborne	Port Gibson	UNK
CB752	Claiborne	Port Gibson	UNK
CB753	Claiborne	Port Gibson	UNK
CB759	Claiborne	Willows	UNK
CB763	Claiborne	Widows Creek	NE
CB765	Claiborne	Port Gibson	UNK
CB766	Claiborne	Willows	UNK
CB768	Claiborne	Port Gibson	UNK
CB773	Claiborne	Port Gibson	NE
CB775	Claiborne	Port Gibson	NE
CB776	Claiborne	Port Gibson	UNK
CB777	Claiborne	Port Gibson	UNK
CB778	Claiborne	Port Gibson	UNK
CB779	Claiborne	Port Gibson	UNK
CB780	Claiborne	Port Gibson	UNK
CB781	Claiborne	Port Gibson	UNK
CB783	Claiborne	Port Gibson	UNK
CB784	Claiborne	Port Gibson	UNK
CB785	Claiborne	Port Gibson	UNK
CB786	Claiborne	Port Gibson	UNK
CB787	Claiborne	Port Gibson	UNK
CB788	Claiborne	Port Gibson	UNK
CB789	Claiborne	Port Gibson	UNK
CB790	Claiborne	Port Gibson	UNK
CB791	Claiborne	Port Gibson	UNK

Table 2.12-1 (Continued)
Archeological Sites Within a 10-mile Radius of GGNS

Site	County/Parish	Quad	NRHP
CB792	Claiborne	Port Gibson	UNK
CB793	Claiborne	Port Gibson	UNK
CB794	Claiborne	Port Gibson	UNK
CB795	Claiborne	Port Gibson	UNK
CB797	Claiborne	Port Gibson	UNK
CB797	Claiborne	Widows Creek	UNK
CB798	Claiborne	Port Gibson	UNK
CB799	Claiborne	Port Gibson	UNK
CB800	Claiborne	Port Gibson	UNK
CB801	Claiborne	Widows Creek	E
CB803	Claiborne	Port Gibson	UNK
CB804	Claiborne	Port Gibson	UNK
CB805	Claiborne	Port Gibson	UNK
CB813	Claiborne	Widows Creek	PE
CB819	Claiborne	Port Gibson	UNK
CB820[a]	Claiborne	Grand Gulf	NE
CB821[a]	Claiborne	Grand Gulf	NE
CB822[a]	Claiborne	Grand Gulf	NE
CB823[a]	Claiborne	Grand Gulf	NE
CB824[a]	Claiborne	Grand Gulf	NE
CB825[a]	Claiborne	Grand Gulf	NE
CB826[a]	Claiborne	Grand Gulf	NE
CB827[a]	Claiborne	Widows Creek	NE
CB828[a]	Claiborne	Widows Creek	NE
CB829[a]	Claiborne	Grand Gulf	UNK

Table 2.12-1 (Continued)
Archeological Sites Within a 10-mile Radius of GGNS

Site	County/Parish	Quad	NRHP
CB862	Claiborne	Port Gibson	UNK
TE8	Tensas	Newellton	E
TE119	Tensas	Newellton	UNK
TE150	Tensas	Newellton	UNK
TE151	Tensas	Grand Gulf	UNK
TE152	Tensas	Grand Gulf	UNK
TE153	Tensas	Grand Gulf	UNK
TE154	Tensas	Grand Gulf	UNK
TE155	Tensas	Grand Gulf	UNK
TE156	Tensas	Newellton	UNK
TE157	Tensas	Newellton	UNK
TE159	Tensas	Grand Gulf	PE
TE160	Tensas	Newellton	UNK
TE163	Tensas	Newellton	PE
TE164	Tensas	Newellton	PE
TE166	Tensas	Newellton	PE
TE167	Tensas	Newellton	PE
TE168	Tensas	Newellton	PE
TE169	Tensas	Newellton	PE
TE170	Tensas	Newellton	PE
TE171	Tensas	Newellton	PE
TE172	Tensas	Newellton	PE
TE173	Tensas	Newellton	PE

Reference: Enercon 2010e, Table 1
E = Eligible NE = Not Eligible PE = Potentially Eligible OR = On Register UNK = Unknown

a. Located on GGNS property.
b. Confirmation would be needed to determine if it is not eligible.

