6. CUMULATIVE EFFECTS

This chapter discusses potential impacts resulting from other facilities, operations, and activities that, in combination with potential impacts from the proposed project, might contribute to cumulative impacts. Cumulative impacts are impacts on the environment that result from the incremental impact of the proposed project when added to other past, present, and reasonably foreseeable future actions, regardless of the agency (federal or non-federal) or person that undertakes such other actions (40 CFR 1508.7). An inherent part of the cumulative effects analysis is the uncertainty surrounding actions that have not yet been fully developed. CEQ regulations provide for the inclusion of uncertainties in the EIS analysis, and state that "(w)hen an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking" (40 CFR 1502.22). Consequently, the analysis contained in this chapter includes what could be reasonably anticipated to occur given the uncertainty created by the lack of detailed investigations to support all cause and effect linkages that may be associated with the proposed project and the indirect effects related to construction and long-term operation of the facilities.

Because cumulative impacts accumulate as to a specific resource area, the analysis of impacts must focus on particular resources or impact areas as opposed to merely aggregating all of the actions occurring in and around the proposed facilities and attempting to form some conclusions regarding the effects of the many unrelated impacts. Narrowing the scope of the analysis to resources where there is a likelihood of reasonably foreseeable cumulative impacts supports the goal of the NEPA process: "to reduce paperwork and the accumulation of extraneous background data" and "emphasize real environmental issues and alternatives" (40 CFR 1500.2[b]). The resources and impact areas that were identified with a likelihood of cumulative impacts include: (1) atmospheric resources, including CO_2 emissions contributing to global climate change; (2) surface water resources; (3) ground water resources and related withdrawal issues; (4) social and economic resources and related traffic congestion issues; (5) environmental justice issues; and (6) other issues. The lack of significant impacts to some other resources by the proposed project combined with the absence of any other known or anticipated events or effect linkages precludes the need to address other resources in this cumulative effects analysis.

Each resource analyzed has an individual spatial (geographic) boundary, although the temporal boundary (time frame) can generally be assumed to equal the 40-year life expectancy of the proposed facilities.

6.1 ATMOSPHERIC RESOURCES

6.1.1 AIR QUALITY

For air quality, the dispersion modeling analysis in Subsection 4.2.1.2 indicates that maximum predicted concentrations would be greater than the SILs for all criteria pollutants except CO. For CO the SILs could be used as thresholds for determining the potential for cumulative impacts under NEPA. For SO_2, NO_2, and PM_{10}, additional modeling, including other sources and background air quality concentrations, was performed. These detailed analyses addressed other emissions sources well beyond the predicted areas of impact for the proposed project and also added background concentrations to address other sources not otherwise accounted for. These analyses demonstrated that no air quality standards or PSD air quality increments would be exceeded (see Tables 4.2-4 and 4.2-5). The highest total impacts, including other sources and background air quality, for SO_2, NO_2, and PM_{10}, were equal to 12.5, 18.0, and 52.0 percent of their respective NAAQS, respectively. (Total impacts relative to $PM_{2.5}$ NAAQS were also estimated but were due almost entirely to ambient levels and not predicted impacts due to project facilities.) In addition, no other future projects that would constitute new major sources of air emissions are known to be in development (MDEQ, 2009e). Consequently, adverse cumulative air quality impacts from the proposed Kemper County IGCC Project facilities, existing sources, and other sources that might be constructed in the foreseeable future, would not be expected.

The potential impacts on human health resulting from emissions of HAPs from the Kemper County IGCC Project were assessed in Subsection 4.2.19.2. Risks due to inhalation and ingestion of fish contaminated by mercury were both evaluated. It was found that the total impacts from all HAPs being emitted by the project would result in risks well below levels of concern for both cancer and noncancer effects, i.e., cancer risk below one in a million, and hazard index below one. Cumulative effects were assessed by incorporating background levels of ambient air toxic concentrations and measured regional mercury deposition values. The 2002 NATA results were used to account for toxic air pollutant emissions from other sources (e.g., stationary, mobile, and area sources) as well as background levels.

The results presented in Table 4.2-49 for inhalation risk indicated that the hazard quotient would be less than one. However, the total risk would be over one in a million (i.e., 4.0E-06). The Kemper project was predicted to contribute 10 percent of the total risk. It should be recognized that this was a conservative screening assessment that assumed continuous maximum emissions throughout the year for all HAPs, and the project impacts were for the point of maximum impact. The project's maximum predicted cancer risk in populated areas is 40 percent of that for the point of maximum impact.

The potential risk resulting from Kemper County IGCC mercury emissions from ingesting fish from the nearby Okatibbee Reservoir resulted in low oral hazard quotients of 0.06 for a subsistence fisher and 0.01 for a recreational fisher. However, cumulative oral risk was predicted to be higher, 12.9 for a subsistence fisher and 2.7 for a recreational fisher. The high cumulative levels are mainly attributable to background deposition that is more than 100 times higher than that predicted for the Kemper County IGCC Project alone. Current flesh mercury concentrations for Okatibbee Reservoir fish are at levels where EPA would suggest limiting consumption.

6.1.2 CLIMATE CHANGE

Background—A worldwide environmental issue is the likelihood of changes in the global climate as a consequence of global warming produced by increasing atmospheric concentrations of GHGs (International Panel on Climate Change [IPCC], 2007a). The atmosphere allows a large percentage of incoming solar radiation to pass through to the earth's surface, where it is converted to heat energy (infrared radiation) that is more readily absorbed by GHGs such as CO_2 and water vapor than incoming solar radiation. The heat energy absorbed near the earth's surface increases the temperature of air, soil, and water.

GHGs include water vapor, CO_2, methane, nitrous oxide, ozone, and several chlorofluorocarbons. The GHGs constitute a small percentage of the earth's atmosphere. Water vapor, a natural component of the atmosphere, is the most abundant GHG. The second-most abundant GHG is CO_2, which remains in the atmosphere for long periods of time. Due to man's activities, atmospheric CO_2 concentrations have increased approximately 35 percent over preindustrial levels. Fossil fuel burning, specifically from power production and transportation, is the primary contributor to increasing concentrations of CO_2 (IPCC, 2007a). In the United States, stationary CO_2 emission sources include energy facilities and industrial plants. Industrial processes that emit these gases include cement manufacture, limestone and dolomite calcination, soda ash manufacture and consumption, CO_2 manufacture, and aluminum production (EIA, 2009a).

In the preindustrial era (before 1750 A.D.), the concentration of CO_2 in the atmosphere appears to have been in the range of 275 to 285 ppm (IPCC, 2007a). In 1958, C.D. Keeling and others began measuring the concentration of atmospheric CO_2 at Mauna Loa in Hawaii (Keeling *et al.*, 1976). The data collected by Keeling's team and others since then indicate that the amount of CO_2 in the atmosphere has been steadily increasing from approximately 316 ppm in 1959 to 386 ppm in 2008 (NOAA, 2009). This secular increase in atmospheric CO_2 is attributed almost entirely to the anthropogenic activities noted previously. In addition, industrial and agricultural activities release GHGs other than CO_2—notably methane, NO_x, ozone, and chlorofluorocarbons—to the atmosphere, where they can remain for long periods of time.

Kemper County IGCC Project Emissions of GHGs—The Kemper County IGCC Project, operating at an 85-percent capacity factor (i.e., at full capacity), would emit approximately 1.8 to 2.6 million tpy of CO_2 while burning lignite coal and firing natural gas in the duct burners, assuming CO_2 capture of 67 and 50 percent, respectively (see Table 2.5-1). It would also emit small amounts (approximately 91,000 tpy of CO_2 equivalents) of other GHGs (e.g., nitrous oxide from the CTs)[1].

Based on a study of life cycle GHG emissions from IGCC power systems (Reuther *et al.*, 2004), DOE estimates that plant operations support, maintenance, and lignite mining could increase annual GHG emissions attributable to the operation of the generating station by approximately 130,000 tons (for a total of approximately 2.0 to 2.8 million tons annually). Total emissions of GHGs from construction activities would be approximately 430,000 tons of CO_2 equivalents (approximately 15 to 22 percent of 1 year's operating emissions).

The initial 6-month operation of the Kemper IGCC plant would rely on coal delivered by truck from the Red Hills mine. These temporary deliveries would result in an additional 4,400 tons of CO_2, which were not included in the life cycle estimates.

GHG emissions from the coal-mining operations would primarily result from the combustion of diesel fuel in mining equipment and off-road vehicles. The mining equipment would include loaders, large dump trucks, dozers, backhoes, graders, and hydraulic shovels. Emissions were conservatively estimated based on a 7-day-per-week, 24-hour-per-day operating schedule, and a best guess as to the number of pieces of equipment and the percent of time that they would be used. For comparative purposes, the annual emissions of CO_2 from mining operations were estimated at approximately 45,000 tons. These emissions would represent less than 2 percent of the annual Kemper County IGCC Project emissions.

Annual emissions of GHGs from construction activities were estimated to be approximately 27,000 tons of CO_2 (i.e., approximately 1 percent of 1 year's operating emissions of the IGCC facility).

Operating at full capacity with beneficial use of CO_2 for EOR and geologic storage, the facility would constitute one of the larger point sources of CO_2 emissions in Mississippi. Neither federal law nor Mississippi law place limits on CO_2 emissions on sources such as the Kemper County IGCC Project, and generally there are few economic incentives or regulatory requirements for utilities to reduce emissions of GHGs from their power plants at this time. However, the federal government is considering several approaches to addressing global warming by limiting emissions of GHGs, including regulating them under the CAA.

[1] These other GHGs would be released by combustion of syngas to generate electricity; combustion of fuels (diesel and gasoline) for transportation and coal mining activities; and the combustion of fuels to produce energy needed for operations and maintenance.

The GHGs emitted by the Kemper County IGCC Project would add a relatively small increment to emissions of these gases in the United States and the world. Overall GHG emissions in the United States during 2007 totaled approximately 7,881.6 million tons (7,150.1 million metric tonnes) of CO_2-equivalents, including approximately 6,727.8 million tons (6,103.4 million metric tonnes) of CO_2. These emissions resulted primarily from fossil fuel combustion and industrial processes. Approximately 42 percent of CO_2 emissions came from the generation of electrical power (EPA, 2009). By way of comparison, annual operational emissions of GHGs from the proposed generating station would equal approximately 0.04 percent of the United States' total 2007 emissions.

The release of anthropogenic GHGs and their potential contribution to global warming are inherently cumulative phenomena. That is, emissions of GHGs from the proposed power plant by themselves would not have a direct impact on the global, regional, or local environment. Similarly, current scientific methods do not allow one to correlate emissions from a specific source with a particular change in either local or global climates.

Impacts of GHGs on Climate—Climate is usually defined as the average weather of a region, or more rigorously as the statistical description of a region's weather in terms of the means and variability of relevant parameters over time periods ranging from months to thousands of years. The relevant parameters include temperature, precipitation, wind, and dates of meteorological events such as first and last frosts, beginning and end of rainy seasons, and appearance and disappearance of pack ice. Because GHGs in the atmosphere absorb energy that would otherwise radiate into space, the possibility that anthropogenic releases of these gases could result in warming that might eventually alter climate was recognized soon after the data from Mauna Loa and elsewhere confirmed that the atmosphere's content of CO_2 was steadily increasing (IPCC, 2007a).

