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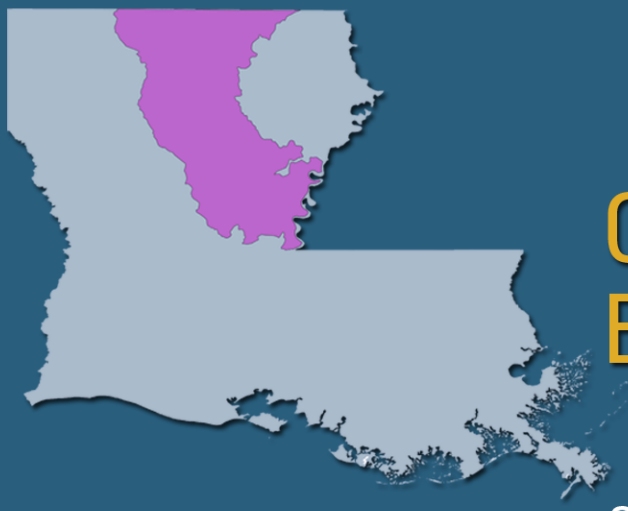

Ouachita River Basin

Characterization Report

Louisiana State Reservoir Priority and Development Program

moffatt & nichol

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Ouachita River Basin

Characterization Report

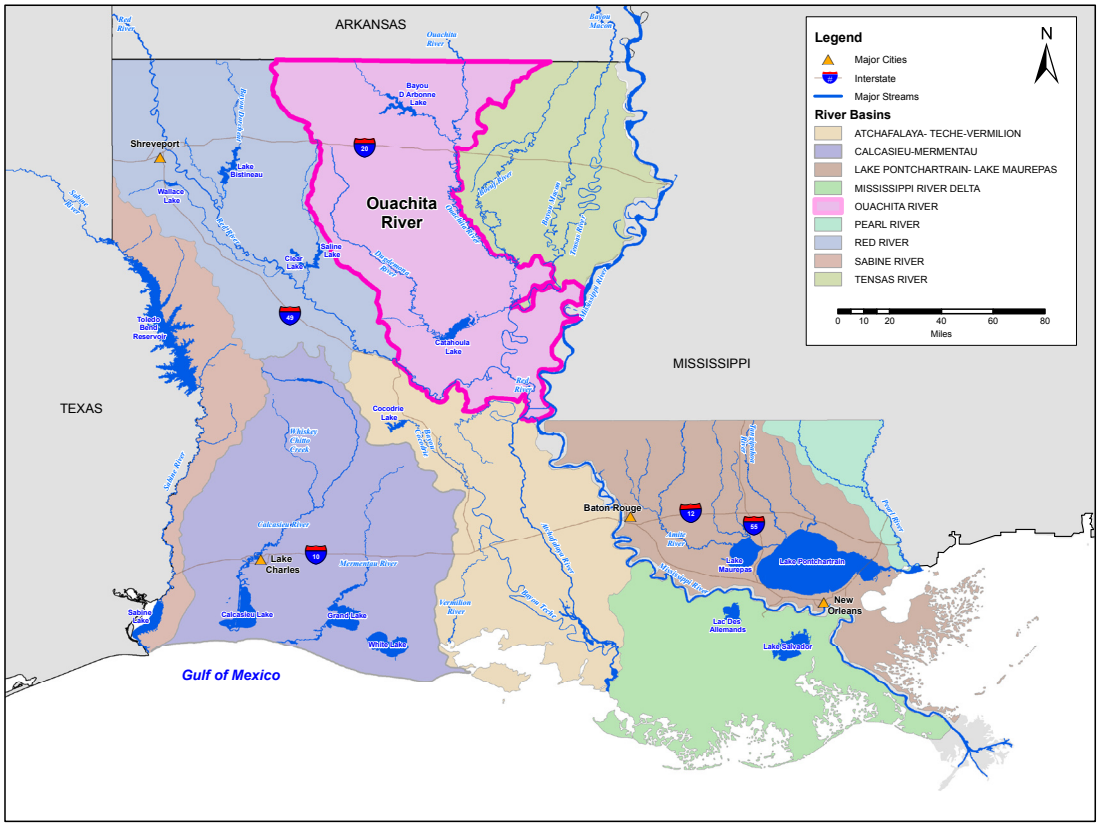
Louisiana State Reservoir Priority
and Development Program

BASIN CHARACTERIZATION REPORT FOR THE OUACHITA RIVER 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 Ouachita River Basin (ORB) **(Map 1)**. Additional technical information on important issues may be provided in separate technical reports.

