2009

Lake Pontchartrain-Lake Maurepas Basin

Characterization Report

Louisiana State Reservoir Priority
and Development Program

moffatt & nichol

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2009

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BASIN CHARACTERIZATION REPORT FOR THE LAKE PONTCHARTRAIN-LAKE MAUREPAS BASIN

The Louisiana Department of Transportation and Development (DOTD) is responsible for reviewing and prioritizing proposed reservoir projects for which State of Louisiana (State) funding is being sought, and then recommending projects to the State Legislature. To support reservoir project review, prioritization, and recommendation efforts, DOTD has prepared characterization reports of water resources conditions in each of the nine principal surface water basins in the State. These characterization reports provide an overview of water uses, needs, and concerns, and can be used by applicants for State funding, and by State agencies as they evaluate the applications. The basin characterization reports also contain extensive references that interested parties can use to find more information from Federal, State, and local agencies or other sources. The reports represent a "snapshot" of conditions in early 2009 (or when the references cited in the reports were published).

Based on available data, this basin characterization report provides an overview of the water uses, needs, and key water resources concerns for the Lake Pontchartrain-Lake Maurepas Basin (PMB) (**Map 1**). Additional technical information on important issues may be provided in separate technical reports.

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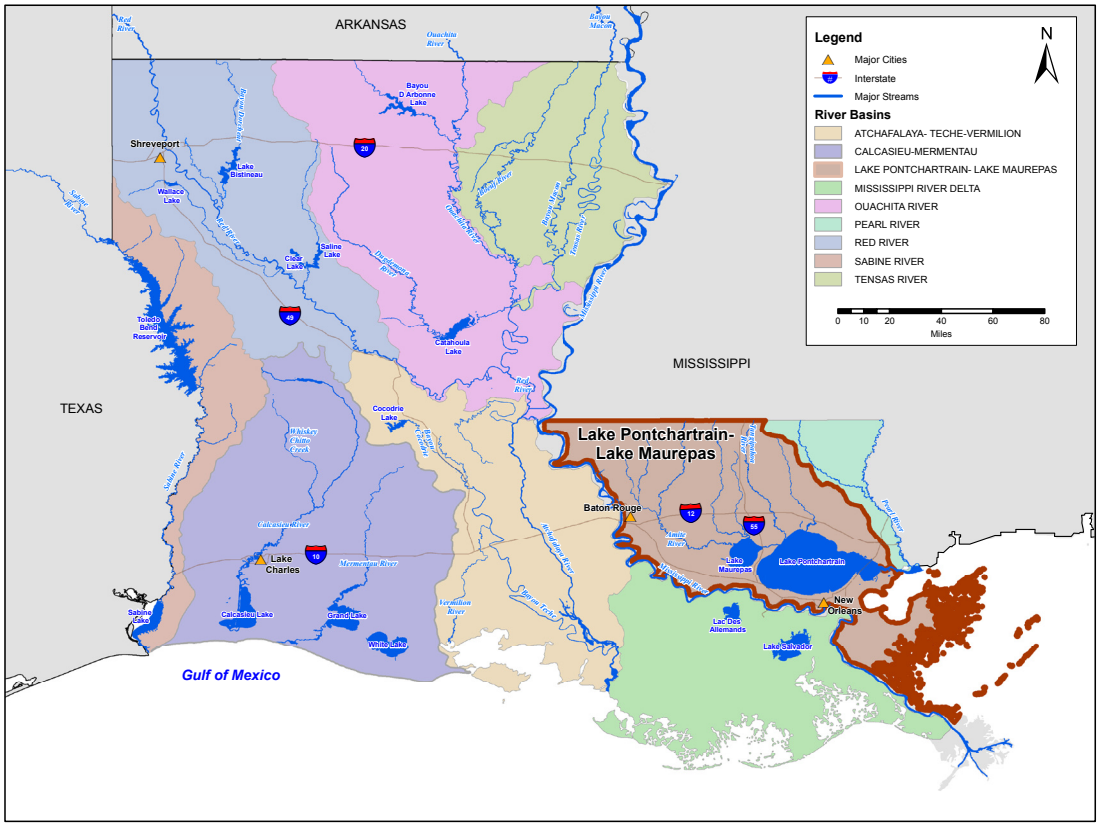
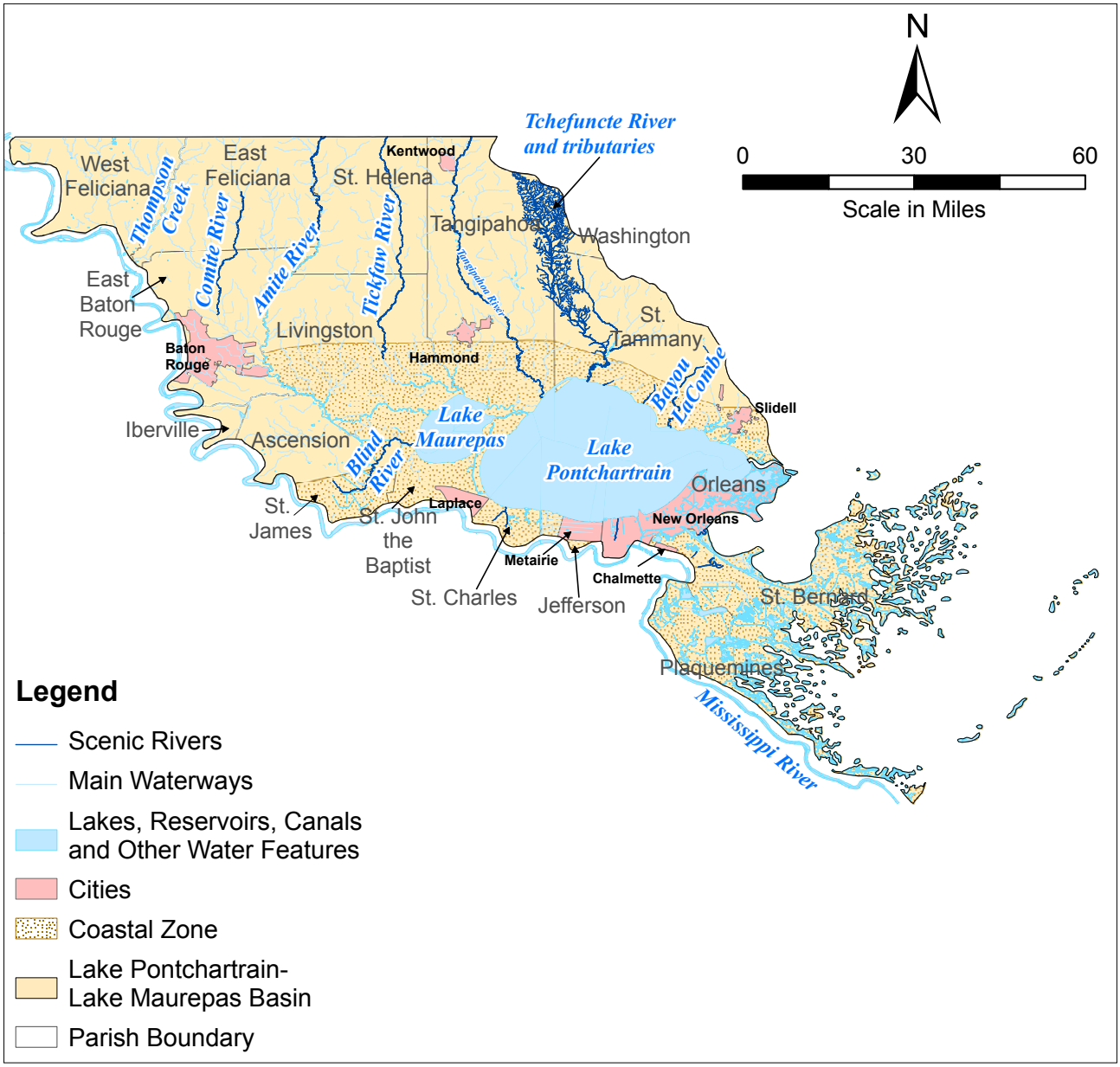


Map 1. Major Surface Water Basins of Louisiana[1]

BASIN OVERVIEW

The PMB is located in southeastern Louisiana and has an area of 5,056 square miles (see **Map 2**).[2] The PMB is bounded by the Mississippi-Louisiana state line to the north, the Atchafalaya-Teche-Vermilion Basin to the west, the Pearl River Basin to the east, and the Mississippi River Delta Basin to the south. The southern PMB is in the Coastal Zone, as delineated by the Louisiana Department of Natural Resources (LDNR).



Map 2. Parishes, Main Waterways, and City Boundaries[3]

Seventeen parishes are either completely or partly encompassed by the PMB. The largest cities in the basin are New Orleans and Baton Rouge (**Map 2**). Estimated total population in the PMB in 2005 was 1,597,994. **Table 1** shows the 2005 population distribution in the PMB by parish. Population increased steadily from 1960 to 2005, as shown in **Figure 1**. Continued growth at the historical rate would likely increase demand for high quality potable water sources.

Principal economic activities in the PMB include oil and gas production, petrochemical manufacturing, tourism, arts and entertainment, food processing and consumer products manufacturing, shipbuilding, and the technology and biotechnology industries.[5] The region's research universities, including Louisiana State University, Tulane University, the University of New Orleans, and Xavier University of Louisiana, are hubs of biotechnology research.[6] All of these current economic activities are likely to continue growing in the future, particularly technology industries that involve electronic and Web-based commerce. Some growing economic activities, particularly oil and gas production, could substantially increase water supply, water treatment, and/or water disposal demands in the PMB.

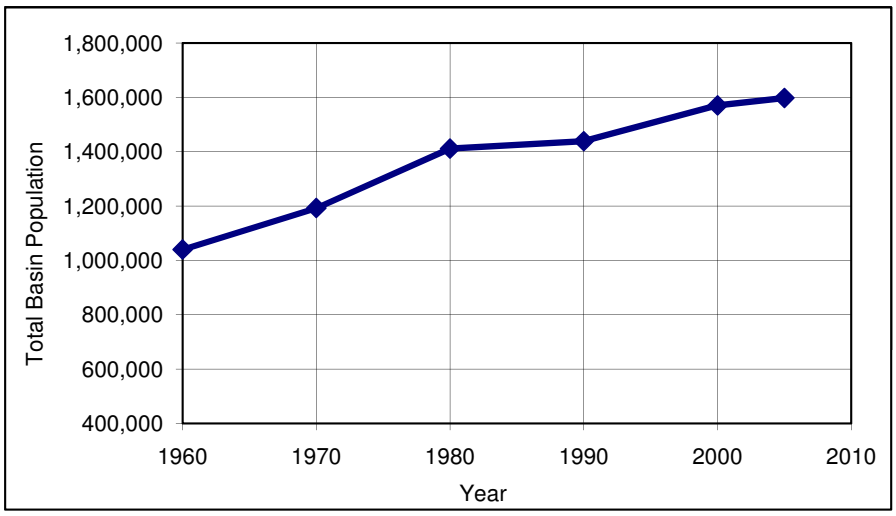


Figure 1. Historical PMB Population

Table 1. PMB Population by Parish in 2005[4]

Parish	Population
Ascension*	76,474
East Baton Rouge*	399,183
East Feliciana	20,557
Iberville*	6,160
Jefferson*	223,764
Livingston	107,480
Orleans*	344,361
Plaquemines*	1,157
St. Bernard*	38,475
St. Charles*	9,109
St. Helena	10,183
St. James*	6,850
St. John the Baptist*	28,086
St. Tammany*	203,146
Tangipahoa*	105,891
Washington*	2,081
West Feliciana*	15,038
TOTAL	1,597,994

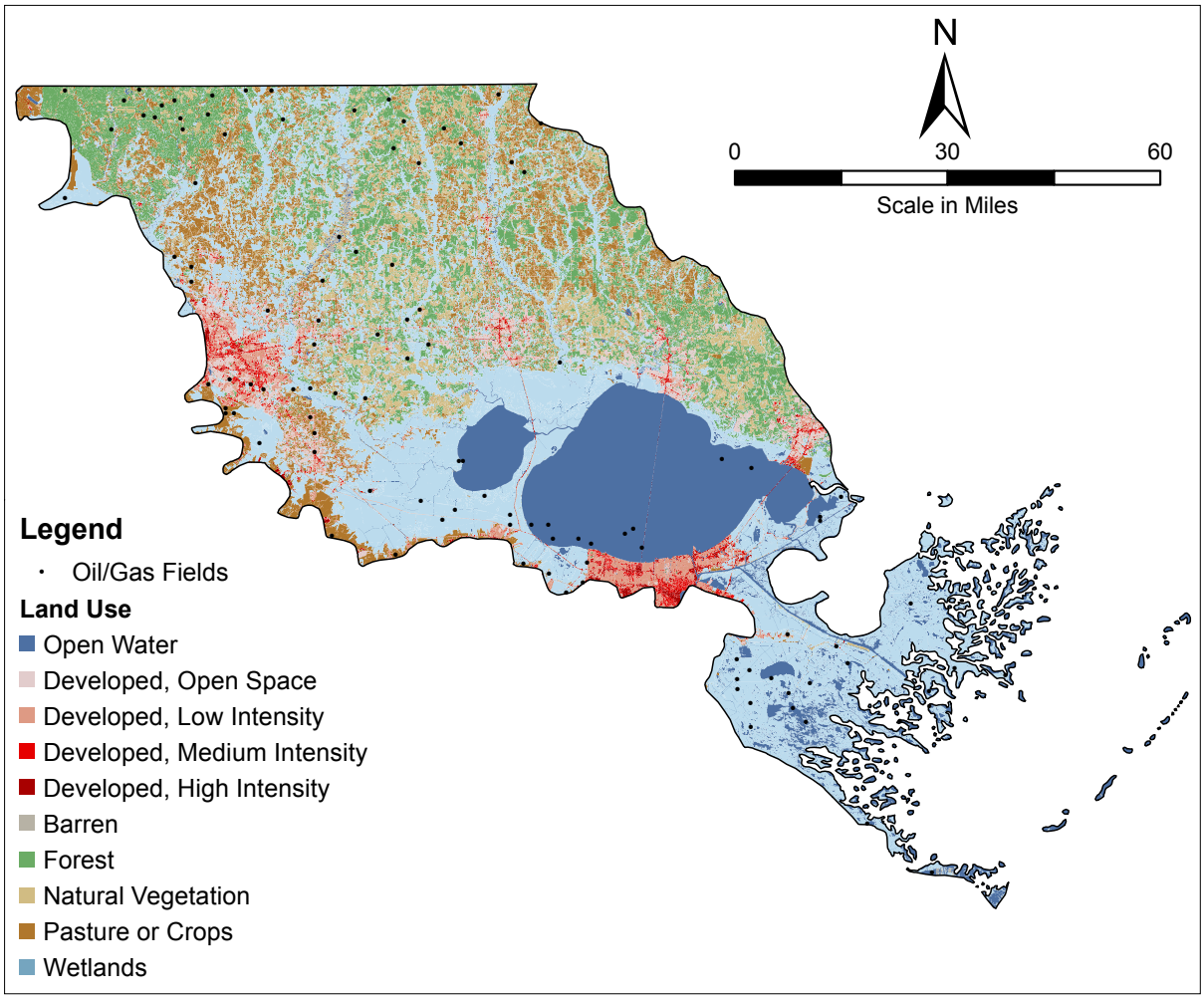
*Parish located in more than one basin; population estimated for the area within the PMB.