Table 2.12-2
Historical Resources Within a 10-Mile Radius of GGNS

State	County/Parish	Resource Name	Quad	NRHP	State Listing
LA	Tensas	Lakewood	St. Joseph	1983	
LA	Tensas	St. Joseph Historic District	St. Joseph	1980	
LA	Tensas	Tensas Parish Courthouse	St. Joseph	1979	
MS	Claiborne	Bayou Pierre Site	Port Gibson	1978	
MS	Claiborne	Bethel Presbyterian Church	St. Joseph	1978	1004
MS	Claiborne	Buena Vista Cotton Gin (Watson Steam Gin)	Port Gibson	1974	5003
MS	Claiborne	Building 801 Chinquepin Street	Port Gibson	1979	
MS	Claiborne	Canemount	St. Joseph	1982	1003
MS	Claiborne	Catholic Cemetery	Port Gibson	1979	
MS	Claiborne	Catledge Archeological Site	St. Joseph	1974	
MS	Claiborne	Canters Creek Mound	Port Gibson	1973	
MS	Claiborne	Civil War Earth Works	Grand Gulf	Eligible	2003
MS	Claiborne	Civil War Earth Works	Grand Gulf	Eligible	2004
MS	Claiborne	Chamberlain-Hunt Academy Historic District	Port Gibson	1979	
MS	Claiborne	Cabinwood House Plantation	Port Gibson	Eligible	5010
MS	Claiborne	Claremont	Port Gibson	1979	
MS	Claiborne	Collina	Port Gibson	1979	
MS	Claiborne	Connor House	Port Gibson	Eligible	5014
MS	Claiborne	Drake Hill Historic District	Port Gibson	1979	
MS	Claiborne	Golden West Cemetery	Port Gibson	1979	
MS	Claiborne	Grand Gulf Military State Park	Port Gibson	1972	

Table 2.12-2 (Continued)
Historical Resources Within a 10-Mile Radius of GGNS

State	County/Parish	Resource Name	Quad	NRHP	State Listing
MS	Claiborne	Hermitage House	Willows	Eligible	5508
MS	Claiborne	Hollyrood	Port Gibson	1979 (delisted 1992)	
MS	Claiborne	Humphrey Family Cemetery	Willows	Eligible	5509
MS	Claiborne	Idlewild	Port Gibson	1979	
MS	Claiborne	Jewish Cemetery	Port Gibson	1979	
MS	Claiborne	Market Street-Suburb Ste. Mary Historic District	Port Gibson	1979	
MS	Claiborne	McGregor	Port Gibson	1979	
MS	Claiborne	Mount Gomer House	Widows Creek	Eligible	1005
MS	Claiborne	Mount Zion Church	Willows	Eligible	5507
MS	Claiborne	John Nelson Site	Willows	1974	
MS	Claiborne	OA Hoxie House	Widows Creek	Eligible	5004
MS	Claiborne	Oakland Chapel (Oakland Memorial Chapel)	St. Joseph	1974	
MS	Claiborne	Old Brickyard Place (Port Gibson Brick and Manufacturing Company)	Port Gibson	1979	
MS	Claiborne	Old Depot Restaurant and Lounge	Port Gibson	1979	
MS	Claiborne	Owens Creek Bridge	Lorman	1988	
MS	Claiborne	Port Gibson Battle Site	Widows Creek	2005	
MS	Claiborne	Port Gibson Battlefield	Widows Creek	1972	5100
MS	Claiborne	Port Gibson Historic District	Port Gibson	Eligible	
MS	Claiborne	Port Gibson Oil Works Mill Building	Port Gibson	1979	