Changes in climate are difficult to detect because of the natural and complex variability in meteorological patterns over long periods of time and across broad geographical regions[2]. There is much uncertainty regarding the extent of global warming caused by anthropogenic GHGs, the climate changes this warming has or will produce, and the appropriate strategies for stabilizing the concentrations of GHGs in the atmosphere. The World Meteorological Organization (WMO) and United Nations Environment Programme (UNEP) established IPCC to provide an objective source of information about global warming and climate change, and IPCC's reports are generally considered to be an authoritative source of information on these issues.

According to the IPCC fourth assessment report, "[w]arming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level" (IPCC, 2007b). The IPCC report finds that the global average surface temperature has increased by approximately 0.74°C in the last 100 years; global average sea level has risen approximately 150 millimeters over the same period; and cold days, cold nights, and frosts over most land areas have become less frequent during the past 50 years. The report concludes that most of the temperature increase since the middle of the twentieth century "is very likely due to the observed increase in anthropogenic [GHG] concentrations."

The 2007 report estimates that, at present, CO_2 accounts for approximately 77 percent of the global warming potential attributable to anthropogenic releases of GHGs, with the vast majority (74 percent) of this CO_2 coming from the combustion of fossil fuels. Although the report considers a wide range of future scenarios regarding

[2] Detection of these types of changes was also difficult because of the limited tools that were available for collecting data and for modeling climate systems. However, scientific advances over the last 20 years have vastly improved the tools available for climatological research.

GHG emissions, CO_2 would continue to contribute more than 70 percent of the total warming potential under all of the scenarios. IPCC therefore believes that further warming is inevitable, but that this warming and its effects on climate could be mitigated by stabilizing the atmosphere's concentration of CO_2 through the use of: (1) "low-carbon technologies" for power production and industrial processes, (2) more efficient use of energy, and (3) management of terrestrial ecosystems to capture atmospheric CO_2 (IPCC, 2007b).

Environmental Impacts of Climate Change—IPCC and the U.S. Climate Change Science Program (CCSP) have examined the potential environmental impacts of climate change at global, national, and regional scales. The IPCC report states that, in addition to increases in global surface temperatures, the impacts of climate change on the global environment may include:

- More frequent heat waves, droughts, and fires.
- Rising sea levels and coastal flooding; melting glaciers, ice caps, and polar ice sheets.
- More severe hurricane activity and increases in frequency and intensity of severe precipitation.
- Spread of infectious diseases to new regions.
- Loss of wildlife habitats.
- Heart and respiratory ailments from higher concentrations of ground-level ozone (IPCC, 2007b).

On a national scale, average surface temperatures in the United States have increased, with the last decade being the warmest in more than a century of direct observations (CCSP, 2008). Impacts on the environment attributed to climate change that have been observed in North America include:

- Extended periods of high fire risk and large increases in burned area.
- Increased intensity, duration, and frequency of heat waves.
- Decreased snow pack, increased winter and early spring flooding potentials, and reduced summer stream flows in the western mountains.
- Increased stress on biological communities and habitat in coastal areas (IPCC, 2007b).

On a regional scale, there is greater natural variability in climate parameters that makes it difficult to attribute particular environmental impacts to climate change (IPCC, 2007b). However, based on observational evidence, there is likely to be an increasing degree of impacts such as coral reef bleaching, loss of specific wildlife habitats, reductions in the area of certain ecosystems, and smaller yields of major cereal crops in the tropics (*ibid.*). For the northern hemisphere, regional climate change could affect physical and biological systems, agriculture, forests, and amounts of allergenic pollens (*ibid.*)[3].

In the region where the Kemper County IGCC Project would be located, the average temperature over the last century has decreased slightly at a rate of 0.5 to 1°F per century (1901 to 2006), and precipitation in some areas of Mississippi has increased at a rate of 0 to 7 percent per century (EPA, 2008). During the next century, Mississippi's climate may change even more—IPCC predicts that the largest increases in future temperatures are likely to occur in the northern latitudes (IPCC, 2007b).

[3] The IPCC report provides more detailed information on the current and potential environmental impacts of climate change and on how climate may change in the future under various scenarios of GHG emissions.

Addressing Climate Change—Because climate change is a cumulative phenomenon produced by releases of GHGs from industry, agriculture, and land use changes around the world, it is generally accepted that any successful strategy to address it must rest on a global approach to controlling these emissions. In other words, imposing controls on one industry or in one country is unlikely to be an effective strategy. And because GHGs remain in the atmosphere for a long time and industrial societies will continue to use fossil fuels for at least 25 to 50 years, climate change cannot be avoided. As IPCC report states, "[s]ocieties can respond to climate change by adapting to its impacts and by reducing [GHG] emissions (mitigation), thereby reducing the rate and magnitude of change" (IPCC, 2007b).

According to the IPCC, there is a wide array of adaptation options. While adaptation will be an important aspect of reducing societies' vulnerability to the impacts of climate change over the next two to three decades, "adaptation alone is not expected to cope with all the projected effects of climate change, especially not over the long term as most impacts increase in magnitude" (IPCC, 2007). Therefore, it will also be necessary to mitigate climate change by stabilizing the concentrations of GHGs in the atmosphere. Because these gases remain in the atmosphere for long periods of time, stabilizing their atmospheric concentrations will require societies to reduce their annual emissions. The stabilization concentration of a particular GHG is determined by the date that annual emissions of the gas start to decrease, the rate of decrease, and the persistence of the gas in the atmosphere. The IPCC report predicts the magnitude of climate change impacts for a range of scenarios based on different stabilization levels of GHGs. "Responding to climate change involves an iterative risk management process that includes both mitigation and adaptation, taking into account actual and avoided climate change damages, co-benefits, sustainability, equity, and attitudes to risk" (IPCC, 2007b).

Climate Change, GHGs, and the Kemper County IGCC Project—DOE estimates that annual emissions of GHGs from the Kemper County IGCC Project would range from approximately 2.0 to 2.8 million tpy of CO_2-equivalents. Over the 40-year commercial life of the project, total emissions would be up to approximately 80 to 112 million tons. The estimates of emissions from the Kemper County IGCC Project account for CO_2 removal that would occur as a result of the carbon capture and sequestration systems. As mentioned earlier, the plant would be designed to capture and sequester approximately 50 to 67 percent of the CO_2 created in the syngas production process. The annual emissions of GHGs from the Kemper County IGCC Project would add to the approximately 2.64 billion tons (2.40 billion metric tonnes) of energy-related CO_2 emissions released annually by the electric power sector in the United States (EPA, 2009). Coal-fired power plants account for 2.17 billion tons (1.97 billion metric tonnes) of that amount (EPA, 2009). Globally, 54 billion tons (49 billion metric tonnes) of CO_2-equivalent anthropogenic GHGs are emitted annually, with fossil fuel combustion contributing approximately 32 billion tons (29 billion metric tonnes). However, it cannot be assumed that, if the Kemper County IGCC Project were not built, these additional emissions would be avoided—other less efficient and/or more CO_2-emitting fossil fuel power plants might be constructed in its stead, or existing plants might produce more power, thereby increasing their CO_2 emissions.

As noted earlier, emissions of GHGs from the proposed power plant by themselves would not have a direct impact on the environment in the proposed plant's vicinity; neither would these emissions by themselves cause appreciable global warming that would lead to climate changes. However, these emissions would increase the atmosphere's concentration of GHGs, and, in combination with past and future emissions from all other sources, contribute incrementally to the global warming that produces the adverse effects of climate change described previously. At present there is no methodology that would allow DOE to estimate the specific impacts (if any) this increment of warming would produce in the vicinity of the plant or elsewhere.

The mining operations and linear facilities associated with the Kemper County IGCC Project would also result in changes in CO_2 sequestration potential of the affected land. Approximately 195 to 375 acres per year would be disturbed in conducting the mining operations (see Subsection 2.2.1.1). A total of 10,225 acres, or 256 acres per year on average, would be disturbed in the mining operation. Following lignite extraction, approximately 275 acres per year would be reclaimed over a 3-year period. On EPA's carbon sequestration Web site, the table of representative carbon sequestration rates for agricultural and forestry practices shows a range of 0.3 to 2.1 metric tons of carbon per acre per year for reforestation. A typical southeastern forest of loblolly or slash pine is expected to have a sequestration potential at the higher end of this range (i.e., 2.1 metric tons of carbon per acre per year). Therefore, assuming that all disturbed land supports forest, up to 790 metric tons of carbon sequestration potential would be lost per year of mining. However, within several years of the beginning of mining, reclamation of the mined area would begin. Therefore, assuming that at any point in time during the life of mine a total of 1,024 acres (i.e., 4 years times 256 acres per year) is disturbed and the sequestration potential is unavailable, the annual loss of sequestration potential would be 2,147 tons. The total sequestration potential lost over the life-of-mine period would be 86,000 tons. After mining is complete, the entire mined area will have been reclaimed, and there would be no permanent loss in sequestration potential.

Approximately 1,600 acres of land would be required for the linear facilities and substations. Most of this land is currently forested, and most of it is expected to be planted with perennial grasses following completion of these facilities. Since the carbon sequestration potential of grasses is lower by perhaps 1 metric ton of carbon per acre per year, there might be a permanent loss of carbon sequestration potential on these areas of approximately 1,000 to 2,000 metric tons per year.

Climate Change, GHGs, and the CCPI—As described in more detail in Subsection 1.2, CCPI provides funding to the private sector for projects intended to demonstrate the commercial potential of advanced technologies that could improve the performance of coal-fired power plants as to energy efficiency, pollution control, and cost of operation.

Increased efficiencies can result in small but cumulatively significant reductions in CO_2 emissions from power stations because less fuel is burned in producing each kilowatt-hour of electricity. Producing power with IGCC units can facilitate carbon capture because the volume of the gas stream from which the CO_2 would be removed is much smaller; it is a precombustion stream and at a higher pressure than the exhaust gas of a pulverized coal unit.

Demonstrations of technologies that increase efficiency, facilitate carbon capture, and sequester CO_2 are important steps in developing strategies for stabilizing atmospheric concentrations of GHGs. The IPCC report states that there is high agreement that atmospheric concentrations can be stabilized by "deployment of a portfolio of technologies that are either currently available or expected to be commercialized in coming decades assuming that appropriate and effective incentives are in place for their development." It identifies carbon capture and storage for coal-fired power plants as one of the key mitigation technologies for development before 2030 (IPCC, 2007b). It notes that energy efficiency will also play a key role in stabilizing atmospheric concentrations. DOE believes that the objectives of CCPI embody these recommendations of the IPCC, and that by providing funding to the Kemper County IGCC Project and other CCPI projects, DOE is providing appropriate incentives for developing technologies that can address global warming and the adverse environmental impacts of climate change.