PMB=Lake Pontchartrain-Lake Maurepas Basin

LAND USE AND LEGAL ENTITIES

Map 3 shows 2003 land uses in the PMB. Principal land uses are forests and wetlands, particularly in the southern basin. The Baton Rouge and New Orleans metropolitan areas are densely developed; the cities of Slidell, Hammond, and Laplace are slightly less urbanized. Economic modeling for the 1992 to 2020 period indicates that urban land uses may double around Slidell and increase by 50 to 75 percent in the Amite River watershed (Baton Rouge area) during this period. With increased urban development, forested land is expected to decrease substantially in the PMB.[7]

The northern PMB contains land considered Prime Farmland by the Federal Natural Resources Conservation Service (NRCS).[9] The NRCS must be contacted regarding proposed irreversible conversion of any Prime Farmland for reservoir construction and water storage. Oil and gas fields have been drilled throughout the basin (**Map 3**). Oil and gas drilling can require large amounts of water for extraction, which then needs to be disposed, either to surface or groundwater. Existing oil and gas infrastructure and mineral rights holdings may present potential impediments to development of surface water resources. **Table 2** lists legal entities in the PMB that may affect or be affected by water resources development.



Map 3. PMB Land Uses in 2003[8]

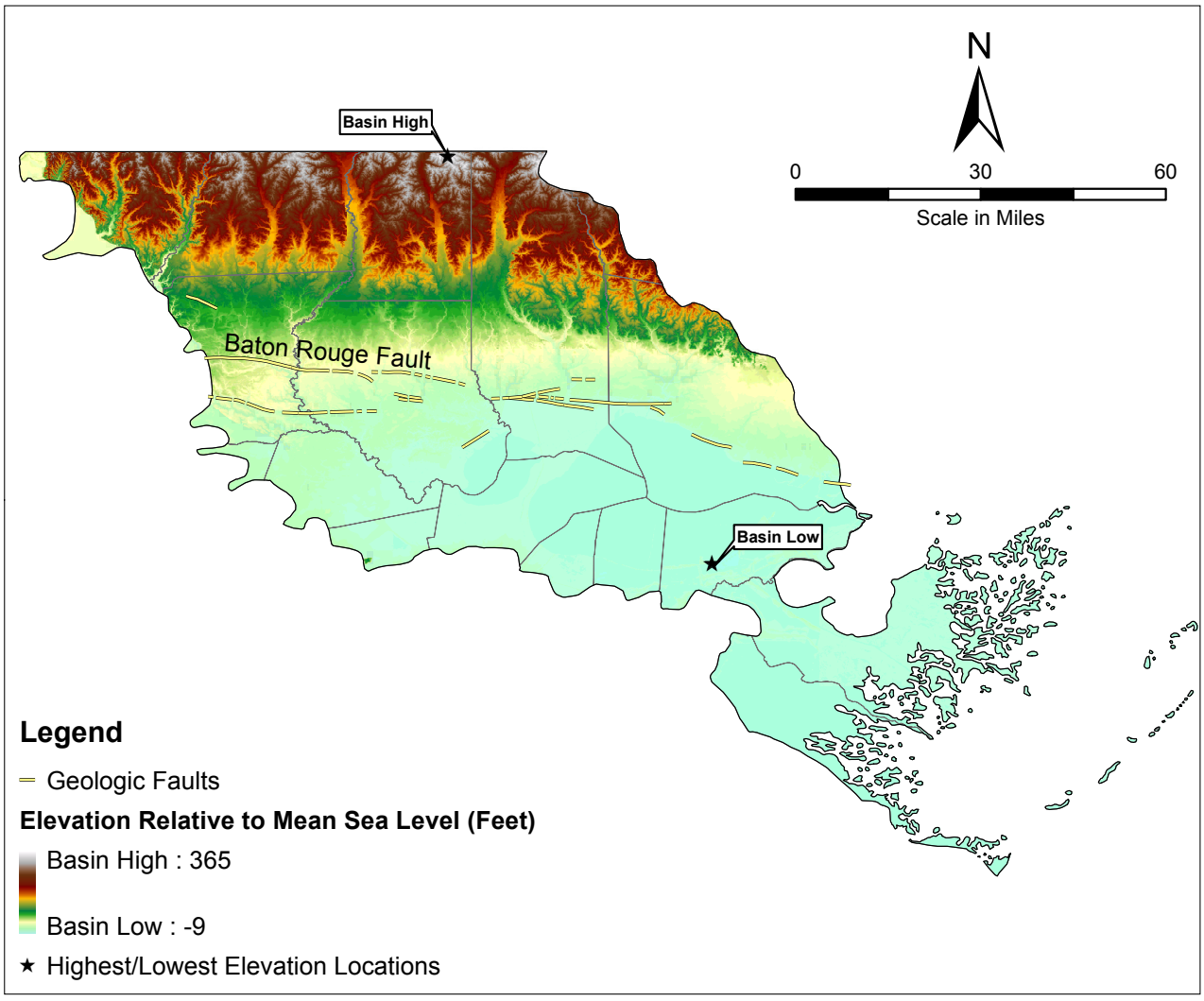
Table 2. PMB Water Resources Legal Entities

Legal Entity	Responsibilities
Capital Area Ground Water Conservation Commission	Promoting orderly use of ground water
Capital Region Planning Commission	Planning and development in southeast/central Louisiana
Regional Planning Commission for Jefferson, Orleans, Plaquemines, St. Bernard, and St. Tammany parishes	Planning and development in southeast/central Louisiana
South Central Planning and Development Commission	Planning and development in south central Louisiana

PMB=Lake Pontchartrain-Lake Maurepas Basin

PHYSIOGRAPHIC AND CLIMATIC INFORMATION

Map 4 shows general basin topography. The north PMB is dominated by the Pine Hills physiographic region, which is characterized by undulating hills covered by pine and hardwood forest. The Coastal Marshes physiographic region dominates the southern PMB, which is characterized by flat land subject to tidal flooding from the Gulf of Mexico. The lowest elevation in the PMB is 9 feet below mean sea level, in the basin center. The highest point, 365 feet above mean sea level, is located in St. Helena Parish, on the northern basin boundary. Geologic faults are oriented east-west across the central PMB, including the Baton Rouge Fault. Historically, depth to saline groundwater is shallower on the south of this fault than on the north side.



Map 4. PMB Topography[10]

Soils in the Pine Hills physiographic region are characterized by thick loess deposits in the east and loamy fluvial deposits in the west. Soils in the Coastal Marshes physiographic region are characterized by loamy and silty deposits.[11]

Historical annual average rainfall throughout the PMB is about 64 inches.[12] **Figure 2** shows historical annual precipitation at Hammond. Total rainfall in the PMB varies widely from year to year; at Hammond, precipitation varies between about 35 and 95 inches per year, with a historical average of about 63 inches per year. Average annual temperature generally increases from north to south in the basin, from 65 to 68 degrees Fahrenheit (°F), respectively.[12] Average high temperature at Hammond in the warmest month, August, is 93°F; average low temperature during the coldest month, January, is 38°F.[13]

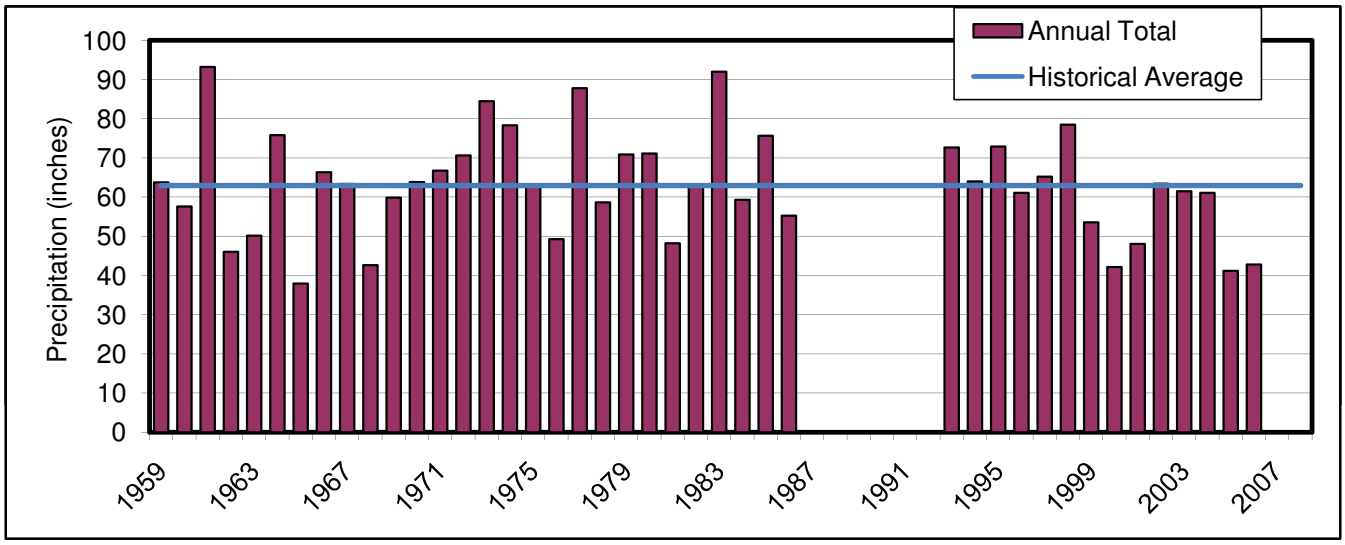


Figure 2. Historical Annual Precipitation at Hammond[12]

WATER USE

Water use in the PMB is summarized in **Table 3** by sector, water type, and parish, as reported for 2005. **Table 3** is based on water withdrawal data, which may be greater than total water consumptive use. For example, the power generation sector withdraws water for both steam generation and cooling, uses that do not entirely consume the withdrawn water, and allow a large percentage of the water to be returned to a waterway. Less than 1 million gallons per day (mgd) of surface water use was reported in 2005.[14]

The majority of reported groundwater withdrawals greater than 100 mgd were used for public supply in 2005. Most municipal water suppliers used less than 2 mgd of groundwater, although the following supplies reported groundwater use equaling or exceeding 2 mgd:

- Baker Utilities – 2 mgd
- Baton Rouge Water Company – 47 mgd
- Denham Springs Water System – 3 mgd
- East Jefferson Water Works (supplies New Orleans) – 47 mgd
- Parish Water Company – 14 mgd
- Zachary Water System – 2 mgd

Over 80 mgd of groundwater was used by the industrial sector in 2005, concentrated in East Baton Rouge Parish. Because groundwater use is not reported by surface water basin, individual parish groundwater use was estimated by multiplying total parish groundwater use by the percentage of total parish population within the PMB; actual groundwater use by parish may differ from this estimation (**Table 3**).

Figure 3 shows trends in surface water and ground water use in the PMB at 5-year intervals from 1990. Industrial surface water use increased substantially from 1990 to 2000, rising from 5 mgd to 177 mgd. No industrial surface water use was reported in 2005, although this could represent a lack of data rather than a decline in use. Public supply groundwater use has fluctuated since 1990, peaking at 115 mgd in 2000 and declining to 84 mgd in 2005. Total water use in the PMB also peaked in 2000 at over 400 mgd, declining to 285 mgd in 2005.

Table 3. Water Use in the PMB in 2005[14]

Sector	Surface Water (mgd)	Groundwater (mgd)
Aquaculture	0.0	9.9
General irrigation	0.1	1.3
Industry	0.0	87.7
Livestock	0.6	0.8
Power generation	0.0	9.7
Public supply	0.0	117.3
Rice irrigation	0.0	0.0
Rural domestic	0.0	15.9
TOTAL	0.8	242.4

* Water use from the Mississippi River Gulf Outlet is reported in the Mississippi River Delta Basin Report.