Table 2.12-2 (Continued)
Historical Resources Within a 10-Mile Radius of GGNS

State	County/Parish	Resource Name	Quad	NRHP	State Listing
MS	Claiborne	Sacred Heart Roman Catholic Church (Confederate Memorial Chapel)	Port Gibson	1987	
MS	Claiborne	Smithfield Site	St. Joseph	1978	
MS	Claiborne	Valley of the Moon Bridge	Carlisle	2005	5503
MS	Claiborne	Van Dorn House (The Hill)	Port Gibson	1971	
MS	Claiborne	Widows Creek Bridge	Widows Creek	1988	5011
MS	Claiborne	Windsor Ruins	Widows Creek	1971	1001
MS	Claiborne	Windsor Site	Widows Creek	1979	
MS	Claiborne	Wintergreen Cemetery	Port Gibson	1979	
MS	Claiborne	Mallot-Brewer House	Widows Creek	Eligible	5009
MS	Claiborne	Bayou Pierre Church	Widows Creek	Eligible	5013

Reference: Enercon 2010e, Table 2

2.13 Related Federal Project Activities

Entergy has reviewed the potential cumulative impacts that the following projects may have on the renewal of the GGNS OL:

GGNS Power Uprate

A license amendment for an EPU for GGNS was submitted to the USNRC in September 8, 2010. The submittal included an evaluation of the environmental impacts of the proposed GGNS EPU from 3,898 MWt to 4,408 MWt. The GGNS EPU Environmental Assessment provided sufficient information for the USNRC Staff to evaluate the environmental impacts of EPU in accordance with the requirements of 10 CFR Part 51. Impacts from the power uprate would be SMALL and do not warrant additional mitigation.

GGNS Early Site Permit

SERI submitted an ESP application on October 16, 2003, for property co-located with the existing GGNS Unit 1 site. Under USNRC regulations in 10 CFR Part 52, USNRC prepared an environmental impact statement as part of its review of an ESP application (NUREG-1817) and issued the Grand Gulf ESP on April 5, 2007.

GGNS COLA—Unit 3

SERI submitted a COLA on February 27, 2008, for a COL for an Economic Simplified Boiling Water Reactor (GGNS Unit 3) to be co-located with the existing GGNS Unit 1, for which the USNRC had issued the ESP. On January 9, 2009, Entergy informed the USNRC that it was considering alternate reactor design technologies and requested the USNRC suspend its review effort until further notice. USNRC is closing out the environmental Draft Supplemental Environmental Impact Statement preparation.

River Bend Station

River Bend Station (RBS) is located within the 50-mile region of GGNS extending from Mississippi RM 262 to 264. EOI submitted a COLA on September 25, 2008, for an Economic Simplified Boiling Water Reactor co-located on the RBS property near St. Francisville, Louisiana. On January 9, 2009, Entergy informed the USNRC that it was considering alternate reactor design technologies and requested the USNRC suspend its review effort until further notice. USNRC has suspended all activities associated with the RBS COLA.

Entergy has advised the USNRC of its plans to seek license renewal to extend the RBS operating license for an additional 20 years. Based on previous Entergy license renewal application submittals, it is anticipated that no refurbishment or other construction activities would occur as a result of this activity.

U.S. Army Corps of Engineers

The USACE periodically completes operation and maintenance projects for dredging to provide project depth for navigation to enable transportation of goods viable to the economy and national security. The nearest project as of September 22, 2010, was at the Claiborne County Port just downriver from GGNS. The next closest project was for the mouth of the Yazoo River in Warren County approximately 31 river miles upriver at Vicksburg, Mississippi. [USACE 2010] Cumulative impacts due to USACE projects are expected to be SMALL relative to GGNS operations during the license renewal term and would not warrant additional mitigation measures for GGNS.

In conclusion, there are no Federal projects that would make it desirable for another Federal agency to become a cooperating agency in the license renewal process.