The net effects of market penetration of IGCC technology would depend on the mix of technology being displaced. For example, the displacement of conventional coal-fired power plants would result in lower emissions; whereas, displacement of natural gas-fired power plants would generally result in net increases in emissions. Although projections of net effects of commercialization of IGCC technology alone are not currently available, DOE has made projections of the market penetration of various technologies under various scenarios of fuel prices and regulations to estimate the benefits of the implementation of its fossil energy research and development (R&D) program (DOE, 2006b). This analysis considers the potential market penetration of fossil energy technologies, as well as nuclear and renewable energy technologies. Depending on the scenario, the implementation of the fossil energy R&D program would result in IGCC plants capturing from 3 to 9 percent of the total market by 2025. Since fossil energy would still provide a substantial portion of the nation's electricity supply under all scenarios, the analysis shows that implementation of the fossil energy R&D program, which includes IGCC, would result in emission reductions of NO_x, SO_2, and CO_2 by the year 2025, relative to a scenario that does not involve fossil energy R&D and the subsequent advancement of IGCC technology.

Regulatory Developments Regarding GHGs—There have been some regulatory developments since the preparation of the Draft EIS relevant to emissions of GHGs. These developments include the endangerment finding by EPA, a proposed rule focused on large stationary sources of GHGs, and the GHG reporting rule.

On December 7, 2009, the EPA Administrator signed a finding that the current and projected concentrations of the six key well-mixed GHGs—CO_2, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride—in the atmosphere threaten the public health and welfare of current and future generations. On December 15, 2009, EPA published the final findings in the *Federal Register* (74 FR 66496). More information may be found at the EPA's Web site http://www.epa.gov /climatechange/endangerment.html. Although this finding does not by itself impose restrictions on industry, it is a prerequisite for regulation of GHGs under the CAA.

The proposed rule, focused on large facilities emitting more than 25,000 tpy of GHGs, would require new or modified facilities to obtain permits that would demonstrate the use of the best practices and technologies to minimize GHG emissions. Since the PSD permit for the Kemper County IGCC Project has been issued, and this proposed rule has not been finalized, this proposed rule would not be applicable to the PSD permit. However, this facility would eventually need a Title V operating permit under the CAA, which would incorporate applicable GHG requirements. (In a letter dated February 22, 2010, the EPA Administrator stated that EPA expects to phase in permit requirements and regulation of GHGs for large stationary sources beginning in 2011 [EPA, 2010b].)

In a related development, on October 30, 2009, the Mandatory Reporting of Greenhouse Gases Rule was published in the *Federal Register* (74 FR 56260). The rule requires reporting of GHG emissions from large sources and suppliers in the United States and is intended to collect accurate and timely emissions data to inform future policy decisions. Additional information on the rule may be found on EPA's Web site http://www.epa.gov/climatechange/emissions/ghgrulemaking.html. Since the Kemper County IGCC

Project would be an electrical generating unit subject to the acid rain provisions of the CAA, it would be required to report emissions of CO_2, methane, and nitrous oxide under this rule. Also, since the facility would be a supplier of CO_2, the amount of CO_2 captured in the process and its end use (in this case, EOR) would be reported annually under the rule.

In addition, under Subpart RR of the Mandatory Reporting Rule, on March 22, 2010, EPA proposed requirements for CO_2 injection and geologic sequestration facilities. All facilities that inject CO_2 for purposes of EOR or long-term geologic sequestration would be required to annually report the mass of CO_2 transferred onsite, the mass of CO_2 injected into the subsurface, and the source of the CO_2 (in this case, an electric generating unit). Additional requirements would apply to long-term sequestration facilities such as reporting the amount of CO_2 geologically sequestered using a mass balance approach and developing and implementing an EPA-approved site-specific monitoring, reporting, and verification plan. However, these latter requirements are not being proposed for EOR facilities that are not injecting CO_2 for long-term sequestration, although EOR facilities could choose to opt-in and monitor and report the additional information required for geologic sequestration. Additional information on the proposed rule can be found on EPA's Web site at www.epa.gov/climatechange/emissions /proposedrule.html. The EOR facilities to which the Kemper County IGCC Project's CO_2 will be delivered are not presently designed for long-term sequestration of CO_2.

6.2 SURFACE WATER RESOURCES

Surface water resources could be affected by **three** separate actions under consideration by DOE: (1) the Kemper County IGCC Project evaluated in this EIS**;** (2) construction and operation of a strategic petroleum reserve (SPR) facility downstream at Richton in Perry County, Mississippi**; and (3) issuing a loan guarantee to Mississippi Gasification, LLC (MG), for the Mississippi Gasification facility at Moss Point in Jackson County, Mississippi, and in a related action providing cofounding in a cooperative agreement with Leucadia Energy, LLC, and Denbury Onshore, LLC, for a two-phase project to support CO_2 capture at the facility and subsequent EOR sequestration**. Figure 6.2-1 illustrates the locations of these **three** projects.

In addition, USACE's Civil Works program actions could affect surface water resources in two ways: regulatory approvals of **Section** 404 permit applications and reasonably foreseeable navigation, hydraulics, and habitat projects. **Other public and private actions not requiring Section 404 permits could also affect surface water resources.**

There are no other reasonably foreseeable actions that could combine with the Kemper County IGCC Project to result in cumulative impacts.

6.2.1 AREAL EXTENT OF CUMULATIVE EFFECTS ANALYSIS

The areal extent of potential cumulative effects associated with the Kemper County IGCC Project and reasonably foreseeable actions is the Pascagoula River basin, including the saltwater/freshwater interface in the estuary at the river's mouth. Figure 6.2-1 illustrates the watershed of the river, along with the headwater and tributary streams, and other relevant attributes.

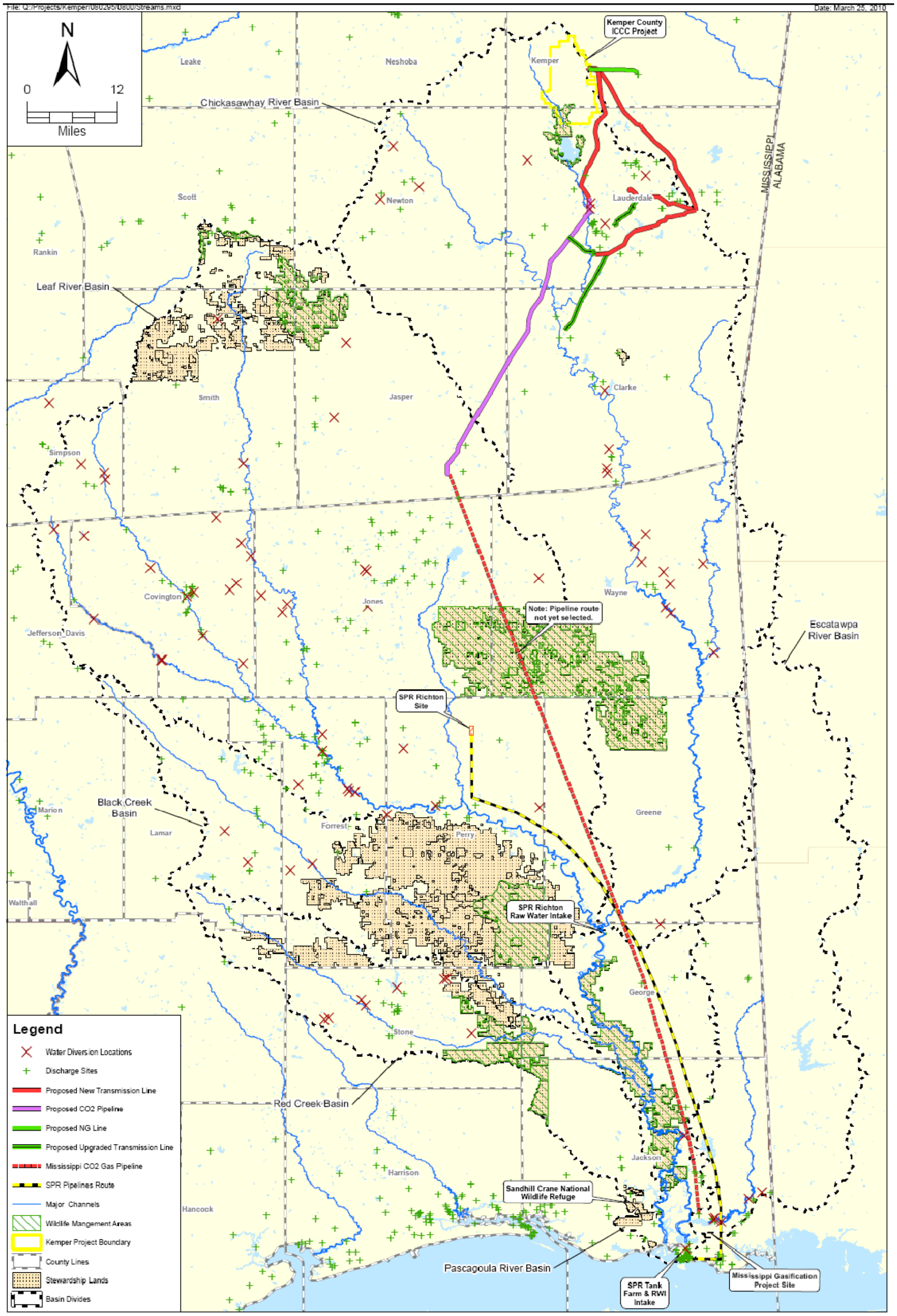


Figure 6.2-1. Pascagoula River Basin

Source: **USDA National Land Cover, 2007. MARIS, 2008.** ECT, 2010.

6.2.1.1 Pascagoula River Basin

The Pascagoula River Basin encompasses approximately 9,500 mi^2, or 6.09 million acres, principally in southeast Mississippi, but also in southwest Alabama (MARIS, 2010). The Pascagoula River Basin extends northward from the Gulf of Mexico some 90 linear miles (not channel miles) to its headwaters in Kemper and Neshoba Counties, where land surface elevations reach 650 ft NGVD. Landforms are low-lying flatlands and marshlands along the coast and low rolling hills and broad, flat floodplains in the inland areas. As shown on Figure 6.2-1, the principal sub-basins are the Leaf River, Chickasawhay River, Black Creek, Red Creek, and Escatawpa River, which is located mostly in Alabama.

Pascagoula River Flows and Patterns

The Pascagoula River is formed by the confluence of the Chickasawhay and Leaf Rivers. From this point, the Pascagoula River flows southward for approximately 25 linear miles before reaching the Gulf of Mexico.

Upstream, the Leaf River extends northwestward for approximately 44 linear miles, and the Chickasawhay River extends northward for approximately 65 linear miles. Downstream, flows are contributed by the Escatawpa River and Red and Black Creeks.

Pascagoula River flow volumes have been measured by USGS at Merrill, as well as stage levels at Graham Ferry downstream. Upstream, the Leaf River flow is measured near McClain, approximately 15 miles above the confluence. Other gauging stations are located upstream on the Chickasawhay River at Leakesville and Enterprise.