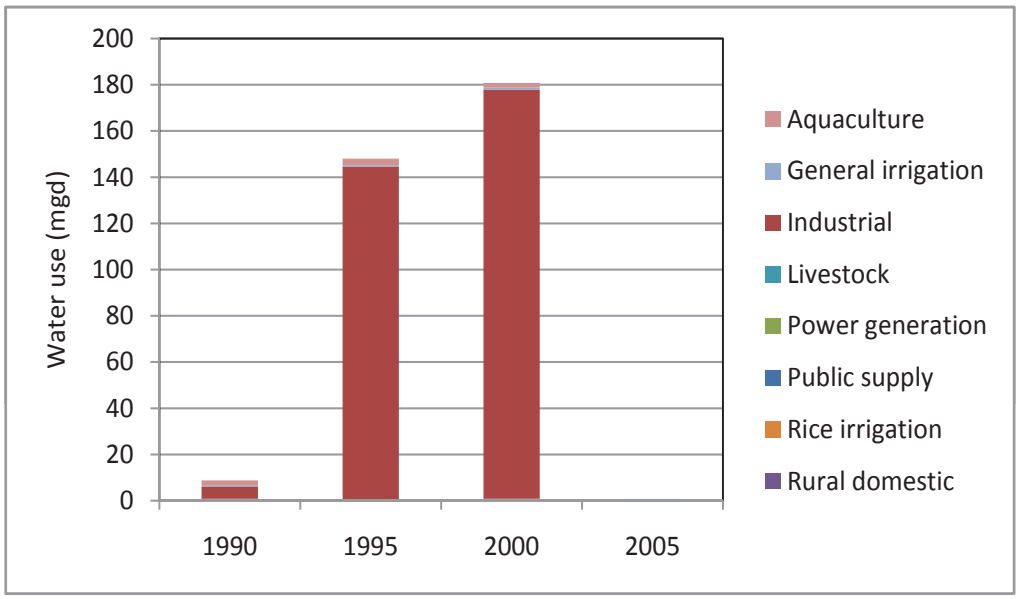
** Groundwater use estimated for parishes with at least five percent of their population within the PMB.

mgd=million gallons per day

PMB=Lake Pontchartrain-Lake Maurepas Basin

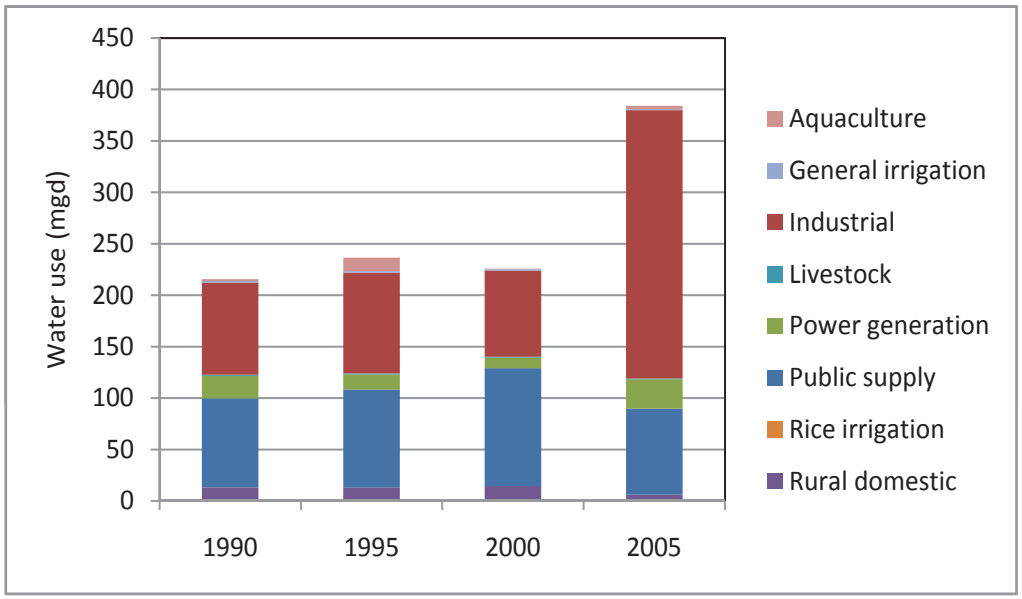
Parish	Surface Water (mgd)	Groundwater* (mgd)
Ascension	0.0	10.0
East Baton Rouge	0.0	141.3
East Feliciana	0.2	3.3
Iberville	0.0	4.9
Jefferson	0.0	1.4
Livingston	0.0	13.9
Orleans	0.0	3.8
St. Bernard	0.0	0.0
St. Charles	0.0	0.9
St. Helena	0.0	1.3
St. James	0.0	7.4
St. John the Baptist	0.0	8.2
St. Tammany	0.1	21.2
Tangipahoa	0.3	19.0
West Feliciana	0.1	5.9
TOTAL	0.7	236.7

Recent Historical Surface Water Use



mgd=million gallons per day

Recent Historical Groundwater Use



mgd=million gallons per day

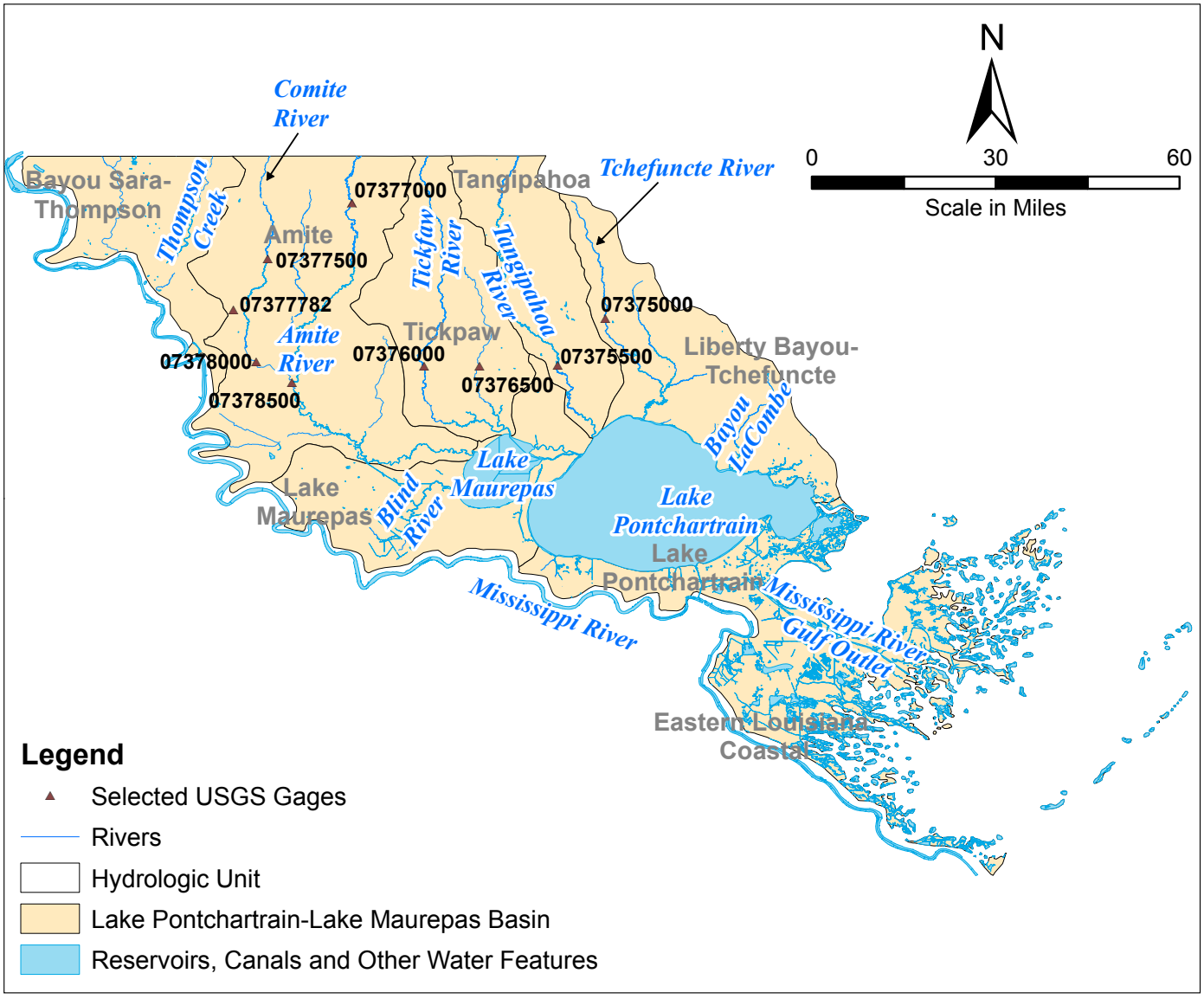
Figure 3. Trends in Water Use in PMB by Sector[15]

Reasonable per capita (person) per day water use could not be calculated for the PMB based on rural domestic and public supply uses and parish populations.[14] Per capita water use estimates could likely be calculated based on municipal water service provider data. Continued population growth at the historical rate could increase demand for potable and industrial water supplies.

SURFACE WATER

Primary surface water features in the PMB include rivers, streams, bayous, lakes, and canals, as shown in **Map 5**. **Map 5** also shows eight subwatersheds, or hydrologic units, delineated by the U.S. Geological Survey (USGS), and stream gages referenced in this report.

Extensive surface water and groundwater data for Louisiana, including gaged streamflows and lake levels, are available through the USGS National Water Information System (NWIS) Web site.[17] Streamflow statistics for selected PMB gages with long-term streamflow records are summarized in **Table 4**.



Map 5. Surface Water Features[16]

Table 4. Historical Streamflow Statistics for Selected Gages[15]

Stream Gage Informaiton			Period of Record Streamflow Statistics (cfs)				Percent of Streamflows Exceed (cfs)		
				Instantaneous					
Location (USGS Gage)	Drainage Area (mi^2)	Period of Record	Annual Average	Max. Peak (date)	Low Flow (date)	7Q10[18]	10	50	90
Amite River near Darlington, LA (07377000)	580	1949-Present	922	104,000 (1/25/90)	167 (9/7/00)	206	1,570	421	253
Amite River near Denham Springs, LA (07378500)	1,280	1938-Present	2,088	112,000 (4/8/83)	229 (10/29/00)	317	4,480	838	420
Natalbany River at Baptist, LA (07376500)	79.5	1943-Present	117	9,810 (4/7/83)	1.8 (11/2/63)	3.3	242	25	7.4
Tickfaw River at Liverpool, LA (07375800)	89.7	1956-Present	112	32,000 (4/6/83)	29 (10/8-9/06)	32	156	52	38
Tickfaw River at Holden, LA (07376000)	247	1940-Present	379	22,500 (4/7/83)	52 (9/6/00)	78	773	163	98
Comite River near Olive Branch, LA (07377500)	145	1942-Present	237	25,300 (6/8/01)	26 (10/31/00)	36	404	79	46
White Bayou southeast of Zachary, LA (07377782)	45	1972-Present	73	4,730 (4/6/83)	0.01 (8/5/98)	0	135	3.5	0.30
Tchefuncte River near Folsom, LA (07375000)	95.5	1943-Present	159	29,800 (4/5/83)	26 (9/4/68)	34	289	70	43
Tangipahoa River at Robert, LA (07375500)	646	1938-Present	1,158	85,000 (4/7/83)	232 (9/7/00)	299	2,050	637	379

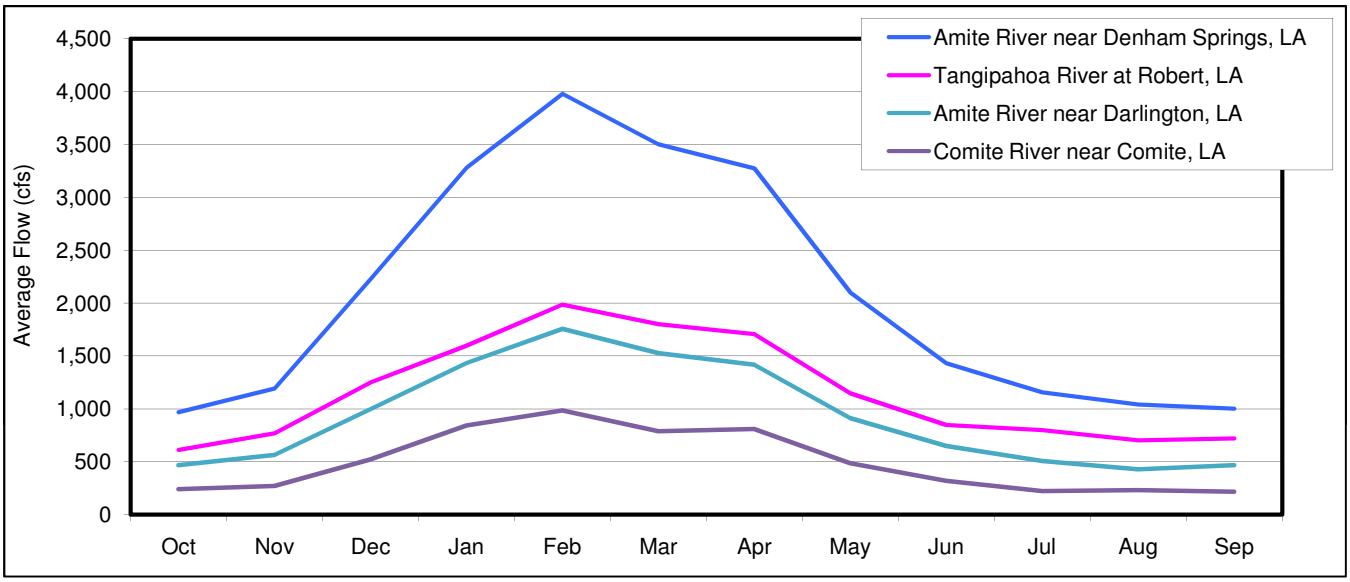
7Q10=7-day low flow with 10-year recurrence
Avg.=average
cfs=cubic foot per second
LA=Louisiana
Max.=maximum
mi^2=square mile
NA=not available in reference
USGS=U.S. Geological Survey

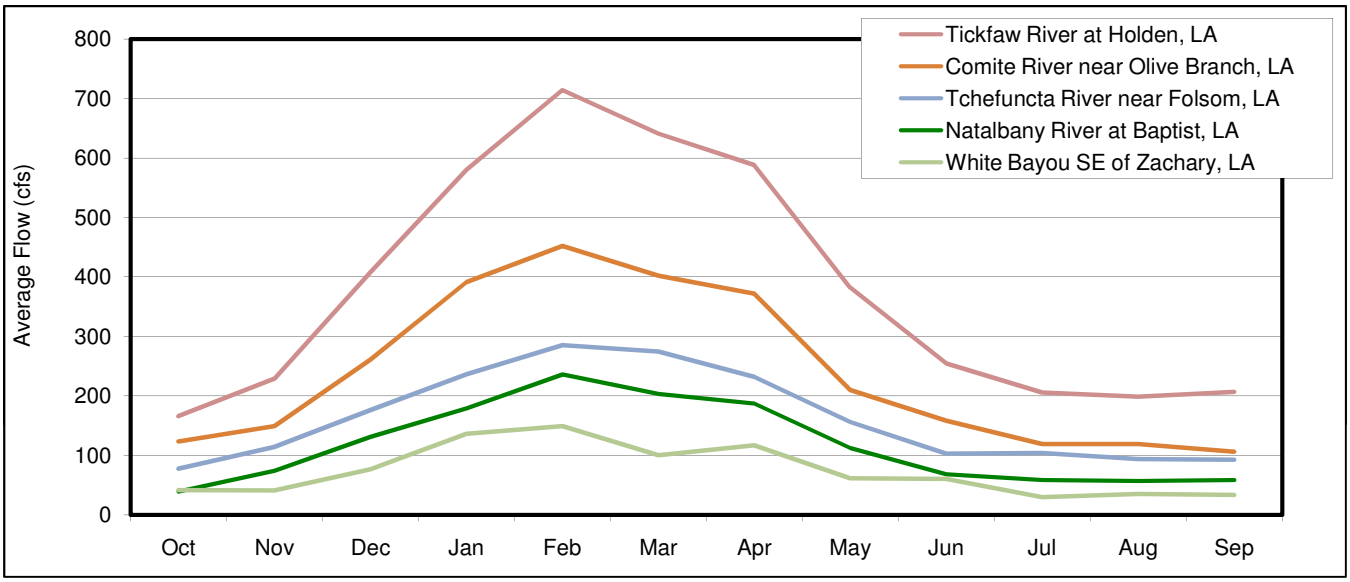
Statistics summarized in **Table 4** can be useful for various purposes. The 7-day low flow with a recurrence interval of 10 years (7Q10) is the statistic used to calculate available dilution in surface water discharge permits. Water bodies with low 7Q10 flows, less than a few cubic feet per second (cfs), typically have extended periods of low flows. White Bayou and the Natalbany River are two gaged streams in the PMB with extended low flows (**Table 4**). Peak flows, including maximum instantaneous discharge, and streamflow exceeded by only 10 percent of flows, are useful for characterizing flooding and high-flow conditions on a stream.

Monthly average flows are shown in **Figure 4** for selected PMB gages. Flows are shown on two graphs of different scales for clarity. Streamflows measured at these gages show a seasonal runoff pattern, with highest flows occurring in winter and spring, and minimal runoff occurring in late summer and early fall.

The PMB contains 1,183 miles of streams designated under Louisiana's Natural and Scenic River System (**Map 2**). These waterways are protected by a permit process and certain restrictions, including prohibitions against channelization, impoundment construction, and channel realignment.[19]

Published characteristics of the two major lakes in the PMB, Lake Pontchartrain and Lake Maurepas, are summarized in **Table 5**. Both lakes are brackish estuaries.





cfs=cubic feet per second
SE=southeast
LA=Louisiana

Figure 4. Historical Monthly Average Streamflow for Selected Gages[15]

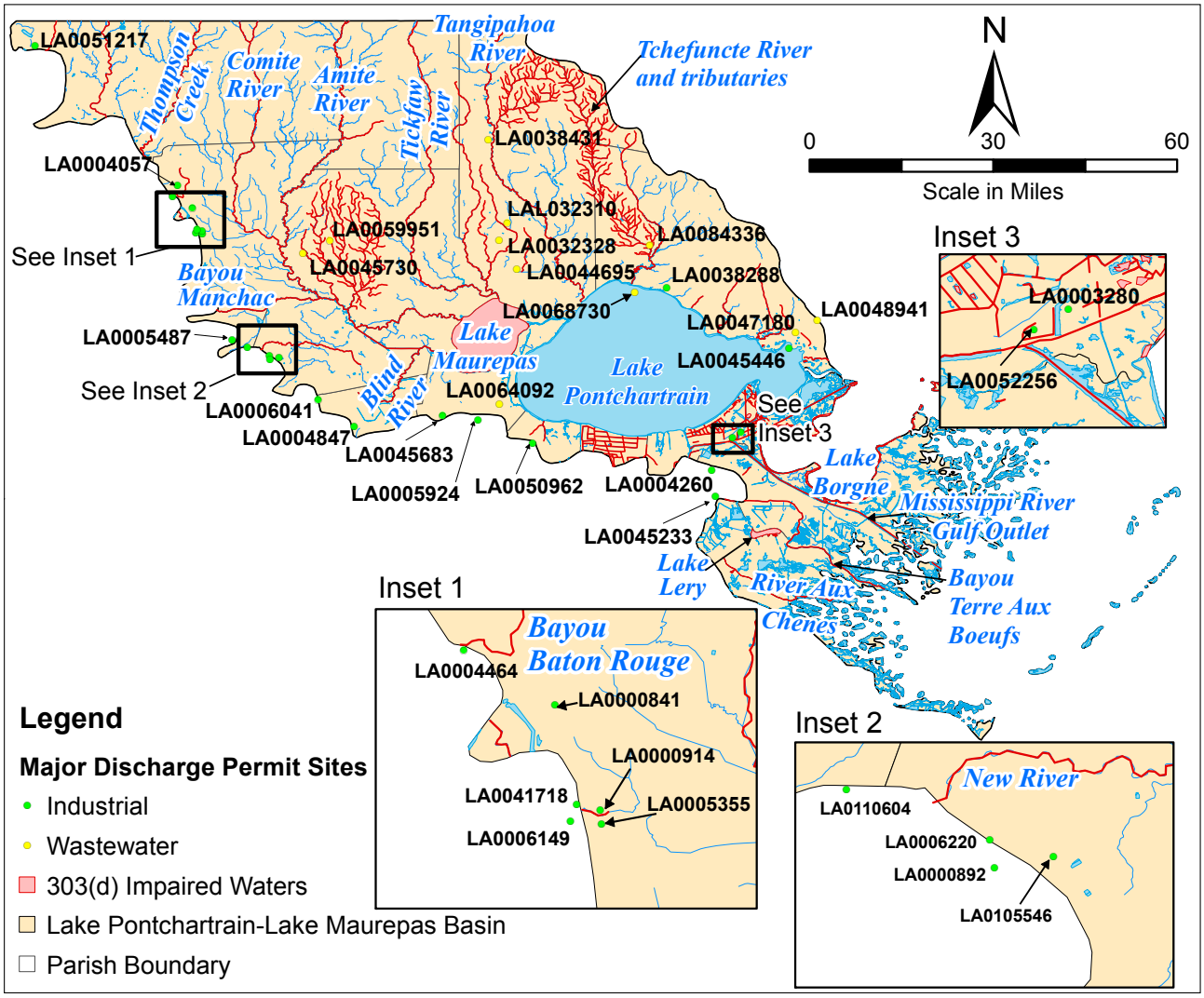
Table 5. Characteristics of Major Lakes in PMB[20]

Name	Surface Area (acres)	Volume (acre-feet)
Lake Maurepas	58,240	530,000
Lake Pontchartrain	403,200	4,540,000

PMB=Lake Pontchartrain-Lake Maurepas Basin

Surface Water Quality

The 303(d) list (named after Section 303(d) of the Federal Clean Water Act) included in Louisiana's Integrated Water Quality Report provides an overview of surface water locations where water quality standards are not met.[21] In these cases, designated uses of the water bodies, such as fish and wildlife propagation, recreation, or drinking water supply, may be impaired. Stream sub-segments on the 2006 303(d) list for the PMB are shown in **Map 6**; many major water bodies in the PMB are considered impaired. Design of new reservoirs either impounding impaired waters or discharging to impaired waters would need to consider these water quality challenges, and any ongoing or planned water quality improvement projects.



Map 6. PMB Impaired Waters from 303(d) List and Major Permitted Discharge Sites[22]

Table 6 summarizes the number of stream and lake sub-segments in the PMB that are on the 2006 303(d) list, and identifies impaired uses and the parameters causing the impairment. Fish and wildlife propagation is the most frequently affected use in the PMB. Fecal coliform, which affects both oyster propagation and recreation in basin surface waters, is the most common parameter causing impairment. Except in the New Orleans area, where elevated fecal coliform is caused by sanitary sewer overflows, most fecal coliform impairments are attributed to septic tanks.[21]

The only parts of Lake Pontchartrain listed as impaired are the south shore beaches, which are impaired for fecal coliform affecting recreational uses. Lake Maurepas, a brackish lake, is impaired by fecal coliform and nonnative plants.

In general, low dissolved oxygen and nutrients impairments tend to be related. In the PMB, these impairments are attributed to a variety of sources, including natural sources, drainage/filling/loss of wetlands, septic systems, and urban runoff.[21]

Mercury is a common impairment in Louisiana and in the PMB, affecting important waters such as the Amite, Tickfaw, Tangipahoa, and Tchefuncte rivers. The Louisiana Department of Environmental Quality (LDEQ) has been investigating the mercury problem throughout the state since fish tissue data for the Ouachita River first resulted in a fish consumption advisory in 1992.[23]

Table 6. Summary of Surface Water Quality Impairments in the PMB[21]

Impaired Use	Sub-segments
Fish and wildlife propagation	146
Primary contact recreation	37
Oyster propagation	12
Secondary contact recreation	11
Outstanding natural resource	9
Limited aquatic life and wildlife	2

FWP=fish and wildlife propagation
LAL=limited aquatic life and wildlife
ONR=outstanding natural resource
OYS=oyster propagation
PCR=primary contact recreation (swimming)
PMB=Lake Pontchartrain-Lake Maurepas Basin
SCR=secondary contact recreation (boating)

Parameter Causing Impairment (affected use)	Sub-segments
Fecal Coliform (OYS, PCR and SCR)	56
Dissolved Oxygen (FWP and LAL)	37
Nutrients (FWP)	25
Mercury (FWP)	23
Total Dissolved Solids (FWP)	13
Chloride (FWP)	12
Sulfate (FWP)	10
Turbidity (FWP and ONR)	9
Hydrocarbons (FWP and PCR)	9
Nonnative Aquatic Plants (FWP)	5
Dissolved Copper (FWP)	3
Lead (FWP and PCR)	3
pH (FWP)	3
Ammonia (FWP)	3
Oil and Grease (FWP)	2
Sedimentation (ONR andPCR)	2
Chlorine (LAL)	1
Total Suspended Solids (ONR)	1

Permitted Surface Water Discharges

LDEQ issues permits for discharges of municipal and industrial wastewater. Permitted discharges classified as "major" by the U.S. Environmental Protection Agency (USEPA) (generally those with flow greater than 1 mgd) are shown in **Map 6**. Major municipal wastewater discharges are summarized in **Table 7**, and major industrial permitted discharges in **Table 8**. Dischargers that are physically located in the PMB, but discharge to the Mississippi River, are not listed. Additional information on all dischargers in Louisiana can be obtained from LDEQ through their public records request process.[24]

The cities of New Orleans and Baton Rouge each have a municipal stormwater discharge permit. The largest municipal wastewater discharge is the City of Slidell, with a permitted discharge of 6 mgd. The largest industrial discharger is Formosa Plastics Corporation, with a permitted discharge of about 45 mgd. Discharge permit conditions are based on receiving-water low-flow quantity and quality. Future water development projects that change low-flow quantity or quality at the discharge location could affect the ability of permit holders to comply with permit conditions.

Table 7. Major Municipal Wastewater Discharge Permits in the PMB[25]

Discharger	Permit Number	Permitted Flow (mgd)	Receiving Water	Parish
Amite, Town of	LA0038431	0.8	Tangipahoa River	Tangipahoa
Coast Waterworks Inc.	LA0045446	1.0	Grand Lagoon Lake Pontchartrain	St. Tammany
Covington, City of	LA0084336	1.8	Tributary to Lake Pontchartrain	St. Tammany
Denham Springs, City of	LA0045730	2.9	Amite River/Lake Pontchartrain	Livingston
Greenleaves Utility Company	LA0068730	4.9	NA	St. Tammany
Hammond, City of (South)	LA0032328	2.5	Natalabany River	Tangipahoa
Hammond, City of, North Sewage Treatment Plant	LAL032310	2.0	Ponchatoula CR-Natalbany River	Tangipahoa
Mandeville City of (Hickory)	LA0038288	1.5	Bayou Chinchuba	St. Tammany
Ponchatoula, City of	LA0044695	1.0	NA	Tangipahoa
Slidell, City of	LA0047180	6.0	Canal Salt Bayou	St. Tammany
Southeast Louisiana Water and Sewer Co. LLC	LA0120154	NA	NA	St. Tammany
St Tammany Parish (Cross Gates)	LA0048941	1.0	NA	St. Tammany
St. John the Baptist Parish Woodland Treatment Plant	LA0064092	3.3	Vicknair Canal	St. John the Baptist
Walker, Town of	LA0059951	0.5	Taylor Creek-Middle Colyell Creek	Livingston

Information presented in this table is directly from USEPA (2009a). For detailed explanation, this reference should be consulted.
mgd=million gallons per day
LLC=limited liability company
NA=not available
PMB=Lake Pontchartrain-Lake Maurepas Basin

Table 8. Major Industrial Discharge Permits in the PMB[25]