The annual average flow of the Pascagoula River at the Merrill gauging station is 10,120 cfs (6.54 billion gpd). Seasonally, flows are lowest in October (3,227 cfs) and highest in March (20,110 cfs), with the majority of flow occurring from December through May. Flows at the Graham Ferry gauge are approximately 33 percent greater than measured at Merrill, and flows in the Leaf River are on average approximately half of the flow measured at Merrill.

Upstream in the Chickasawhay River, USGS measures flow at Leakesville and Enterprise. The mean daily flow at Leakesville is approximately 39 percent of flow at Merrill, while flows at Enterprise are 12 percent of flow at Merrill. USGS also maintains gauges on Okatibbee Creek (Arundel) and the Chunky River. Both of these gauges are upstream of the Chickasawhay River gauging station at Enterprise. Daily mean flows at these two stations at Arundel and Chunky contribute 41 and 39 percent of the flow at Enterprise, respectively.

Base flows are proportionally greater as a percentage of total flow in upstream reaches. MDEQ has established the (7Q10) minimum low flow at the Merrill gauge at 917 cfs.

Flow patterns and volumes in the Chickasawhay River are controlled in part by the release schedule developed and implemented by USACE at the Okatibbee Lake Dam. No other dams are present on the Pascagoula River or its major tributaries. Therefore, in all other sub-basins, flow patterns and volumes are controlled by rainfall and evapotranspiration (Applied Science, 2009). The higher winter seasonal flow volumes discussed previously are attributable to higher precipitation and lower evaporation. The potential evapotranspiration has been estimated at 1,533.6 millimeters per year (USGS, 2010) (60.38 inches per year); these theoretical values are relatively constant across the state. Therefore, the historical evapotrans-

piration losses of 40 inches per year measured at Okatibbee Lake appear reasonable, because actual evapotranspiration will seldom reach potential evapotranspiration. Evapotranspiration can be increased by human activities by constructing surface water impoundments, irrigating cropland, converting uplands into wetlands, and converting grasslands into forests. Evapotranspiration can be decreased by human activities through urban development, converting forests into pasture and cropland, and converting wetlands into uplands.

Flows in the Pascagoula River are decreased by diversions of 3.3 MGD for irrigation, 4.2 MGD for livestock watering, and for industrial uses (ICF Jones & Stokes, 2009). The Jackson County Industrial Water System (JCIWS), operated by the Jackson County Port authority, has a permit to withdraw up to 100 MGD, but the system is currently designed to withdraw, treat, and distribute up to 55 MGD. Most of the water distributed by JCIWS is used by industry in and around the Port of Pascagoula. Mississippi Power's Plant Daniel receives water from the system for cooling. Other significant industrial users include the Chevron refinery (13 MGD makeup water) and Mississippi Phosphates plant (14 MGD). The JCIWS can only withdraw from the Pascagoula River if the minimum flow of 1,030 cfs is being maintained or exceeded. Other large diversions upstream provide cooling water to MPC's Plant Eaton and the Leaf River cellulose plant, both of which are located adjacent to the Leaf River. Mississippi Power's Plant Sweat uses ground water for cooling.

There are 331 permitted discharges (NPDES) outfalls located on the Pascagoula River and its tributaries (see Figure 6.2-1). These permitted outfalls return substantially all of the cooling water supply diverted from the river system.

6.2.1.3 Pascagoula River Water Quality

Water quality in the Pascagoula River generally is good. Most stream segments have clear water, although some tributary segments containing significant wetlands acreage are considered *blackwater* streams due to tannic acid leached from vegetation.

MDEQ's 2008 303(d) list of impaired streams for the Pascagoula River basin is presented in Table 6.2-1. The locations of the listed impaired stream reaches are shown on Figure 6.2-2. MDEQ has also released a Draft 2010 Section 303(d) list of impaired water bodies that has not been approved by EPA or adopted by the state of Mississippi. The Draft 2010 303(d) list contains six new stream reaches in the Pascagoula River Basin. MDEQ is proposing a change of reach IDs for two water bodies in 2010: Davis Dead River and an unnamed tributary of the Leaf River. MDEQ is also proposing reach ID changes for Okatibbee Creek, Sowashee Creek, and Tallahoma Creek in addition to breaking those 2008 impaired reaches into multiple parts. Lastly, Goodwater Creek is proposed to be dropped from the draft 2010 list; a draft fecal coliform TMDL has been prepared for Goodwater Creek, dated February 2010. The 2010 proposed Draft Section 303(d) list of impaired streams in the Pascagoula River basin is presented in Table 6.2-2.

As is evident in both the 2008 303(d) list and the Draft 2010 303(d) list, fish and wildlife support use is the prominent water body use impairment in the Pascagoula River basin that has not yet been addressed with a TMDL. Biological impairment is listed as the pollutant for all of those cases except for Reese Creek; organic enrichment and low dissolved oxygen are listed as the pollutants in that case. The only other use impairment is fish consumption caused by mercury in fish tissue.

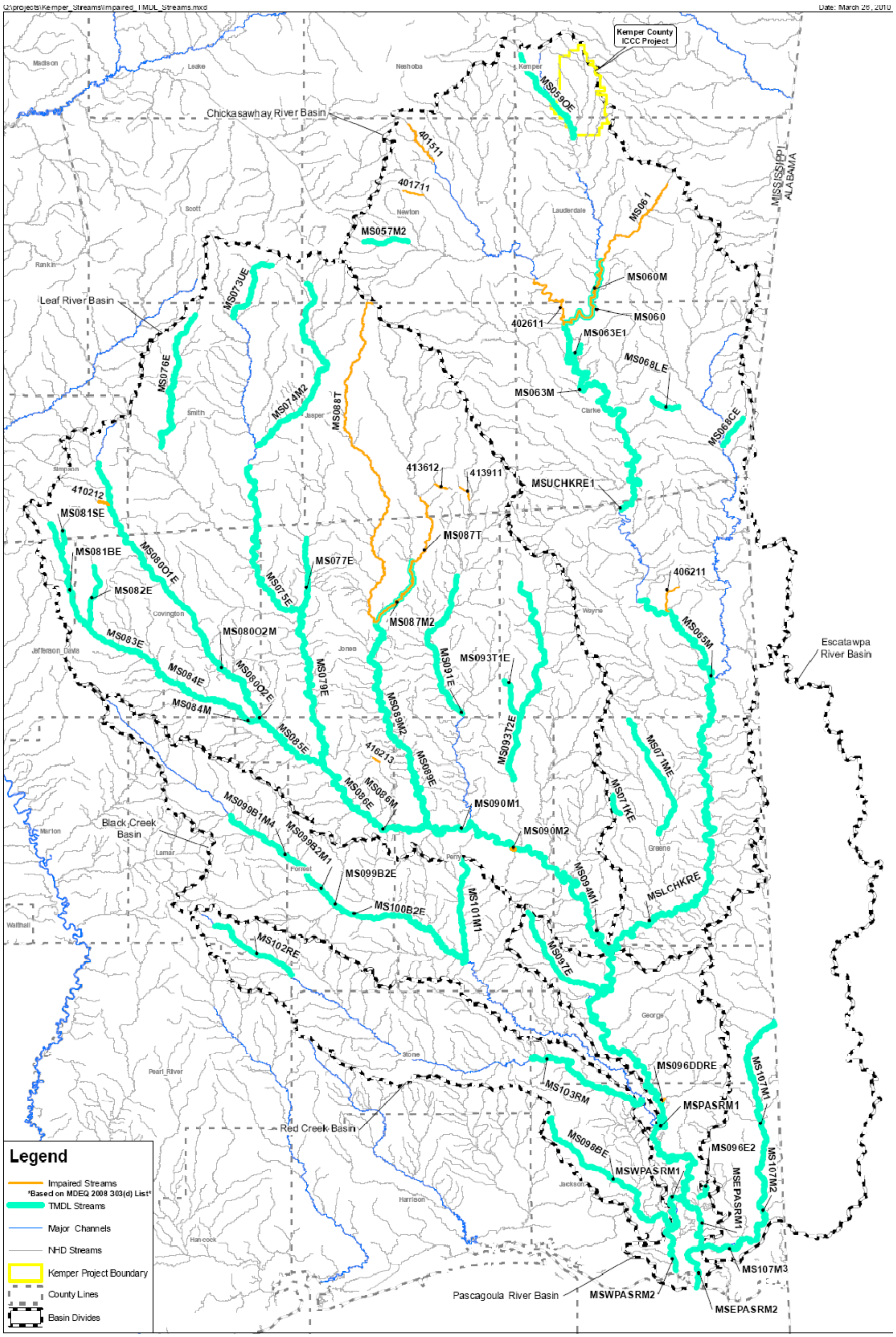


Figure 6.2-2. Stream Segment Impairment Status

Source: MDEQ, 2010. MARIS Watershed, 2008. ECT, 2010.

Table 6.2-1. Mississippi 2008 Adopted Section 303(d) List of Impaired Streams in the Pascagoula River Basin

Water Body Name	Reach ID	County	USGS HUC	Impaired Use	Pollutant
Chunky Creek	401511	Newton	3170001	Fish and wildlife	Biological impairment
Chunky River	402611	Lauderdale	3170001	Fish and wildlife	Biological impairment
Davis Dead River	MS096DDRE	Clarke	3170006	Fish consumption	Mercury
Goodwater Creek	410212	Jackson	3170004	Recreation	Pathogens
Horse Branch	413612	Simpson	3170005	Fish and wildlife	Biological impairment
Okatibbee Creek	MS060	Jasper	3170001	Fish and wildlife	Biological impairment
Patton Creek	406211	Lauderdale	3170002	Fish and wildlife	Biological impairment
Prairie Creek	413911	Wayne	3170005	Fish and wildlife	Biological impairment
Reese Creek	416213	Jasper	3170004	Fish and wildlife	Organic enrichment/low DO
Sowashee Creek	MS061	Forrest	3170001	Fish and wildlife	Biological impairment
Tallahala Creek	MS087T	Lauderdale	3170005	Fish and wildlife	Biological impairment
Tallahoma Creek	MS088T	Jones	3170005	Fish and wildlife	Biological impairment
Unnamed tributary of Leaf River	MS090M2	Jasper/Jones	3170005	Fish and wildlife	Biological impairment

Source: MDEQ, 2010.

Table 6.2-2. Mississippi Proposed Draft 2010 Section 303(d) List of Impaired Streams in the Pascagoula River Basin

Water Body Name	Reach ID	County	USGS HUC	Impaired Use	Pollutant
Anderson Branch	401711	Newton	3170001	Fish and wildlife	Biological impairment
Archusa Creek	405212	Clarke	3170002	Fish consumption	Mercury
Chunky Creek	401511	Newton	3170001	Fish and wildlife	Biological impairment
Chunky Creek	401811	Newton	3170001	Fish and wildlife	Biological impairment
Chunky River	402611	Lauderdale/ Clarke	3170001	Fish and wildlife	Biological impairment
Davis Dead River	417614	Jackson	3170006	Fish Consumption	Mercury
Horse Branch	413612	Jasper	3170005	Fish and wildlife	Biological impairment
Leonards Mill Creek	410312	Covington	3170004	Fish and wildlife	Biological impairment
Long Creek	403111	Clarke	3170002	Fish and wildlife	Biological impairment
Okatibbee Creek	401011	Lauderdale	3170001	Fish and wildlife	Biological impairment
Okatibbee Creek	401111	Lauderdale	3170001	Fish and wildlife	Biological impairment
Patton Creek	406211	Wayne	3170002	Fish and wildlife	Biological impairment
Prairie Creek	413911	Jasper	3170005	Fish and wildlife	Biological impairment
Reese Creek	416213	Forrest	3170004	Fish and wildlife	Organic enrichment/low DO
Souenlovie Creek	404811	Newton/Jasper	3170002	Fish and wildlife	Biological impairment
Sowashee Creek	400811	Lauderdale	3170001	Fish and wildlife	Biological impairment
Sowashee Creek	400911	Lauderdale	3170001	Fish and wildlife	Biological impairment
Tallahala Creek	MS087T	Jones	3170005	Fish and wildlife	Biological impairment
Tallahoma Creek	412511	Jasper/Jones	3170005	Fish and wildlife	Biological impairment
Tallahoma Creek	412711	Jasper/Jones	3170005	Fish and wildlife	Biological impairment
Tallahoma Creek	412811	Jasper/Jones	3170005	Fish and wildlife	Biological impairment
Tallahoma Creek	412911	Jasper/Jones	3170005	Fish and wildlife	Biological impairment
Unnamed tributary of Leaf River	416511	Perry	3170005	Fish and wildlife	Biological impairment

Source: MDEQ, 2010.

MDEQ has also completed 57 TMDLs that have been approved by EPA through the 2009 calendar year (see Figure 6.2-2 for the TMDL reach locations). Table 6.2-3 lists the water bodies and pollutants addressed by the TMDLs. Multiple TMDLs have been completed for some water bodies to address multiple use impairments and pollutants.

It should be noted that the high concentration of confined-animal feeding operations throughout the upstream watersheds have only recently come under more complete regulation by the federal NPDES permit program. In these watersheds, a large number of poultry grow-out houses are operated by individuals under contract to companies such as Tyson Foods and Sanderson Farms. Historical poultry litter management practices have been documented to cause pathogen, organic enrichment, nutrients (poultry litter can be as concentrated as 6-2-2 fertilizer), and low dissolved oxygen levels, all of which can contribute to biological impairment. The recent regulatory changes are intended to cause reversals, at least in part, to these impairments. It should also be noted that certain of the sediment impairment designations are due to channel instability and stream bank erosion as compared to turbid runoff from the contributing watershed (MDEQ, 2005).

6.2.1.4 Pascagoula River Basin Historical and Current Land Use

Figure 6.2-3 illustrates land use and vegetative cover as of 2007 in the Pascagoula River Basin. Table 6.2-4 converts the spatial data into a tabular summary of acreages by principal sub-basin. The land use/land cover classifications shown are those applied by USDA when developing the data.

As shown on Figure 6.2-3, the Pascagoula River Basin is largely rural, with sizeable urban areas limited to Meridian, Laurel, Hattiesburg, and Pascagoula. Overall, the basin is 66-percent forested, 12-percent agriculture land, and 6-percent developed land (USGS, 2010). Forestry in the form of pine plantations is a dominant land cover and a significant contributor to the economy. Most agricultural land is pasture, with row crop fields comprising less than 2 percent of the basin. Similarly, open water bodies comprise less than 2 percent of the watershed, with Okatibbee Lake and the estuary being the only significant waterbodies.

Mining was not mapped separately by USDA. However, barren land, which would include active mining areas not yet reclaimed, totals less than 10,000 acres or 0.1 percent of the basin. MDEQ and USACE records indicate currently active mining areas are located near metropolitan areas and provide construction aggregate materials. Historically, aggregate mining has been documented in the channels of Thompson Creek and the Bowie River (UF, 2008); both of these streams are tributaries to the Leaf River.

6.2.1.5 Stewardship Lands

A total of more than 653,000 acres of stewardship lands are located in the Pascagoula River Basin. These areas, shown on Figure 6.2-3, are comprised of eight wildlife management areas, the Bienville National Forest, the DeSoto National Forest, the Sandhill Crane National Wildlife Refuge, and Mississippi Department of Marine Resources Pascagoula River Marsh. A total of 21 miles of Black Creek within the DeSoto National Forest have been designated a Wild and Scenic River

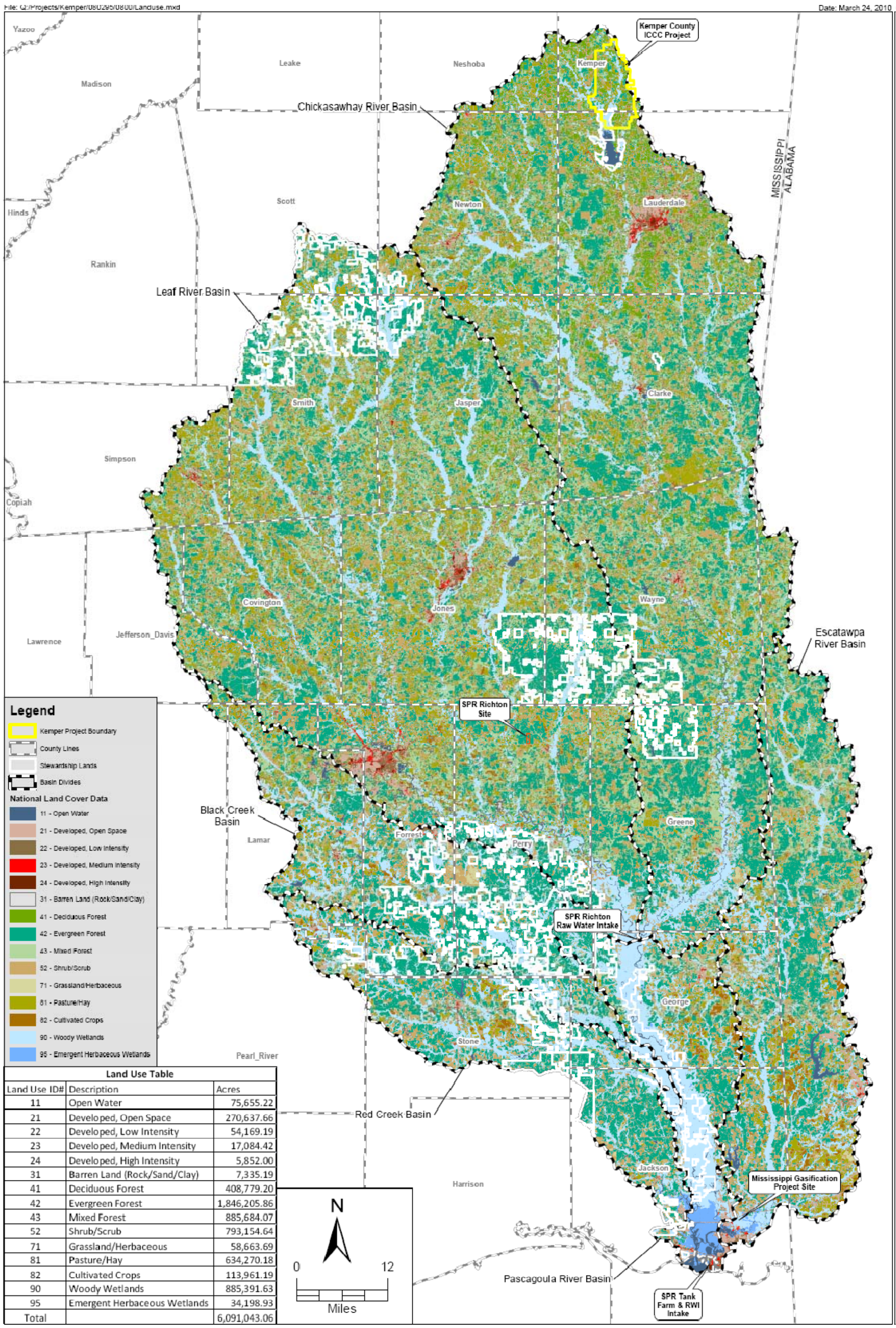
Table 6.2.3 List of TMDLs Completed by MDEQ for Water Bodies in the Pascagoula River Basin

Water Body Name	Impaired Reach ID	Pollutants
Big Creek	MS077E	Pathogens
Big Creek	MS071KE	Pathogens
Black Creek	MS099B1M4	Pathogens
Black Creek	MS100B2E	Pathogens
Black Creek	MS099B2E	Pathogens
Black Creek Seg 1	MS099B2M1	Pathogens
Bluff Creek	MS098BE	Sediment
Bogue Homo	MS091E	Nutrient pollution, organic enrichment/low DO
Bostic Branch	MS063E1	Sediment
Bowie Creek	MS084M	Pathogens
Bowie Creek	MS081BE	Pathogens
Bowie Creek	MS084E	Pathogens
Bowie Creek	MS083E	DDT, nutrient pollution, organic enrichment/low DO, pathogens, sediment, toxaphene
Bowie River	MS085E	DDT, nutrient pollution, organic enrichment/low DO, pathogens, sediment, total toxics acute, total toxics chronic, toxaphene
Cedar Creek	MS068CE	DDT, nutrient pollution, sediment, toxaphene
Chickasawhay River	MS063M	Pathogens
Chickasawhay River	MSUCHKRE1	Sediment
Chickasawhay River	MSLCHKRE	DDT, nutrient pollution, sediment, toxaphene
Chickasawhay River Seg 2	MS065M	Pathogens
Cypress Creek	MS101M1	Pathogens
Dry Creek	MS082E	Pathogens, sediment
East Pascagoula River	MSEPASRM2	Mercury
East Pascagoula River	MSEPASRM1	Mercury
Escatawpa River	MS107M3	Nonpriority organics, organic enrichment/low DO, pathogens, pH, total toxics
Escatawpa River	MS107M1	Mercury
Escatawpa River	MS107M2	Mercury
Leaf River	MS086E	Nutrient pollution, organic enrichment/low DO, pathogens, sediment
Leaf River	Ms079e	DDT, nutrient pollution, sediment, toxaphene
Leaf River	Ms073ue	Sediment
Leaf River	Ms086m	Pathogens
Leaf River	Ms075e	DDT, nutrient pollution, sediment, toxaphene
Leaf River Seg 1	Ms090m1	Pathogens
Leaf River Seg 2	Ms094m1	Pathogens
Long Branch	Ms068le	Salinity/TDS/chlorides
Mason Creek	Ms071me	Sediment
Oakahay Creek	Ms076e	Nutrient pollution, organic enrichment/low DO, sediment
Okatibbee Creek	Ms060m	Pathogens
Okatibbee Creek	Ms059oe	Pathogens
Okatoma Creek	Ms080o2m	Pathogens
Okatoma Creek	Ms080o2e	Pathogens
Okatoma Creek	Ms080o1e	Pathogens
Okatoma Creek	Ms080o2m	Pathogens
Pascagoula River	Mspasrm1	Mercury, pathogens
Red Creek	Ms102re	Nutrient pollution, organic enrichment/low DO, pathogens

Table 6.2.3 List of TMDLs Completed by MDEQ for Water Bodies in the Pascagoula River Basin (Continued, Page 2 of 2)

Water Body Name	Impaired Reach ID	Pollutants
Red Creek	Ms103rm	Pathogens
Richardson Mill/ Potterchitto Creeks	Ms057m2	Organic enrichment/low DO, unionized ammonia
Skiffer Creek	Ms081se	Pathogens, sediment
Tallahala Creek Seg 1	Ms087m2	Organic enrichment/low DO
Tallahala Creek Seg 2	Ms089m2	Pathogens
Tallahalla Creek	Ms089e	Pathogens
Thompson Creek	Ms093t2e	Sediment
Unnamed Tributary to Clark Bayou	Ms096e2	Organic enrichment/low DO
West Little Thompson Creek	Ms093t1e	Sediment
West Pascagoula River	Mswpasrm1	Mercury
West Pascagoula River	Mswpasrm2	Mercury
West Tallahala Creek	Ms074m2	Sediment
Whiskey Creek	Ms097e	Sediment

Source: MDEQ, 2010.