Discharger	Permit Number	Permitted Flow (mgd)	Receiving Water	Type	Parish
Air Products and Chemicals INC – Industrial Gas Production Facility	LA0003280	Nitrogen fertilizers	1.2	Maxent Canal/ Intracoastal Waterway	Orleans
Amax Metals Recovery Incorporated	LA0045233	Smelt/ nonferrous metals	5.3	NA	Plaquemines
BASF DNT Plant	LA0105546	Industrial organic chemicals	1.5	Bayou Goudine-Smith	Calcasieu
Carville Energy Center	LA0110604	Electrical services	3.9	Mississippi River and Bayou Braud	Iberville
Exide Technologies – Baton Rouge Smelter	LA0004464	Smelt/ nonferrous Metals	3.4	Bayou Baton Rouge	East Baton Rouge
Exxonmobil Chemical CO – Baton Rouge Chemical Plant	LA0005355	Plastics, resins, elastomers	15.2	Fortune Bayou	East Baton Rouge
Exxonmobil Chemical CO – Baton Rouge Resin Finishing Plant	LA0000841	Plastics, resins, elastomers	2.0	Comite River	East Baton Rouge
Exxonmobil Refinery Complex	LA0004260	Petroleum refining	2.4	Mississippi River/ Guichard Canal	St. Bernard
Ferro Corporation Grant Chemical Division	LA0004057	Organic chemicals	1.1	Bayou Baton Rouge	East Baton Rouge
Formosa Plastics Corporation Louisiana	LA0006149	Organic chemicals	44.9	Monte Santo Bayou	East Baton Rouge
LADPS LA State Penitentiary	LA0051217	Correctional onstitutions	1.3	Sugar Lake Bayou	West Feliciana
Lion Copolymer LLC – Baton Rouge Plant	LA0000914	Synthetic rubber	2.7	Monte Sano Bayou	East Baton Rouge
Lockheed Martin – Space Systems CO	LA0052256	Space propulsion units and parts	13.8	Michoud Canal	Orleans
Marathon Asland Petroleum LLC	LA0045683	Petroleum refining	8.4	Mississippi River/Union Canal	St. John the Baptist
Mosaic Fertilizer LLC – Uncle Sam Plant	LA0004847	Phosphatic fertilizers	2.5	Mississippi River, Bayou Des Acadians	St. James
Motiva Enterprises LLC	LA0006041	Petroleum refining	4.2	Mississippi River/St. James Canal	St. James
Rubicon LLC – Geismar Plant	LA0000892	Cyclic crudes interm., dyes	3.0	Mississippi River and New River	Ascension
Syngenta Crop Protection INC – St. Gabriel Plant	LA0005487	Pesticides and agricultural chemicals	1.0	Bayou Manchac	Iberville
Union Carbide Corp – Cypress Polypropylene Plant	LA0050962	Plastics, resins, elastomers	5.1	Bayou Trepagnier	St. Charles
UOP LLC – Baton Rouge Plant	LA0041718	Industrial inorganic chemicals	4.2	Monte Sano Bayou	East Baton Rouge

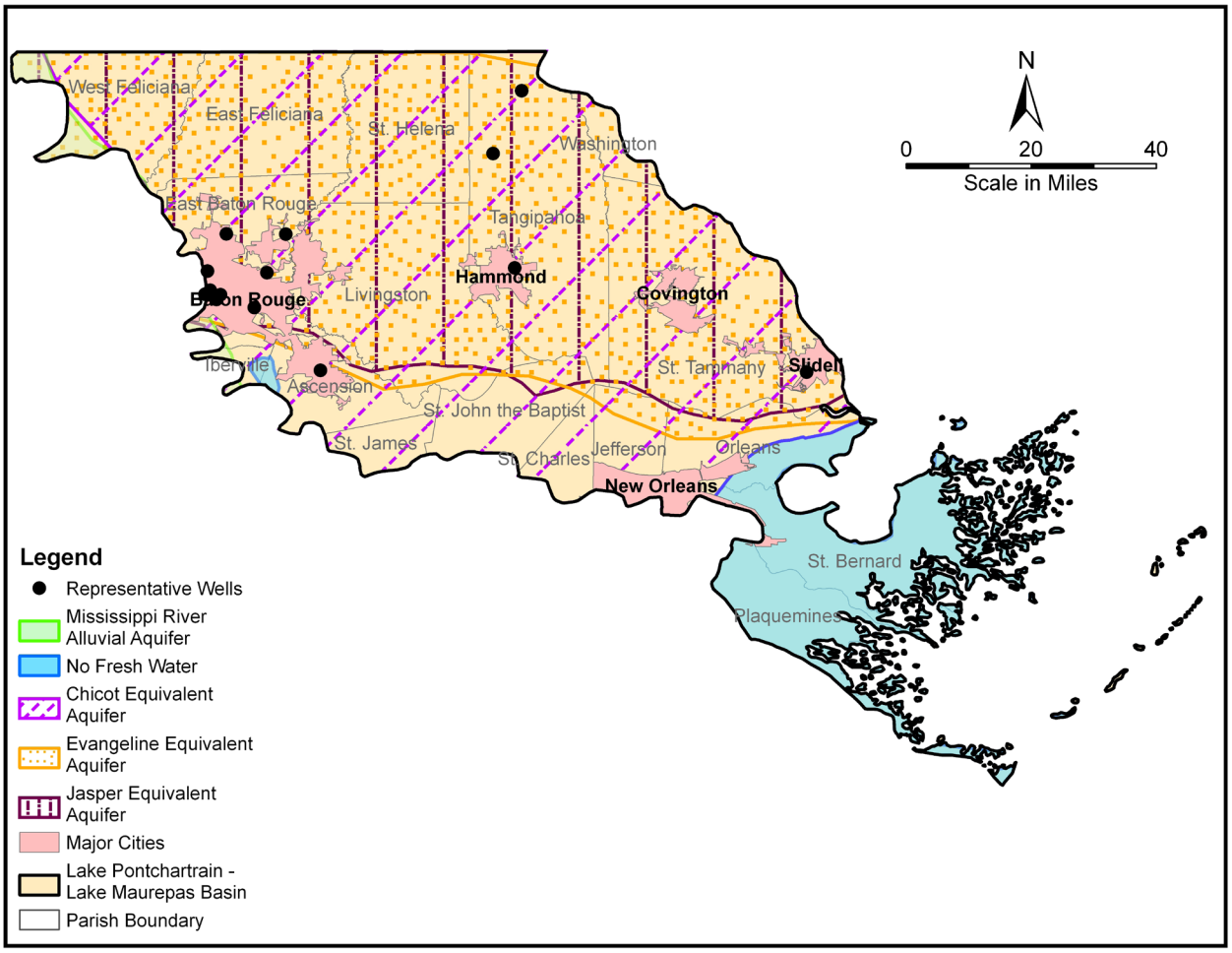
Information presented in this table is directly from USEPA (2009a). For detailed explanation, this reference should be consulted.
LA=Louisiana
LADPS=Louisiana Department of Public Safety
LLC=Limited Liability Company
mgd=million gallons per day
NA=not available
PMB=Lake Pontchartrain-Lake Maurepas Basin

GROUNDWATER

The State has registered about 3,300 groundwater wells in the PMB.[17] The following major aquifers underlie parts of the PMB:

- Chicot Equivalent Aquifer
- Evangeline Equivalent Aquifer
- Jasper Equivalent Aquifer

These major aquifers are shown in **Map 7** and their characteristics are summarized in **Table 9**. Aquifer areas overlap because the aquifers occur at different depths. Although the Mississippi River Alluvial Aquifer underlies the PMB, it is not heavily used in the basin.



Map 7. Spatial Extents of Major PMB Aquifers[26]

Table 9. Overview of PMB Major Aquifer Characteristics[2]

Aquifer	Range of Thickness of Freshwater Interval (feet)	Typical Well Yields (gpm)	Hydraulic Conductivity (feet/day)	Specific Capacity (gal/min/ft of drawdown)	Depth to Groundwater in 2005 (feet)[17]
Mississippi River Alluvial	50 – 500	500 – 4,000 7,000 (large capacity)	10 – 530	5 – 90	NA
Chicot Equivalent	50 – 1,100	500 – 1,000 3,500 (large capacity)	10 – 200	10 – 200	2 – 92
Evangeline Equivalent	50 – 1,000	200 – 4,000	10 – 200	10 – 200	-40* – 170
Jasper Equivalent	1,200 – 2,350	200 – 3,400	10 – 200	10 – 200	-25* – 310

*Negative values indicate artesian wells
gpm=gallons per minute
gal/min/ft=gallons per minute per foot
NA=not available
PMB=Lake Pontchartrain-Lake Maurepas Basin

The Chicot Equivalent, Evangeline Equivalent, and Jasper Equivalent aquifers collectively make up the Southern Hills Aquifer System. Aquifers in this system are locally divided and recognized independently, here called aquifer units. Local names have been given to aquifer units based on location and depth.[27] **Table 10** shows 2007 groundwater withdrawals in the greater Baton Rouge area by aquifer and aquifer unit. As the table shows, the 1,200-foot, 1,500-foot, 2,000-foot, 2,400-foot, and 2,800-foot sands of Baton Rouge are the most heavily used aquifer units in this region.

Table 10. 2007 Groundwater Withdrawals from Baton Rouge Aquifer Units[2]

Baton Rouge Aquifer Unit	Groundwater Withdrawal (mgd)
400/600-foot	13.2
600-foot	6.4
1,000-foot	6.5
1,200-foot	22.0
1,500-foot	16.0
1,500/1,700-foot	7.7
1,700-foot	6.5
2,000-foot	21.2
2,400-foot	19.4
2,800-foot	27.4
Other	7.6
Total	153.9

mgd=million gallons per day

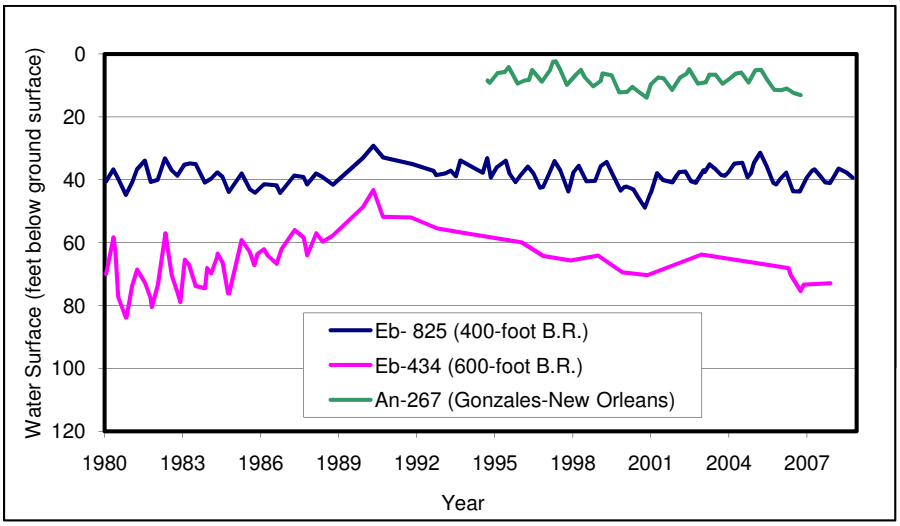
In the PMB, the 400-foot and 600-foot sands of Baton Rouge and the Gonzales-New Orleans aquifer unit are the most heavily used parts of the Chicot Equivalent Aquifer where groundwater level data are available. Overall, groundwater levels in the Chicot Equivalent Aquifer have been fairly stable since 1980 (Well Eb-825 in **Figure 5**), although a groundwater level decline of about 2 feet per year since 1990 in some parts of the aquifer (Well Eb-434 in **Figure 5**). Seasonal groundwater level fluctuations are likely in response to precipitation, common in surficial aquifers such as the Chicot Equivalent Aquifer. A comparison of groundwater levels in the 600-foot sand of the Baton Rouge Aquifer shows a localized groundwater level decline of 3 to 7 feet from 1996 to 2005 on the west side of Baton Rouge.[29]

The Gonzales-New Orleans aquifer unit has historically been the primary source of freshwater in the area surrounding New Orleans. In 1990, a total of 33 mgd was withdrawn from the aquifer, and a large area of groundwater drawdown developed northeast of downtown New Orleans from 1987 – 1993. Groundwater level data from Well An-267, completed in the Gonzales-New Orleans aquifer unit in Ascension Parish (see **Figure 5** suggests that groundwater levels have more recently remained stable in this aquifer unit.

In the PMB, the most heavily used aquifer units of the Evangeline Equivalent Aquifer include the 800-foot, 1,000-foot, 1,200-foot, 1,500-foot, and 1,700-foot sands of the Baton Rouge area aquifer unit, as well as the Kentwood and Slidell aquifer units. Overall, units of the Evangeline Equivalent Aquifer have experienced groundwater level decline since 1980 (**Figure 6**). In East Baton Rouge Parish, the 800-foot and 1,000-foot sands of Baton Rouge aquifer units have undergone a 1-foot to 2-foot annual decline in groundwater levels in the past 25 years. Comparison of additional USGS data from 1996 and 2005 indicates that groundwater levels

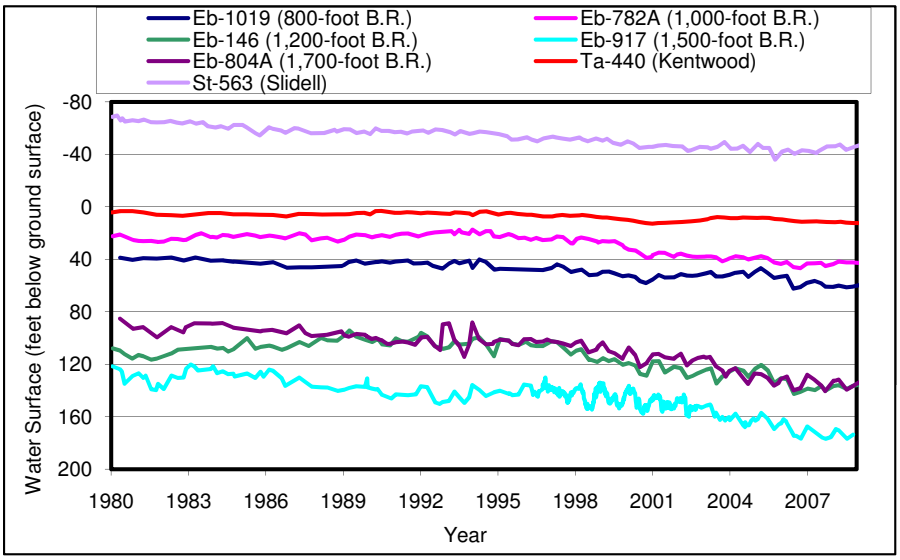
in the 800-foot sand declined 5 to 25 feet in the Baton Rouge area from 1996 to 2005.[32] The 1,200-foot sand of Baton Rouge in East Baton Rouge Parish experienced stable groundwater levels until 1996; since then, an annual decline of 3 to 4 feet has been observed (Well Eb-146 in **Figure 6**). Groundwater levels began declining earlier, since 1985, in the 1,500-foot and 1,700-foot sands of Baton Rouge aquifer units in East Baton Rouge Parish, (Wells Eb-917 and Eb-804A in **Figure 6**). Additional USGS data suggest that groundwater levels in the 1,000-foot, 1,200-foot, 1,500-foot, and 1,700-foot sands of Baton Rouge aquifer units declined 8 to 30 feet in the Baton Rouge area from 1996 to 2005.[31]