Land Use Table

Land Use ID#	Description	Acres
11	Open Water	75,655.22
21	Developed, Open Space	270,637.66
22	Developed, Low Intensity	54,169.19
23	Developed, Medium Intensity	17,084.42
24	Developed, High Intensity	5,852.00
31	Barren Land (Rock/Sand/Clay)	7,335.19
41	Deciduous Forest	408,779.20
42	Evergreen Forest	1,846,205.86
43	Mixed Forest	885,684.07
52	Shrub/Scrub	793,154.64
71	Grassland/Herbaceous	58,663.69
81	Pasture/Hay	634,270.18
82	Cultivated Crops	113,961.19
90	Woody Wetlands	885,391.63
95	Emergent Herbaceous Wetlands	34,198.93
Total		6,091,043.06

Figure 6.2-3. Pascagoula Basin Land Cover

Sources: USDA National Land Cover, 2007. MARIS, 2008. ECT, 2010.

Table 6.2-4. Current Land Use/Land Cover

Sub-Basin	Open Water	Developed	Deciduous Forest	Evergreen Forest	Mixed Forest	Shrub/ Scrub	Herbaceous /Grass	Hay/ Pasture	Cropland	Wetland Forest	Wetland Herb	Total Wetlands	Total Native Cover	Converted Land
Black Creek	1.12%	4.03%	0.68%	38.37%	5.90%	13.31%	2.86%	6.65%	1.53%	24.06%	0.34%	24.40%	47.15%	52.85%
Chickasawhay River	1.17%	5.39%	13.15%	28.34%	18.35%	12.78%	0.23%	9.21%	1.34%	9.81%	0.19%	10.00%	54.51%	45.49%
Escatawpa River	1.41%	4.96%	0.98%	32.09%	10.30%	15.08%	2.29%	11.35%	3.61%	16.02%	0.86%	16.88%	45.54%	54.46%
Leaf River	0.90%	4.38%	6.03%	28.85%	17.99%	12.79%	0.22%	13.57%	1.85%	11.47%	0.13%	11.59%	48.64%	51.36%
Pascagoula River	4.47%	4.91%	0.02%	23.61%	3.58%	9.41%	2.27%	5.55%	2.53%	36.04%	5.29%	41.33%	56.62%	43.38%
Red Creek	0.92%	4.52%	0.02%	40.33%	2.48%	14.40%	3.16%	5.90%	1.71%	24.68%	1.02%	25.70%	45.76%	54.24%
Minimum	0.90%	4.03%	0.02%	23.61%	2.48%	9.41%	0.22%	5.55%	1.34%	9.81%	0.13%	10.00%	45.54%	43.38%
Maximum	4.47%	5.39%	13.15%	40.33%	18.35%	15.08%	3.16%	13.57%	3.61%	36.04%	5.29%	41.33%	56.62%	54.46%
Average	1.66%	4.70%	3.48%	31.93%	9.77%	12.96%	1.84%	8.71%	2.09%	20.35%	1.31%	21.65%	49.70%	50.30%

Sources: USDA National Land Cover, 2007.
MARIS Watershed, 2008.

In addition to these publicly owned lands, privately held lands are subject to conservation easement protection as a result of Section 404 mitigation requirements. These include mitigation banks operated by the Mississippi Department of Transportation and Chevron, among others. Private lands can also be encumbered temporarily or permanently by the Conservation Reserve Program, Grassland Reserve Program, or Longleaf Pine Initiative, all Farm Bill programs.

Fee-simple land and conservation easement (deed restrictions) purchases by conservation organizations and corporations also encumber and protect property in the Pascagoula River basin. For example, The Nature Conservancy has preserved and manages 75,000 acres along the Pascagoula River and operates three wetland and stream mitigation banks in Jackson and George counties.

State of Mississippi wildlife management areas include:

WMA Name	County
Okatibbee	Lauderdale County
Chickasawhay	Jones
Leaf River	Perry
Pascagoula River	George and Jackson
Ward Bayou	Jackson
Red Creek	Stone, George, and Jackson
Mason Creek	Green
Tallahala Creek	Scott, Newton, Smith, and Jasper

6.2.1.6 Natural Land Cover

As shown in Table 6.2-4, total remnant natural cover ranges from 46 to 57 percent on a sub-basin basis and averages 50 percent across the entire watershed. This data suggests between 44 and 54 percent of the land on a sub-basin basin and 50 percent across the entire watershed has been converted to agriculture or urban development.

Wetland land cover ranges from 10 to 41 percent in the sub-basins of the Pascagoula River, with an overall average of 22 percent. With the exception of the downstream coastal marshes, herbaceous wetlands are less than 1 percent of the land cover. Nearly all wetlands are riparian forests that adjoin the river and tributary channels. It should be noted that wetland land cover does not correspond exactly to USACE's definition of wetlands.

6.2.2 REASONABLY FORESEEABLE FUTURE DOE ACTIONS

DOE has proposed to construct additional SPR capacity in the Pascagoula River basin and is considering issuing a loan guarantee to MG for the Mississippi Gasification facility at Moss Point in Jackson County, Mississippi, and in a related action providing cofunding in a cooperative agreement with Leucadia Energy, LLC, and Denbury Onshore, LLC, for a two-phase project to support CO_2 capture at the facility and subsequent EOR sequestration. Potential water resources impacts associated with these foreseeable future actions are summarized in the following subsections.

6.2.2.1 SPR Expansion

The Energy Policy Act of 2005 (EPACT) (P.L. 109-58) required DOE to expand the SPR from its current 727-million-barrel capacity to 1 billion barrels. To fulfill its NEPA requirements, DOE prepared an EIS **to evaluate its** site selection **alternatives**. The preferred alternative **identified in** the EIS was the **development** of a new SPR facility near Richton, Mississippi, due to the presence of a large, undeveloped salt dome, enhanced oil distribution capabilities, and an inland location less vulnerable to hurricanes. **The SPR expansion is not included in the fiscal year 2011 budget at this time; however, the following analysis assumes the project would be built.**

The principal effects on water resources attributable to the SPR expansion would be: (1) the need to withdraw up to 50 MGD (i.e., approximately 77 cfs) continuously during the construction period and during petroleum withdrawals (i.e., to replace the volume of petroleum withdrawn with water to maintain the integrity of the dome); (2) the need to discharge brine generated by dissolution of the salt to form the petroleum storage cavity, as well as when brine is pumped out of the cavity to make room for petroleum additions**; and (3) wetland impacts due to site and pipeline construction**. The volume of brine discharge would correspond to the volume of raw water makeup.

DOE is **propos**ing **to** locat**e** the raw water intake immediately downstream of the confluence of the Leaf and Chickasawhay Rivers in the Pascagoula River near the USGS Merrill gauging station. The brine discharge would occur offshore in the Gulf of Mexico. The Kemper County IGCC Project site is inland and located in a different watershed than the proposed SPR brine discharge facility. Therefore, no cumulative effects would be associated with the contemplated brine discharges **and the Kemper County IGCC Project**.

DOE conduct**ed** two modeling efforts to predict the effects of the water withdrawals required by the SPR Richton site on the Pascagoula River: (1) a Pascagoula River Habitat Study: IFIM; and (2) a Pascagoula River Salt Water **Intrusion** Study (available at http://fossil.energy.gov/programs/reserves/spr /expansion_reports_and _studies.html). The habitat study **affirm**ed DOE**'s** propos**ed** limits to withdrawals to maintain the minimum instream flow necessary to support the federally protected species in the river. The proposed withdrawal limits would be:

- No withdrawals would occur during flows of less than 1,000 cfs.
- Withdrawals of up to 39 cfs would occur at flows of 1,000 to 1,100 cfs (3.5 to 3.9 percent of flow).
- Withdrawals of up to 78 cfs would occur at flows of more than 1,100 cfs (up to 7.1 percent of flow).
- **No restrictions would be applied during declared national emergencies.**

Because yearly low flows predictably occur in October, DOE would also schedule system maintenance to occur at that time, thereby reducing the need to operate the Pascagoula River diversion during annual low flows (DOE, 2009). **During low flow conditions, the SPR and JC IWS combined withdrawals would remove approximately 23 percent of river flow. During average flow conditions, the combined withdrawals would comprise 2.3 percent of river flow.**

Under this proposed withdrawal schedule, the salt water wedge study concluded salinity intrusion would move inland from 0 to 0.2 km (656 ft) during average and above average flow conditions. At the 1,000-cfs flow rate, salinity intrusion would move inland between 1.1 and 1.2 km (3,609 and 3,937 ft).

Across the 78-year period of record for the USGS flow gauge at Merrill, the average daily flow is 1,120 cfs. The drainage area at the Merrill gauge is 6,590 mi^2; the 31,000-acre Kemper County IGCC Project study area represents 0.74 percent of the Merrill gauge drainage area. MDEQ has set the 7Q10 flow at the Merrill gauge at 917 cfs. These flow measurements include historic releases from Okatibbee Lake according to the schedule shown in Table 6.2-**5**. The proposed DOE SPR withdrawal schedule does not require or request USACE to adjust the Okatibbee Lake release schedule to augment low-flow conditions to facilitate development of the SPR.

Table 6.2-5. Okatibbee Dam Minimum Discharges

Month	Minimum Discharge (cfs)
January	10
February	10
March	10
April	50
May	50
June	70/50/30*
July	70/50/30*
August	70/50/30*
September	30
October	30
November	10
December	10

*Pulse and minimum releases subject to lake level.