On the other hand, the Kentwood Aquifer in Tangipahoa Parish has experienced relatively stable water levels, aside from a minor decline from 1999 to 2000 during a moderate to severe drought in southern Louisiana (Well Ta-440 in **Figure 6**). However, similar to the sands of Baton Rouge, the Slidell Aquifer in St. Tammany Parish has experienced 1-foot to 2-foot annual decline in groundwater levels since 1980 (Well St-563 in **Figure 6**). Groundwater level mapping of the Slidell Aquifer shows a 10-foot decline near the city of Slidell between 1996 and 2005.[32]



B.R. = Baton Rouge

Figure 5. Historical Trends in PMB Groundwater Levels in Representative Wells in Chicot Equivalent Aquifer[17]



Negative numbers on the y-axis scale indicate elevations above land surface.
B.R. = Baton Rouge

Figure 6. Historical Trends in PMB Groundwater Levels in Representative Wells in Evangeline Equivalent Aquifer Units in the PMB[17]

In the PMB, the most heavily used aquifer units of the Jasper Equivalent Aquifer include the 2,000-foot, 2,400-foot, and 2,800-foot sands of Baton Rouge and Hammond and Amite aquifer units. Overall, the Jasper Equivalent Aquifer has experienced a decline in groundwater levels. The 2,000-foot, 2,400-foot, and 2,800-foot sands of Baton Rouge aquifer units have experienced approximately 2 feet per year of groundwater level decline in East Baton Rouge Parish since the late 1980s and early 1990s (Wells Eb-304, Eb-322, and Eb-944, respectively, in **Figure 7**). Comparison of 1996 and 2005 groundwater levels in these aquifer units shows a 10- to 25-foot decline in the 2,000-foot sand, an approximately 25-foot decline in the 2,400-foot sand, and a 6- to 10-foot decline in the 2,800-foot sand in the Baton Rouge area.[32]

Tangipahoa Parish relies on the Amite and Hammond aquifer units for the majority of its water supply.14 Groundwater levels have declined approximately 1 foot per year in both aquifer units since 1980 (Wells Ta-260 and Ta-268 in **Figure 7**). Comparison of historical data from 1996 and 2005 suggest that groundwater levels have declined about 5 to 10 feet in the western Amite Aquifer Unit and 15 to 20 feet in the eastern Amite Aquifer Unit.[32]

Groundwater Quality

Groundwater quality issues reported in 2005 and 2006 LDEQ Baseline Monitoring Program reports are summarized by aquifer in **Table 11**.[33] Water in no tested wells in the major PMB aquifers exceeded Federal primary drinking water standards. Water in some wells exceeded secondary standards for pH, total dissolved solids (TDS), color, chloride, and iron. Although no Federal or State standard has been established for chloroform, a volatile organic compound, it was detected at very low levels in one East Baton Rouge Parish well, used for industrial purposes, completed in the Chicot Equivalent Aquifer. Water in wells completed in the Jasper Equivalent Aquifer did not exceed the water quality standard for chloride, but the aquifer does show an increasing trend for this constituent.

Saltwater intrusion is a concern in the Baton Rouge area.[34] Groundwater withdrawal in southeastern Louisiana, particularly in the Baton Rouge area, has caused saltwater to encroach into some of the 10 freshwater aquifers in the region. Saltwater intrusion was initially detected as early as the 1960s, when groundwater investigations delineated a freshwater-saltwater interface located at the Baton Rouge fault. Generally, aquifers south of the fault contain saltwater and aquifers to the north contain freshwater. By the 1990s, saltwater had been detected in six of the aquifers north of the fault, including the 2,000-foot sand of Baton Rouge.

The Capital Area Groundwater Conservation Commission (CAGWCC) was formed by the State Legislature in 1974 to address problems such as water level declines, water quality concerns (e.g., saltwater encroachment), and land subsidence. CAGWCC regulation of groundwater in the area has been successful in reducing some groundwater demand near Baton Rouge.[35]

In 1999, CAGWCC completed a saltwater remediation project that connected the 800-foot and 1,500-foot sands of Baton Rouge, allowing groundwater from the 800-foot sand to flow directly to the 1,500-foot sand. The hydraulic head that has built up extends outward and acts as a barrier to movement of saltwater toward pumping wells.[36] Beginning in October 2007, CAGWCC has been modeling the 1,500-foot and 2,000-foot sands of Baton Rouge. The 4-year study is a joint venture with DOTD and the East Baton Rouge Department of Public Works.[37]

Table 11. Secondary Drinking Water Standards Exceedences in Major PMB Aquifers

Aquifer	pH	TDS	Color	Chloride	Iron
Chicot Equivalent	■	■	■	■	■
Evangeline Equivalent	■		■		■
Jasper Equivalent	■		■		

■ – One or more wells exceeded the secondary standard
TDS=total dissolved solids
PMB=Lake Pontchartrain-Lake Maurepas Basin

FLOODING

Historically, flooding has occurred year-round in the PMB. Low elevation and low relief characterize much of the Mississippi River alluvial valley, including the PMB. At elevations below mean sea level, pumping is the only effective method for dewatering the land surface after flooding.[35] Backwater flooding from many rivers in the basin, overbank flooding due to intense rainfall events, storm surge flooding in coastal areas and inland lakes, and flooding due to failure of Mississippi River levees are all causes of flooding in the PMB.[38,2]

Extensive flood control projects have been constructed in the PMB. Hurricane protection efforts, including levee systems, floodwalls, outfall canals, and pumping stations, have been built, as well as additional flood control projects not related to hurricane protection.[38] Nevertheless, the PMB has experienced significant damages in the last 5 years due to flooding. The U. S. Army Corps of Engineers (USACE) dedicates part of its Web site to plans and projects underway to reduce the risk of damage from future hurricanes and storms.[39]

Ten of the parishes wholly or partially located in the PMB (Ascension, East Baton Rouge, Livingston, Orleans, Plaquemines, St. Bernard, St. Helena, St. John the Baptist, St. Tammany, and Tangipahoa) have become participants in the National Flood Insurance Program (NFIP) offered through the Federal Emergency Management Agency (FEMA). As part of the NFIP, FEMA prepares Flood Insurance Studies (FIS) and Flood Insurance Rate Maps (FIRM) for rivers and bayous prone to damaging floods; member communities regulate development in floodplains. These studies and maps document flooding problems within parishes and delineate 100-year flood zones along major waterways. Some 100-year flood zone maps areavailable as digital geographic information system layers; detailed maps and reports can be obtained from FEMA.[40]

USGS estimated flood flow magnitudes for different return periods at streamflow gages throughout the State. Gages within the PMB where significant historical data have been measured are listed in **Table 12**, along with their estimated peak discharges for various recurrence intervals. The USGS analysis is only valid for rural, unaltered waterways, such as those listed in **Table 12**. Also included in **Table 12** are peak discharges for major waterways, as reported in the FISs reviewed as part of this basin characterization.

Table 12. Peak Flow Discharges in the PMB[41]

Source	Location		Flood Magnitude (cfs)			
	Gage Number	Name	2-year	10-year	100-year	500-year
USGS	07378500	Amite River near Denham Springs, LA	29,300	70,000	137,400	193,500
	07375500	Tangipahoa River at Robert, LA	15,000	37,700	74,000	103,800
	07376000	Tickfaw River at Holden, LA	5,820	15,100	31,700	45,700
	07377500	Comite River near Olive Branch, LA	7,180	18,200	36,600	52,400
	07376500	Natalbany River at Baptist, LA	3,300	6,760	12,200	16,400
	07378000	Comite River near Comite, LA	11,300	23,700	41,900	57,200
	07375000	Tchefuncte River near Folsom, LA	4,490	14,400	33,800	52,000
FIS	Amite River near Port Vincent		NA	56,500	122,400	181,600
	Sandy Creek at confluence with Amite River		NA	14,734	31,200	45,954
	Darling Creek at confluence with Amite River		NA	10,924	26,215	44,000
	Tickfaw River at Liverpool		NA	13,036	36,789	69,564
	Tangipahoa River at State Route 22		NA	37,900	80,800	117,900
	Natalbany River at State Route 190		NA	7,290	14,100	20,100
	Tchefuncta River at confluence with Lake Pontchartrain		NA	36,500	61,600	111,600

cfs=cubic feet per second
FIS= Flood Insurance Studies
LA=Louisiana
NA=not available
PMB=Lake Pontchartrain-Lake Maurepas Basin
USGS=U.S. Geological Survey

ENVIRONMENTAL AND CULTURAL ISSUES

Environmental and cultural resources are important elements of the quality of life in Louisiana, and can affect siting and operation of water resources facilities, as regulated by Federal and State permitting requirements. As shown in **Map 2**, the southern PMB is designated by LDNR being in the Coastal Zone. Existing environmental issues in the Coastal Zone, such as loss of wetlands and land subsidence, can affect water resources facilities, such as reservoirs.[42]

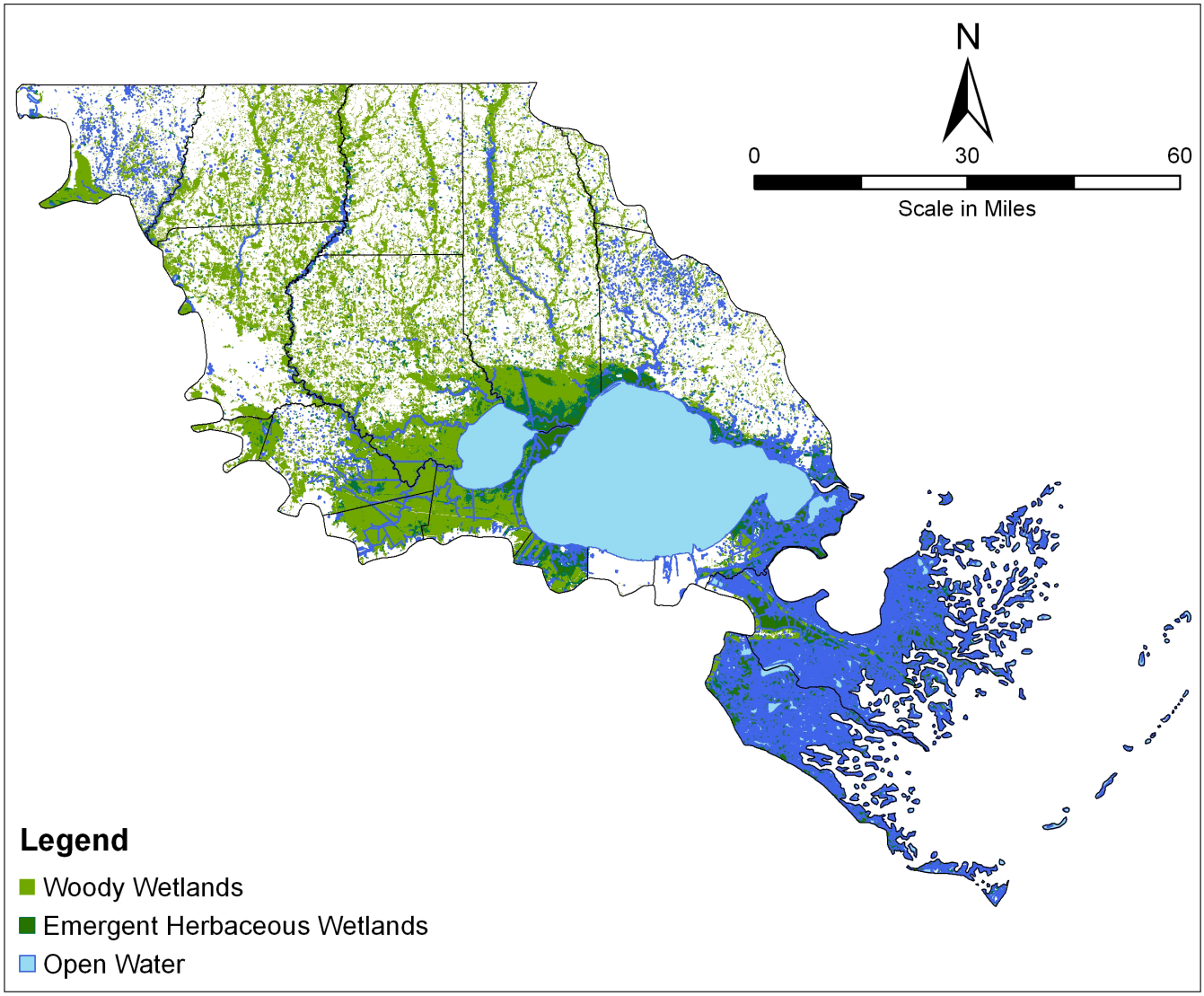
Habitat and Wildlife

The PMB includes parts of the Mississippi River Alluvial Plain, Mississippi Valley Loess Plains, and Southeastern Plains ecoregions, as designated by USEPA.[43] Each ecoregion contains a range of habitats, some of which are associated with species of conservation concern. The Louisiana Wildlife Action Plan prioritizes particular terrestrial habitat types within each ecoregion for conservation.[19]

Terrestrial species Federally listed as threatened or endangered that may reside in the PMB are the Louisiana black bear, interior least tern, brown pelican, piping plover, and red-cockaded woodpecker.[44] The Endangered Species Act gives U.S. Fish and Wildlife Service (USFWS) the authority to protect listed species and their habitat. The USFWS has completed mapping of critical habitat area for the piping plover in the PMB.[45]

Aquatic habitats in the PMB support about 109 species of freshwater fishes, 35 species of mussels, and 13 species of crawfish.[19] State species of concern in the PMB include three crustacean, six freshwater fish, eight mussel, and two reptile species. The State regulates aquatic habitat through surface water quality standards in water bodies designated for fish and wildlife propagation.[46] The Louisiana Wildlife Action Plan does not prioritize aquatic habitats for conservation. USFWS has identified several subwatersheds within the PMB containing surface waters important for conservation of the Alabama heelsplitter mussel, Gulf sturgeon, Louisiana quillwort, and the West Indian manatee, which are species Federally listed as threatened or endangered.[47] LDEQ is currently developing minimum instream flows required to support surface water habitat. These flows would have to be maintained by any future water development project.

Wetlands are an important environmental resource throughout the United States, particularly in Louisiana. Alteration of these areas often requires a Federal Section 404 permit through USACE. **Map 8** shows wetlands areas in the PMB. About 24 percent of the PMB's surface area, or 1,429 square miles, is woody wetlands (i.e., areas where forest or shrubland vegetation accounts for a large portion of the cover, and the soil is periodically saturated or inundated), while 12 percent (740 square miles) is emergent herbaceous wetlands (i.e., areas where perennial herbaceous vegetation accounts for most of the cover, and the soil is periodically saturated or inundated). The 1984 Water Resources Study Commission Report to the Legislature noted that some vegetation in the PMB is under saltwater stress. In some cases, swamp and wetland areas protecting freshwater sources have been drained for urban development.[35]

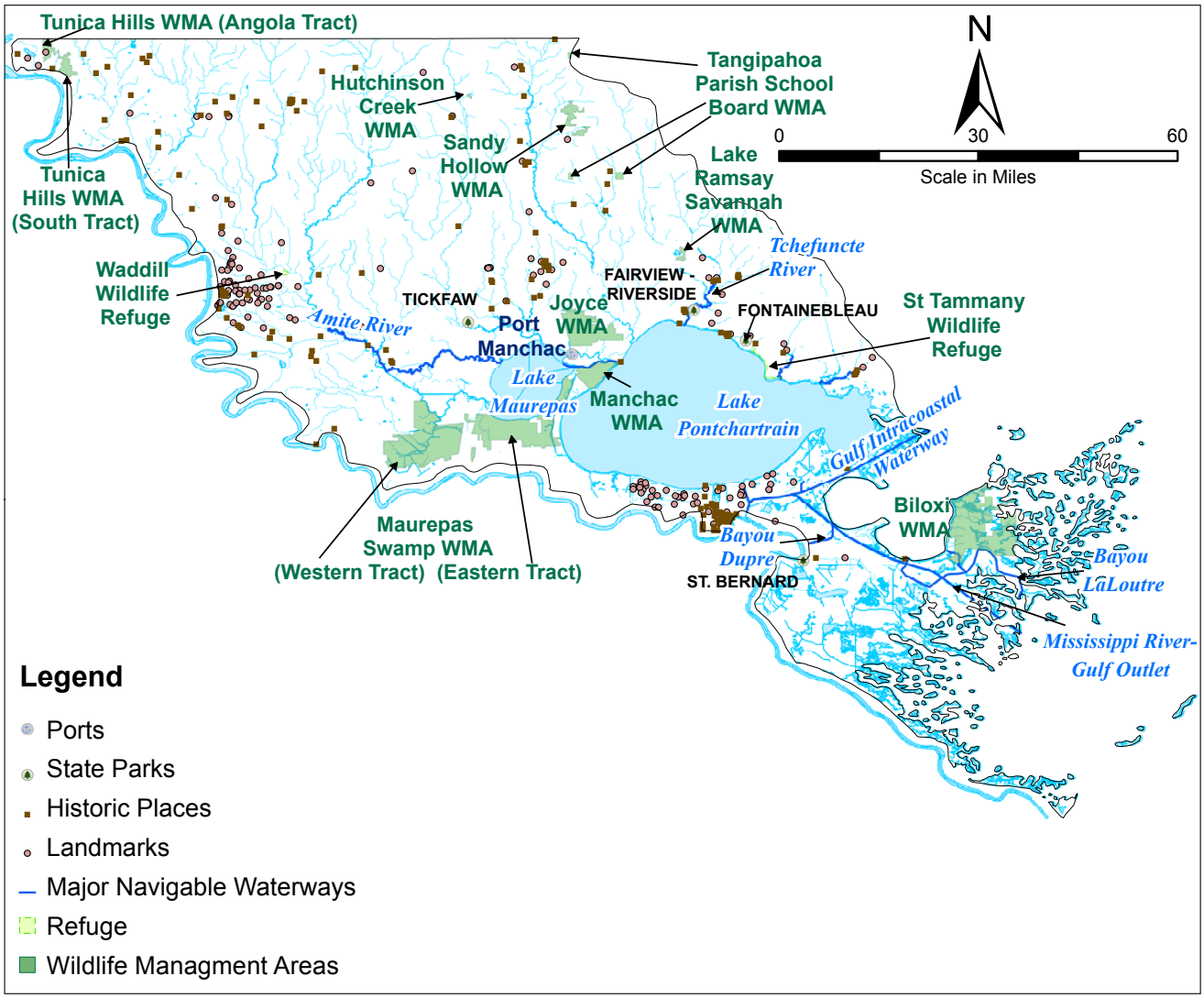


Map 8. Wetlands in the PMB[25]

Cultural Resources

Information on cultural issues and resources is provided by parish-level organizations. Prehistorical (before European colonization) and historical sites are registered with the Louisiana Department of Culture, Recreation, and Tourism (LCRT) and the National Register of Historic Places (NRHP). Some featured historic sites in the basin include churches, houses, cemeteries, post offices, and schools. There are 210 historic points and 1 historic region in the PMB, as shown in **Map 9**. Generalized locations of known cultural resources that could affect reservoir siting or operations are available from the NRHP. Twelve archaeological sites listed on the NRHP are located in the PMB. Additional information is available from the LCRT, Office of Cultural Development, Division of Historic Preservation.

Potentially affected Native American tribes must be notified of any proposed reservoir plans. No Federally recognized tribes are found in the PMB. The only State-recognized tribe in the PMB is the United Houma Indians.



Map 9. Cultural and Recreational Resources and Navigable Waterways in the PMB[48]

RECREATION, NAVIGATION, AND HYDROPOWER

The PMB is heavily used for water-based recreation. Specific recreational resources of regional value are shown in **Map 9**.[35]

Navigable waterways are important to regional and State economics and would have to be maintained by any future water development projects. Fourteen major navigable waterways are within the PMB, as listed in **Table 13**.[38] Pass Manchac provides passage between Lake Maurepas and Lake Pontchartrain. Average annual traffic in Pass Manchac from 1984 through 1995 was 80,170 tons, with major cargo consisting of marine shells and crude petroleum. The waterway is also extensively used for recreational purposes, including water-based sports, camping, boat launch access points, boats, bait, cabins, and restaurant facilities.

The GIWW is a 1,300-mile-long, man-made canal that runs along the Gulf of Mexico coastline, from Texas's southernmost tip at Brownville to St. Marks, Florida. Primarily used for shipping, the GIWW links all Gulf Coast ports, and provides access from these ports to the national inland waterway system.[50] In Louisiana, the GIWW stretches 306 miles along the Louisiana coastline from the Pearl River to the Sabine River, and is maintained at a depth of 12 feet. In 2006, a total of approximately 84 million tons of cargo was transported through the GIWW in Louisiana.[51]

The Mississippi River-Gulf Outlet (MRGO) provides a 36-foot-deep tidewater outlet to the Gulf of Mexico (Gulf) that is about 37 miles shorter than the distance to the Gulf along the Mississippi River. Average annual traffic on the MRGO from 1986 through 1995 was almost 7 million tons. Major types of cargo on the channel include nonmetallic minerals, basic chemicals and products, building cement, ferroalloys, and iron and steel scrap. MRGO was closed to ship traffic in 2009 to reduce flooding in the New Orleans area.

From its mouth at Lake Maurepas to 5 miles above Bayou Manchac, navigable depth of the Amite River is 7 feet. USACE has maintained this channel since the late 1800s, when the Amite River and its tributary, Bayou Manchac, served as a major navigation waterways for the logging industry. Today, the Amite River is used primarily for recreation, propagation of fish and wildlife, and to a lesser extent, water supply, navigation, and waste disposal.

The Tchefuncte River offers a variety of water-based recreational opportunities. Navigational improvements have been completed several times on this river, but cargo traffic is minimal.

Bayou Lacombe, an 8-foot-deep channel from Lacombe to Lake Pontchartrain, is heavily used for boating and fishing; it supports little commercial traffic.

Table 13. Summary of Navigable Waterways in the PMB

River	Outflow	Navigable Depth (feet)[46]	Navigable Length (miles)
Amite River	Lake Maurepas	7	43
Bayou Bonfouca	Lake Ponchartrain	10	7
Bayou Dupre	Lake Borgne	12	6
Bayou Lacombe	Lake Ponchartrain	8	5.5
Bayou LaLoutre	Gulf of Mexico	8	22
Bayou St. Malo	Lake Borgne	11	7
Bayou Yscloskey	Bayou LaLoutre	8	6
GIWW, RM 0 to 15	NA – traverses PMB	36	15
GIWW, RM 15 to 34	NA – traverses PMB	15	19
Inner Harbor Navigation Channel	GIWW	32	3
Michoud Canal	GIWW	36	1.7
Mississippi River-Gulf Outlet*	Gulf of Mexico	36	40
Pass Manchac	Lake Ponchartrain	7	7
Tchefuncte River	Lake Ponchartrain	10	15

*Mississippi River-Gulf Outlet is closed to ship traffic as of 2009.
GIWW=Gulf Intracoastal Waterway
NA=not available
PMB=Lake Pontchartrain-Lake Maurepas Basin
RM=River Mile

Bayou Bonfouca is a 10-foot-deep channel between Slidell and deep water in Lake Pontchartrain. Crude materials are the predominant cargo on the waterway. Average annual traffic from 1994 through 1995 was 201,500 tons. The lower end of Bayou Bonfouca provides access from popular boating areas on Bayou Liberty to Lake Pontchartrain. Bayou Dupre is a 6-foot-deep channel from the highway bridge at Violet to deep water in Lake Borgne. The oil industry provides the major cargo on Bayou Dupre. Average annual traffic from 1986 through 1995 was 159,000 tons.

The Michoud Canal is a short (1.7 miles), 36-foot-deep channel connecting the Port of New Orleans to the GIWW. The canal serves as an area for ship loading at the port, and serves barge traffic to and from plants manufacturing chemicals, Portland cement, and fertilizers.

Bayous LaLoutre, St. Malo, and Yscloskey were originally deepened to provide over 30 miles of waterways for a safer inland route to transport crude oil, oil drilling equipment, and personnel. Now the channels are mainly used by commercial trappers and fishermen en route to Lake Borgne, Chandeleur Sound, and intervening waterways and marshes.

Port Manchac is the only port in the PMB. It is a shallow draft port located in Tangipahoa Parish. Primary inbound cargo includes specialty woods, steel, decorative rock, pipe, and construction materials. Outbound cargo includes plywood and liquid bulk (vegetable oils). Cargo through the port in 2005 totaled 85,999 tons.[52]

No hydropower projects exist in the PMB. The U.S. Department of Energy has identified several potential sites for microhydropower projects (less than 100 kilowatts) within the basin, including on the Amite River, Comite River, and Thompsons Creek.[53]

INTERBASIN AND INTERSTATE ISSUES

The problems of aquifer drawdown and saltwater intrusion in the Southern Hills Aquifer System are regional, interstate concerns. Coastal issues, including loss of wetlands and land subsidence, are concerns for the PMB, as well as other basins, and states along the Gulf of Mexico.[42]

SUMMARY OF MAJOR WATER RESOURCES NEEDS

To identify and prioritize statewide water resources issues, a needs assessment of each of the nine major surface water basins within Louisiana was performed. Because the needs assessment provides the foundation for developing reservoir priority evaluation criteria, it focuses on needs that can be addressed by surface water reservoirs. At the same time, the integrated nature of water resources management requires evaluating issues that could not necessarily be solved, but could be affected, by a reservoir.

Based on the existing compiled information, eight categories of State water resources needs that could be addressed or affected by construction of surface water reservoirs were identified and evaluated. Evaluation criteria were developed for each category to allow interbasin comparison of the needs. To maintain objectivity in the evaluation process, evaluation criteria were developed based on factors that could be evaluated as quantitatively as possible across all basins. High, medium, and low levels of current need were defined based on differences in these factors between basins. Future needs in each basin were assessed by determining whether each current need is increasing, constant, or decreasing. The evaluation criteria are described in detail in the main body of the Statewide Perspective on Water Management Report, to which this basin characterization is an appendix.

The assessed needs in the PMB are summarized below. Details of the assessed needs for all nine major Louisiana surface water basins, as well as a comparison of statewide needs by issue, are presented in the Statewide Perspective on Water Management Report.

Assessed needs in the PMB are shown in **Table 14**, and are discussed below in general order of need, from high-level needs (colored red) to low-level needs (colored green). A high population, combined with extensive commercial and industrial activity, results in high water demand in the basin, and, most categories were identified as high-level needs (**Table 14**), and no low-level needs were identified. With increasing population and development, needs in all categories are expected to increase in importance in the future.

Because of widespread surface water quality impairments and heavy industrial activity along waterways in the PMB,

surface water quality was evaluated as a high-level need. A majority of the major surface waters in the PMB are considered impaired by LDEQ.

Groundwater supply was ranked as a high-level need with increasing importance in the future. In 2005, nearly 250 mgd of groundwater were used in the PMB, making it a significant source of supply for the PMB's growing population of 1.6 million people. Saltwater encroachment is a groundwater quality concern near New Orleans and Baton Rouge, and groundwater quality was evaluated as a high-level need with increasing importance in the future.

Flood control was ranked as a high-level need. Widespread areas of potential flooding are present in the PMB. Comprehensive flood control projects have been conducted or are in the planning stages, but the risk of flood damage to highly populated areas is substantial, as demonstrated by recent hurricanes. Significant ongoing subsidence, combined with potential sea-level rise, threatens the viability of future flood control projects.

Environmental protection and enhancement was ranked as a high-level need with increasing importance in the future. Environmental issues that threaten protection of existing water resources and/or constrain future development of additional water supplies include the presence of widespread wetland areas, areas considered Prime Farmland by NRCS, nearly 1,200 miles of State-designated Natural and Scenic Rivers, and the presence of threatened and endangered species. Extensive reaches of surface water are designated as having impaired water quality. Although most of these impairments are related to aquatic habitat, some affect usability of water for other purposes. Additionally, many PMB water resources are heavily used for industrial purposes or are near industrial activity, which can pose contamination risk from spills.