The hydrologic analyses **present**ed in this Kemper County IGCC Project EIS are **found** in Subsection 4.2.4. Those analyses included incremental water budget analyses and modeling of responses to various storm event responses. The storm event models predicted changes in high-flow conditions, which are not at issue in the SPR evaluations. The water budget of Okatibbee Lake is as follows:

- Rainfall = 57.04 inches.
- Runoff = 17.00 inches.
- Onsite consumption = 40.04 inches.

Onsite consumption **at the Kemper County site** would consist of deep recharge, net ground water outflow, evaporation, and transpiration. Deep recharge **at the Kemper County site** is negligible due to the presence of dense clay beneath the mineable lignite seams. Thus, the predominant onsite consumption factors are evaporation and transpiration.

Onsite consumption during mining would decrease, as up to 3 mi^2 of mined land would consist of disturbed, unreclaimed overburden. These **barren** areas could increase the average annual flow into Okatibbee Lake by approximately 2 cfs, or 1 percent of the annual average flow across the dam. Such changes would represent less than 0.02 percent of the average flow at the Merrill gauge site.

Onsite consumption in the post**mining** condition would be controlled by the percentage of open water, wetlands, forested uplands, and grasslands in the landscape. Onsite consumption would increase if more acres of open water and wetlands exist when compared to the current condition. However, because the total disturbed areas would represent less than 0.3 percent of the Merrill gauge drainage area where the SPR withdrawals would occur, the cumulative effect of the DOE **SPR and Kemper** projects would be insignificant.

In conclusion, the DOE **SPR and Kemper** actions under consideration would not synergize into cumulative effects **in terms of water quantity or water quality**. Because SPR withdrawals would be controlled by flow volumes at the Merrill gauge, any changes to low flow volumes attributable to the Kemper County IGCC Project **c**ould influence when SPR withdrawals could occur but would not combine into cumulative flow reductions downstream beyond those caused by the SPR withdrawals.

Wetland impacts would be cumulative in terms of acreages disturbed. The SPR project could impact up to 1,320 acres of wetlands, and the Kemper County IGCC Project could impact up to 3,000 acres of wetlands, based upon the SPR EIS and Chapter 4 of this EIS. These acreage figures represent worst-case analyses because the USACE evaluations of avoidance, minimization, and cumulative effects are not yet completed for either project. The projects also will be evaluated under the 2008 Mitigation Rule, which requires no net loss of wetland functions.

Because the SPR wetland impacts will occur in the Leaf, Pascagoula, and Escatawpa downstream watersheds and the Kemper County IGCC Project impacts will occur mostly in the Chickasawhay River watershed, cumulative effects on wildlife habitat and utilization and on stream ecology are not likely. Physically, the projects are located approximately 80 miles apart.

6.2.2.2 Mississippi Gasification Facility

On November 12, 2009, DOE issued an NOI to prepare an EIS (*Federal Register* Vol. 74, No. 217 pp. 58262-58265) that will assess the potential environmental impacts of issuing a Federal loan guarantee to MG and providing co-funding in a cooperative agreement with Leucadia Energy, LLC, and Denbury Onshore, LLC (DOE/EIS-0428). The proposed gasification facility would produce 120 million standard cubic ft/day of synthetic natural gas from approximately 7,000 tpd of petroleum coke. MG plans to capture nearly 90 percent of the CO_2 produced and sell it to Denbury under a long-term contract for use in EOR. Denbury would construct a CO_2 pipeline from the MG facility to an existing Denbury pipeline 110 miles to the north that currently distributes CO_2 for use in EOR. Denbury would undertake measurement, modeling, and validation (MMV) studies for the use of CO_2 in EOR projects at the Heidelburg, Soso, and/or the Eucutta oil fields in Mississippi and in the Citronelle oil field in Alabama. Up to 12 MGD of water would be supplied from the Escatawpa River, supplemented by water from the Pascagoula River, well water, and treated water near the site.

The proposed MG facility would be more than 150 linear miles south of the proposed Kemper County IGCC project. This distance would preclude potential cumulative impacts from the two proposed actions on most resources. However, since the Kemper project would potentially affect these resources in the Pascagoula River watershed, DOE considered the potential for cumulative impacts to water resources. Based on a similar analysis as provided previously regarding the effects of the Kemper project on downstream water resources in the Pascagoula River, the effect of the Kemper project combined with the proposed MG facility would not be expected to result in significant cumulative impacts.

The Kemper project and the MG facility under consideration would not produce significant cumulative effects. Because SPR withdrawals upstream of the MG facility would be controlled by flow volumes at the Merrill gauge, any changes to low-flow volumes attributable to the Kemper County IGCC Project would influence when SPR withdrawals could occur but would not combine into cumulative flow reductions downstream beyond those caused by the SPR withdrawals.

With respect to water quality downstream, the effects from the Kemper County IGCC Project would consist principally of an increase in mineralization expressed as TDS. While a localized effect would be measurable as described in Subsection 4.2.4.2, the effect would not be measurable at the Merrill gauging station because of the proportionally small Kemper County IGCC Project contributing area.

Wetland impacts would be cumulative in terms of acres disturbed. As noted previously, potential wetland impacts have yet to be quantified for the MG Project. However, as with the Kemper County IGCC and SPR Projects, USACE evaluations of avoidance and minimization alternatives will be completed to ensure the least environmentally damaging practicable alternative is selected. Prior to issuing a Section 404 permit for the project, USACE would also be required by its regulations to ensure that wetland impacts are minimized and that the mitigation plan fully offsets the potential wetland impacts.

6.2.3 REASONABLY FORESEEABLE FUTURE USACE ACTIONS

USACE is subject to the same cumulative impact assessment standards and criteria that apply to DOE. Both USACE's (a) regulatory permit programs under Section 404 of the CWA and Section 10 of the Rivers and Harbors Act **of 1899** and (b) Civil Works program are subject to these requirements. Accordingly, as USACE **reviews** permit applications under its regulatory **authority** or considers civil works projects, the cumulative effects **analysis is conducted for projects prior to authorization.**

6.2.3.1 Civil Works Programs

With respect to Civil Works Program projects, USACE has advised DOE that no major Civil Works Program projects are planned or scheduled in the immediate vicinity of the Kemper County IGCC Project. Downstream in the Port of Pascagoula, USACE has been evaluating three significant projects, which include:

- **Singing River Marsh Disposal Site—This project involves constructing a dredged material containment structure in open water located east and south of the existing Singing River Island (SRI). The site would encompass 425 acres and accommodate roughly 5,270,000 cubic yards (yd^3) of dredged material from the Pascagoula Harbor Federal Navigation Project. The site would consist of a geotube dike from the northeast point of SRI southward for approximately 5,400 ft and then curving toward the west and west/north. The backend of the geotube dike alignment would tie back into the island. The plan is to beneficially use material dredged from the Pascagoula River Harbor to create emergent tidal marsh habitat at this time.**
- **Pascagoula Harbor Bar Channel Widening—The Pascagoula Bar Widening project will consist of widening the bar channel from 450 to 550 ft. The approximate distance is 7.5 miles. There are also plans to deepen the Horn Island Impoundment Basin. The basin is located beneath the Horn Island Pass Channel.**
- **Bayou Casotte Widening—This project is in the initial planning stages. A feasibility study should be complete by 2014. Construction would occur several years later depending on congressional authorizations or private funding. The plan is to widen up to 7.22 miles of navigation channel from Horn Island Pass to the Bayou Casotte turning basin within the Bayou Casotte Harbor. The current channel width is 350 ft. The study is looking at widening the channel in increments up to 500 ft.**

Due to the distance between these projects, cumulative effects from the Kemper County IGCC Project and the USACE Civil Works Projects are unlikely.

6.2.3.2 Regulatory Program

DOE has examined USACE regulatory program permit actions in the immediate vicinity of the Kemper County IGCC project to determine whether past, present, or reasonably foreseeable future actions would result in cumulative effects on both resources. To facilitate this analysis, USACE provided DOE with a list of permit actions taken since 2000, as well as pending applications. MDEQ's enHANCE database provides additional information concerning permits issued for public and private developments.

The sub-region analyzed included those portions of Kemper, Lauderdale, and Clarke Counties within the Pascagoula River basin. The sub-basins evaluated include Chickasawhay/Okatibbee Creeks, Lower Okatibbee Creek, Sowashee Creek, and the Chickasawhay River. Figure 6.2-4 illustrates the land c over spatially, and Table 6.2-6 presents the land cover acreages in these sub-basins.

As shown in Table 6.2-6, native land cover ranges from 49 to 63 percent of the sub-basins. The highest percentage of converted land occurs in and around the Meridian metropolitan area. Over the entire sub-region, native cover represents 58 percent of the total area.

Similarly, wetland cover is lowest in the Meridian metropolitan area. Wetland land cover ranges from 4 to 12 percent and averages 9 percent.

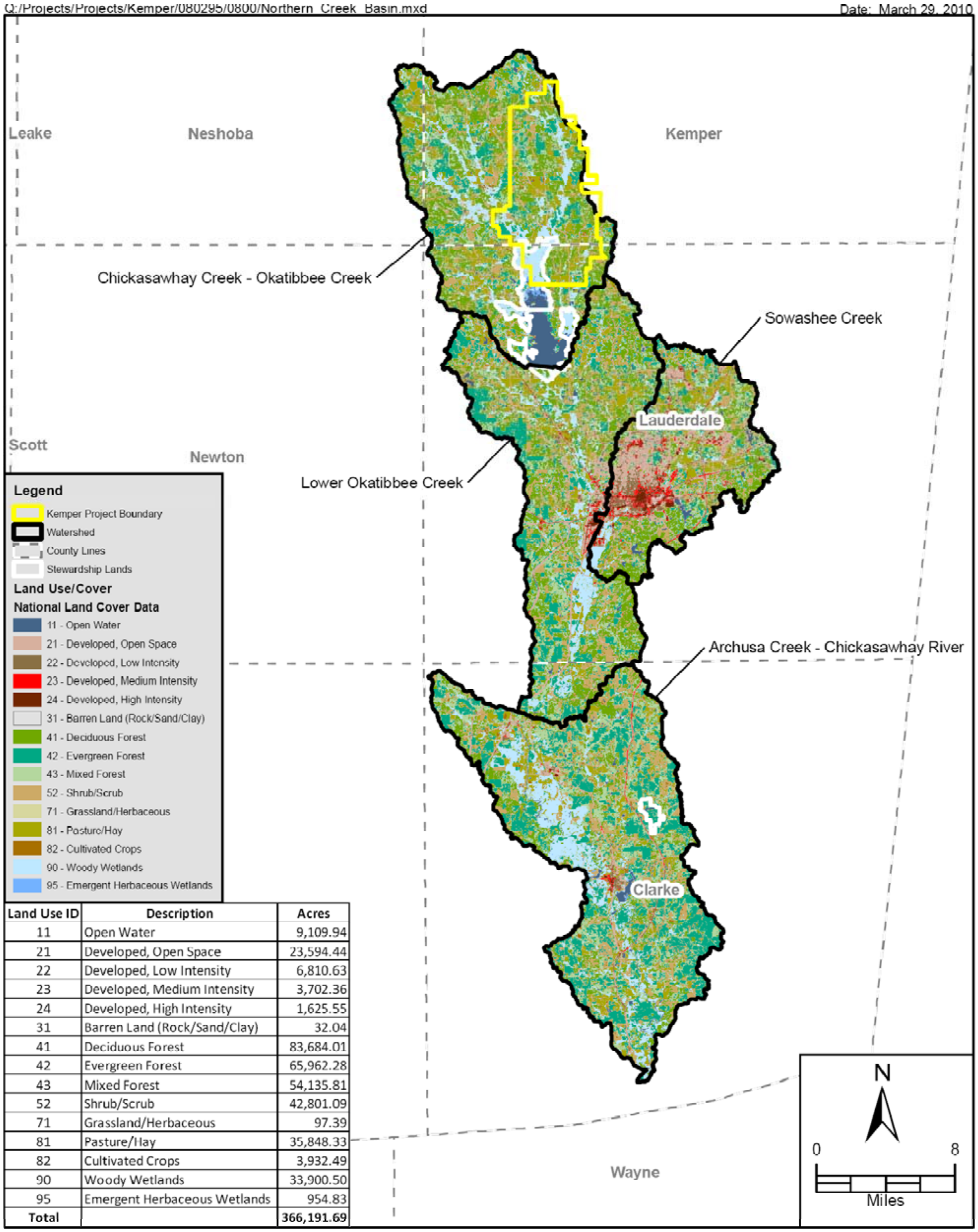
With respect to Regulatory Program actions, USACE has advised DOE that it has issued six individual permits authorizing less than 10 acres of wetland impacts since 2000 in the three-county area. Another 103 Nationwide permit actions have been verified in the three-county area. Impacts associated with these verifications are less than 0.5 acre each. Currently, USACE has no individual permit pending applications, other than the applications necessary to authorize the Kemper County IGCC Project. From a cumulative impact perspective, the locations of the historically permitted and future proposed impacts are distributed across three counties.