Navigation was ranked as a high-level need with increasing importance in the future. The Port of New Orleans is one of the busiest ports in the United States, with 30 million tons of cargo conveyed in 2005. The Port of Baton Rouge throughput was 4.1 million tons in 2006. About 200 miles of navigable waterways are present in the PMB in total. Projects of over 1.4 billion have been undertaken in the past decade, including a $603 million enlargement of the Inner Harbor Navigation Channel (IHNC) lock in 1997. Currently, a surge barrier is being built on the IHNC, and navigation gates costing $700 million will be constructed where the barrier crosses the GIWW, Lake Pontchartrain, and Bayou Bienvenue. Construction is expected to be completed by 2011. Other projects underway include a $187 million diversion canal on the Amite and Comite rivers and the $13.6 million MRGO closure, both of which will serve dual flood protection and navigation purposes.

Recreation was evaluated as a medium-level need with increasing importance in the future. The PMB has two major lakes, and one state park located on Lake Pontchartrain. Recreational opportunities are considered adequate, although they are subject to the demand of the largest and fastest growing population in the State.

Table 14. Assessed Water Resources Needs in the PMB

Category	Current	Future
Surface Water Supply	medium	↑
Surface Water Quality	high	↑
Groundwater Supply	high	↑
Groundwater Quality	high	↑
Flood Control	high	↑
Environmental Protection and Enhancement	high	↑
Recreation	medium	↑
Navigation	high	↑

PMB=Lake Pontchartrain-Lake Maurepas Basin
Red = high-level need; Yellow=medium-level need; Green=low-level need
↑ = increasing importance
— = same importance
↓ = decreasing importance

ABBREVIATIONS

°F	degrees Fahrenheit
7Q10	7-day low flow with a recurrence interval of 10 years
cfs	cubic feet per second
CAGWCC	Capital Area Groundwater Conservation Commission
DOTD	Louisiana Department of Transportation and Development
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
GIWW	Gulf Intracoastal Waterway
Gulf	Gulf of Mexico
INHC	Inner Harbor Navigation Channel
LCRT	Louisiana Department of Culture, Recreation, and Tourism
LDEQ	Louisiana Department of Environmental Quality
LDNR	Louisiana Department of Natural Resources
mgd	million gallons per day
MRGO	Mississippi River-Gulf Outlet
NFIP	National Flood Insurance Program
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWIS	National Water Information System
PMB	Lake Pontchartrain-Lake Maurepas Basin
State	State of Louisiana
TDS	total dissolved solids
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

REFERENCES

1 U.S. Geological Survey (USGS). 1999. 1:2,000,000-scale Hydrologic Units of the United States. Available at <*http://water.usgs.gov/GIS/metadata/usgswrd/XML/huc2m.xml*>.

2 Louisiana Ground Water Management Commission (LAGWMC). 2002. Assistance in Developing the Statewide Water Management Plan. Prepared by C. H. Fenstermaker & Assoc., Inc.; LBG-Guyton Assoc.; Hydro-Environmental Technology, Inc.; and Onebane, Bernard, Torian, Diaz, McNamara & Abell.

3 Louisiana Department of Transportation and Development (DOTD). 2007. Atlas: Louisiana Statewide GIS. Available at <*http://www.atlas.lsu.edu/*>.

4 U.S. Census Bureau. 2009. Population data for Louisiana. Available at <*http://www.census.gov/*>.

5 Louisiana Economic Development. 2009. Industries Division. Baton Rouge, LA: Louisiana Economic Development. Available at <*http://www.ledlouisiana.com/opportunities/key-industries/life-science.aspx*>.

6 Louisiana Economic Development. 2007. Industries Division. Available at <*http://www.louisianaforward.com/louisiana-businesses/industries.aspx*>.

7 Sun, G., S. MucNulty, J. Moore Myers, and E. Cohen. 2008. Impacts of Multiple Stresses on Water Demand and Supply Across the Southeastern United States. Journal of the American Water Resources Association 44/6:1441-1457. Increases from 1992 to 2020.

8 Louisiana Department of Natural Resources (LDNR), Office of Conservation. 2007. Oil and Gas Field Locations. January. Available at <*http://lagic.lsu.edu/data/losco/oil_gas_fields_ldnr_2007_faq.html*>.; USGS. 2003a. Louisiana Land Cover Data Set. Available at <*http://lagic.lsu.edu/loscoweb/*>.

9 Natural Resources Conservation Service. 1997. Acres of Prime Farmland. Available at <*http://www.nrcs.usda.gov/technical/NRI/maps/meta/m4983.html*>.

10 Louisiana Department of Environmental Quality (LDEQ). 2004a. 1:24,000 DEM Mosaic. Available at <*http://www.atlas.lsu.edu/*>.; Stoeser, D., G. Green, L. Morath, W. Heran, A. Wilson, D. Moore, and B. Van Gosen. 2005. Preliminary Integrated Geologic Map Databases for the United States Central States: Montana, Wyoming, Colorado, New Mexico, Kansas, Oklahoma, Texas, Missouri, Arkansas, and Louisiana - The State of Louisiana: USGS Open-File Report 2005-1351, Denver, CO. Available at <*http://tin.er.usgs.gov/geology/state/state.php?state=LA*>.

11 USGS. National Wetlands Research Center. 1998. Louisiana State Soil Geographic, General Soil Map, NWRC (1998) [statsgo_soils_NWRC_1998].

12 Southern Regional Climate Center (SRCC). 2009. Average annual rainfall. Available at <*http://www.srcc.lsu.edu/*>.

13 Weather.com. 2009. Set the Date (Average Monthly Temperature). Available at <*http://www.weather.com/activities/events/weddings/setthedate/index.html?from=wed_welcome*>.

14 USGS. 2007a. Water Use in Louisiana 2005. Water Resources Special Report No. 16. Prepared by B.P. Sargent. Published by DOTD. Available at <*http://la.water.usgs.gov/WaterUse/default.htm*>.

15 USGS. 2007b. Water use reports for Louisiana (1990, 1995, 2000, 2005). Available at <*http://la.water.usgs.gov/WaterUse/default.htm*>.

16 USGS. 2009a. Streamgages-NHD_Locations. Available at <*http://water.usgs.gov/lookup/getgislist*>.; DOTD. 1984. The Louisiana Water Resources Study Commission's Report to the 1984 Legislature.; USGS. 2006. National Atlas of the United States, Major dams of the United States. Available at <*http://nationalatlas.gov/mld/dams00x.html*>.; U.S. Department of Commerce, U.S. Census Bureau, Geography Division. 2006. Second Edition, Census Places of Louisiana.; LDEQ. 2004b. Basin Subsegments from LDEQ source data.

17 USGS. 2009b. National Water Information System. Available at <*http://nwis.waterdata.usgs.gov/la/nwis/*>.

18 USGS. 2003b. Low-Flow Characteristics of Louisiana Streams. Water Resources Technical Report No. 70. P.A. Ensminger and L.S. Wright. Published by DOTD.

19 Louisiana Department of Wildlife and Fisheries (LDWF). 2005. Louisiana Comprehensive Wildlife Conservation Strategy (Wildlife Action Plan).

20 LAGWMC (2002), Where data not included in LAGWMC (2002), surface areas estimated from TIGER 2006 water files from US Census Bureau and volumes based on "Normal Storage" listed in: DOTD (2009). Reservoir table provided by Brian Kendrick on April 17, 2009. Lake Pontchartrain volume from DOTD (1984)

21 LDEQ. 2006a. Louisiana Water Quality Inventory: Integrated Report. Available at <*http://www.deq.louisiana.gov/portal/LinkClick.aspx?link=planning%2F2006+IR+Cover+and+Acknowledgements.pdf*>.

22 U.S. Environmental Protection Agency (USEPA). 2009a. Permit Compliance System. Available at <*http://www.epa.gov/enviro/html/pcs/pcs_query_java.html*>.; USEPA. 2009b. NHD Indexed locations for Section 303(d) Listed Waters. Available at <*http://www.epa.gov/waterspb/data/303D_metadata.pdf*>.

23 LDEQ. 2009a. Summary of Issues Related to Mercury Contamination of Fish. Available at <*http://www.deq.louisiana.gov/portal/default.aspx?tabid=1637*>.

24 LDEQ. 2009. Information and Records. Available at <*http://www.deq.louisiana.gov/portal/Default.aspx?tabid=223*>.

25 USEPA (2009a)

[26] Smoot, C.W. 1986. Water-Resources Investigations Report 86-4150. Louisiana Hydrologic Atlas Map No. 2: Aerial Extent of Freshwater in Major Aquifers of Louisiana.

[27] USGS. 2002. Assistance in Developing the Statewide Water Management Plan, Vol. 1.

[28] Capital Area Ground Water Conservation Commission. 2008. July Newsletter. Vol. 34, Number 1.

[29] USGS. 2005. Water Resources Data Louisiana Water Year 2005, Water-Data Report LA-05-1 & USGS Water Resources Data Louisiana Water Year 1996, Water-Data Report LA-96-1.

[30] USGS. 1995. Louisiana Ground-Water Map No. 11: Water-Level Changes, 1987 – 1993, of the Gonzales-New Orleans Aquifer in Southeastern Louisiana.

[31] USGS Water Resources Data Louisiana Water Year 2005, Water-Data Report LA-05-1;USGS Water Resources Data Louisiana Water Year 1996, Water-Data Report LA-96-1.

[32] USGS (2005) and USGS (1996)

[33] LDEQ. 2006b. Baseline Monitoring Program, FY 2006 of the Triennial Summary Report and LDEQ 2005. Baseline Monitoring Program, FY 2005 of the Triennial Summary Report. Baseline Monitoring Program reports available at <*http://www.deq.louisiana.gov/portal/tabid/1717/Default.aspx*>.

[34] Tomaszewski, D.J. 2005. Movement of Saltwater in the "2000-foot" Sand of the Baton Rouge Area, Louisiana, American Geophysical Union, Spring Meeting. Available at <*http://adsabs.harvard.edu/abs/2005AGUSM.H13C..04T*>.

[35] DOTD (1984)

[36] U.S. Water News Online. 1996. Groundwater commission begins saltwater remediation study. Available at <*http://www.uswaternews.com/archives/arcconserv/6grocom.html*>.

[37] CAGWCC. 2007. Progress Report, October 2007. Available at <*http://www.cagwcc.com/newsletters/newsletter_oct_2007.pdf*>.

[38] U.S. Army Corps of Engineers (USACE). 1998. Water Resources Development in Louisiana. Available at <*http://www.mvn.usace.army.mil/environmental/lca.asp*>.

[39] USACE. 2009. Hurricane & Storm Damage Risk Reduction System. Available at <*http://www.mvn.usace.army.mil/hps2/*>.

[40] Louisiana Geographic Information Center (LAGIC). 2007. Louisiana 2007 DVD Collection. Available at <*http://lagic.lsu.edu/geodata/LOSCO/2007_DVD/catalog_2007DVD.htm*>.; Federal Emergency Management Agency (FEMA). 2009. 100 Year Flood Zone Maps. Available at <http://www.fema.gov/>.

[41] Ensminger, P.A. 1998. Floods in Louisiana, magnitude and frequency (5th ed.): Louisiana Department of Transportation and Development Water Resources Technical Report no. 60, 333 p.

[42] Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority. 1998. Coast 2050: Toward a Sustainable Coastal Louisiana. Louisiana Department of Natural Resources. Baton Rouge, La. 161 p. Available at <*http://www.lacoast.gov/Programs/2050/MainReport/report1.pdf*>.

[43] USEPA. 2004. Ecoregions for Louisiana. Available at <*http://lagic.lsu.edu/data/losco/ecoregions_epa_2004_faq.html#what*>.

[44] U.S. Fish and Wildlife Service (USFWS). 2001. Threatened and Endangered Species by Parish. Available at <*http://lagic.lsu.edu/data/losco/t_e_la_parish_usfws_2001_faq.html*>.

[45] USFWS. 2009. Wetlands Mapper. Available at <*http://www.fws.gov/wetlands/Data/Mapper.html*>.

[46] Louisiana Administrative Code. 2009. Title 33, Part IX, Chapter 11 – Surface Water Quality Standards. Available at <*http://www.deq.louisiana.gov/portal/Default.aspx?tabid=167*>.

[47] USFWS. 2008. 2008-2009 Implementation Strategy for the Louisiana Department of Environmental Quality and the US Fish and Wildlife Service Memorandum of Understanding. Available at <*http://www.deq.louisiana.gov/portal/LinkClick.aspx?fileticket=NedPkSZRWhs%3d&tabid=243*>.

[48] DOTD (2007); National Park Service. 2008. National Register of Historic Places. Available at <*http://www.nr.nps.gov/*>.; U.S. Department of Commerce, U.S. Census Bureau, Geography Division, 2006, TIGER/Line 2006 Second Edition, Landmarks of Louisiana.; Louisiana Oil Spill Coordinator's Office. 1999. Navigated Waterways of Louisiana.; Louisiana Department of Wildlife and Fisheries. 2006. Wildlife Management Areas (WMAs) and Refuges in Louisiana.

[49] USACE. 2006a. National Waterway Network. Shapefile of Navigable Waters. Available at <*http://lagic.lsu.edu/loscoweb/*>.

[50] Texas Department of Transportation. 2009. Gulf Intracoastal Waterway. Available at <*http://www.texasgulfcoastonline.com/portals/0/pdfs/tx_gulfcoastwaterway.pdf*>.

[51] USACE. 2006b. Waterborne Commerce of the United States, Part 2–Waterways and Harbors. Gulf Coast, Mississippi River System and Antilles. Available at <*http://www.ndc.iwr.usace.army.mil/wcsc/pdf/wcusmvgc06.pdf*>.

[52] Ports of Louisiana. 2009. South Tangipahoa Parish Port Commission. Available at <*http://portsoflouisiana.org/documents/port_profiles/South_Tangipahoa.pdf*>.

[53] U.S. Department of Energy. 2009. Idaho National Laboratory Virtual Hydropower Prospector. Available at <*http://hydropower.id.doe.gov/prospector/index.shtml*>.

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