USACE has advised DOE it is unaware of any major public or private sector projects in the surrounding three-county area that would result in cumulative impacts other than the DOE actions described previously. DOE review of MDEQ's enHANCE database likewise shows 22 pending permit applications in the Chickasawhay River Basin. Fourteen of these are poultry confined-animal feeding operation general permits, and none involve individual Section 404 permits. Review of USACE records since 2000 reveals approximately 10 Nationwide permit preconstruction notifications annually in the three-county area. This trend is not expected to increase.

6.2.4 CUMULATIVE IMPACTS TO OKATIBBEE LAKE

Table 6.2-6 documents historical conversions of native cover into developed land uses. The Chickasawhay Creek-Okatibbee Creek watershed listed on this table is the Okatibbee Lake watershed. As shown on this table, the Chickasawhay Creek-Okatibbee Creek sub-basin consists of nearly 63 percent native cover. Lands converted to developed uses include:

- 5-percent open water (i.e., Okatibbee Lake).
- 5-percent urban development.
- 14-percent hay/pasture lands.
- 1-percent cropland.
- 13-percent evergreen forest (managed timber).



Land Use ID	Description	Acres
11	Open Water	9,109.94
21	Developed, Open Space	23,594.44
22	Developed, Low Intensity	6,810.63
23	Developed, Medium Intensity	3,702.36
24	Developed, High Intensity	1,625.55
31	Barren Land (Rock/Sand/Clay)	32.04
41	Deciduous Forest	83,684.01
42	Evergreen Forest	65,962.28
43	Mixed Forest	54,135.81
52	Shrub/Scrub	42,801.09
71	Grassland/Herbaceous	97.39
81	Pasture/Hay	35,848.33
82	Cultivated Crops	3,932.49
90	Woody Wetlands	33,900.50
95	Emergent Herbaceous Wetlands	954.83
Total		366,191.69

Figure 6.2-4. Land Use in the Upper Reaches of the Chickasawhay River
Sources: USDA, National Land Cover, 2007. MARIS, 2008. ECT, 2010.

Table 6.2-6. Current Land Use/Land Cover—Upper Chickasawhay River

Sub-Basin	Open Water	Developed	Deciduous Forest	Evergreen Forest	Mixed Forest	Shrub/ Scrub	Herbaceous /Grass	Hay/ Pasture	Cropland	Wetland Forest	Wetland Herb	Total Wetlands	Total Native Cover	Converted Land
Archusa Creek, Chickasawhay River	**1.57%**	**4.07%**	**15.75%**	**26.82%**	**17.62%**	**13.11%**	**0.04%**	**7.26%**	**1.16%**	**10.90%**	**0.19%**	**11.09%**	**57.61%**	**42.39%**
Chickasawhay Creek, Okatibbee Creek	**4.98%**	**4.56%**	**28.46%**	**13.39%**	**12.65%**	**8.95%**	**0.02%**	**13.57%**	**0.92%**	**11.92%**	**0.56%**	**12.48%**	**62.57%**	**37.43%**
Lower Okatibbee Creek	**1.26%**	**6.59%**	**26.48%**	**17.06%**	**14.97%**	**13.11%**	**0.01%**	**9.54%**	**1.10%**	**7.49%**	**0.13%**	**7.62%**	**62.18%**	**37.82%**
Sowashee Creek	**2.14%**	**15.18%**	**21.57%**	**9.01%**	**12.17%**	**11.04%**	**0.03%**	**8.84%**	**1.12%**	**4.02%**	**0.10%**	**4.12%**	**48.93%**	**51.07%**
Minimum	**1.26%**	**4.07%**	**15.75%**	**9.01%**	**12.17%**	**8.95%**	**0.01%**	**7.26%**	**0.92%**	**4.02%**	**0.10%**	**4.12%**	**48.93%**	**37.43%**
Maximum	**4.98%**	**15.18%**	**28.46%**	**26.82%**	**17.62%**	**13.11%**	**0.04%**	**13.57%**	**1.16%**	**11.92%**	**0.56%**	**12.48%**	**62.57%**	**51.07%**
Average	**2.49%**	**7.60%**	**23.06%**	**16.57%**	**14.35%**	**11.55%**	**0.03%**	**9.80%**	**1.08%**	**8.58%**	**0.25%**	**8.83%**	**57.82%**	**42.18%**

**Sources: USDA National Land Cover, 2007.
MARIS Watershed, 2008.**

The percentage of native cover conversion is the lowest in the Upper Pascagoula River basin (see Table 6.2-6) and lower than the Pascagoula River basin rates shown on Table 6.2-4.

Section 3.13 documents that Kemper County's population has remained steady at just more than 10,000 people for decades and is currently projected to increase only slightly. Subsection 6.2.3.2 documents a relatively low level of USACE permit applications upstream of Okatibbee Lake. Review of regulatory agency records did not identify any other projects in the Okatibbee Lake watershed that would significantly change the historical development patterns.

The Kemper County IGCC Project is not likely to trigger development of other supporting industrial or commercial development. At the existing Red Hills Mine, for example, the only supporting development that occurred was construction and operation of a convenience store. Therefore, cumulative impacts to Okatibbee Lake are not expected.

6.3 GEOLOGIC AND GROUND WATER RESOURCES

The direct and indirect geologic impacts of the action alternative, and the resultant construction and operation of the generation facility, surface lignite mine, and associated linear facilities, were described in Subsection 4.2.2. Adoption of the action alternative would not result in significant cumulative impacts to geological resources such as the potential for seismic activity or the future recovery of minerals in the area.

Potential impacts on ground water resources resulting from the construction and operation of the generation facility, surface lignite mine, and associated linear facilities, were described in Subsection 4.2.5. The cumulative impacts would primarily affect ground water availability in the shallow Middle Wilcox aquifer and the deep Massive Sand aquifer. Current uses of these aquifers were described in Subsection 3.7.2, and the estimated water level drawdowns and impacts were described in Subsection 4.2.5.2. The drawdown in the GS sand interval of the Middle Wilcox aquifer could approach 15 ft only to the extent of approximately 0.5 to 1 mile beyond the active mining area, and those drawdowns would not be permanent at any given location. Modeling estimated approximately 6 ft of drawdown at the nearest existing user of the Massive Sand aquifer. This small change in static head in deep wells would result in no measurable change in pump performance or power requirements.

No changes to ground water quality would be expected in any aquifer, with one possible exception. Ground water in the mine spoil deposits in the reclaimed mine areas would likely have higher TDS concentrations than premining ground water, which could preclude development of shallow freshwater wells in the mined portions of the Middle Wilcox aquifer. Fresh ground water would remain available from the underlying Lower Wilcox aquifer, and perhaps from lower sand intervals within the Middle Wilcox aquifer.

6.4 SOCIAL AND ECONOMIC RESOURCES, INCLUDING TRAFFIC CONGESTION ISSUES

Construction and operation of the proposed power plant and the surface lignite mine would be unlikely to combine with any other development activity in the immediate project area to result in cumulative impacts. The area is rural and has not supported significant commercial or industrial development in the past and is not likely to in the foreseeable future. The anticipated economic impact of the direct-effect multiplier would be likely to occur in and around the established municipalities in the area. Similarly, while there would be traffic congestion and a potential for limited housing opportunities, particularly during construction, in the project area, there would likely not be a combined effect with other projects.

There are no known or planned projects in the surrounding area where the local roadways or local housing market would experience traffic/population influx in addition to that generated by the proposed power plant and surface lignite mine construction and operation. The business development manager for the area economic development corporation informed that net employment resulting from known business expansions and contractions would be negative (i.e., net job loss) (Scaggs, 2009). In addition, a recent study of the area's employment (The Pathfinders, 2008) found that: (a) there are "approximately 12,700 unemployed persons actively seeking work," (b) there is "significant underemployment (employment below skill level)," and (c) the "area has approximately 29,400 available workers for new or expanding businesses." Mississippi Power (2009) inquiries also turned up no plans for major project or development activity in the area during the foreseeable future.

Without the proposed project, the population of Kemper County in 2011 is estimated to decrease from that in 2000. Thus, no cumulative effects on demands for labor and socioeconomic resources would be anticipated as a result of the development of the Kemper County IGCC Project.

6.5 ENVIRONMENTAL JUSTICE

Subsection 4.2.12 discussed environmental justice issues. While an environmental justice population exists, "disproportionately high and adverse" impacts to minority and low-income population would not be expected to result, and no additional current or future stressors were identified. Economic direct and indirect multiplier impacts would most likely accrue to the larger municipal areas in the adjacent counties. There might be additional support development occurring in the DeKalb and Scooba areas where there is infrastructure to support such development. The immediate project area is anticipated to remain rural with only limited commercial development likely to occur.

6.6 OTHER ISSUES

The proposed project would have some impacts to other resources, such as noise and ecological resources. The noise impacts of the IGCC power plant and surface lignite mine would not be cumulative, as shown in Subsection 4.2.18.2. In addition, there are no other known or anticipated developments that could add to the noise environment.

Similarly, the project would impact ecological resources, including wetlands. All wetlands impacted by project activities would be subject to permitting and mitigation. There are no other known or anticipated developments that could result in cumulative impacts on wetlands and other ecological resources.

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