Report Topics	Page



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

BASIN OVERVIEW

The ORB is located in north-central Louisiana and has an area of 7,393 square miles (see Map 2).[2] The ORB is bounded by the Arkansas-Louisiana state line to the north, the Tensas River Basin to the east, and the Red River Basin to the west. The ORB is characterized by level to slightly rolling bottomlands and terraces that make up the alluvial valley of the Mississippi River, dissected by numerous wetlands, lakes, rivers, and bayous. Bayou Bartholomew and Bayou D'Arbonne are the major tributaries of the Ouachita River in the ORB and in Louisiana.[3] The lower Red River and Black River also flow through the ORB.

Map 2. Parishes, Main Waterways, and City Boundaries[4]

Eighteen parishes are either completely or partly encompassed by the ORB. The largest cities in the ORB are Pineville, Ruston, Monroe, and Winnfield. Estimated total population in the ORB in 2005 was 351,355. **Table 1** shows the 2005 population distribution in the ORB by parish. **Figure 1** shows historical population in the basin. Population increased significantly in the 1960s and 1970s, but has remained nearly constant since 1980. Future population growth within the basin would likely increase demand for high quality potable water sources.

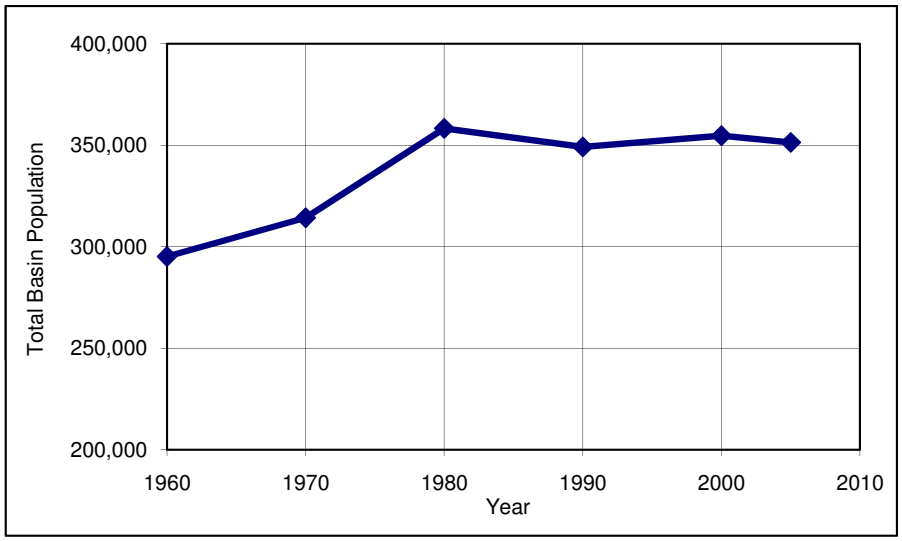


Figure 1. Historical and Projected ORB Population

Table 1. ORB Population by Parish in 2005[5]

Parish	Population
Avoyelles*	12,855
Bienville*	1,795
Caldwell*	9,354
Catahoula*	10,119
Claiborne*	14,127
Concordia*	17,251
Franklin*	91
Grant*	9,378
Jackson	15,068
La Salle	13,904
Lincoln	42,715
Morehouse*	14,316
Ouachita*	105,844
Pointe Coupe*	108
Rapides*	47,632
Tensas*	120
Union	22,741
Winn*	13,936
TOTAL	351,355

*Parish is located in more than one basin; population estimate is for the area within the ORB.

ORB=Ouachita River Basin

Principal economic activities in the ORB include agriculture as well as forestry-related industries such as secondary wood products production and pulp and paper mills.[6] Primary future economic growth areas include manufacturing and wholesale and retail businesses, and the healthcare industry is also continuing to expand throughout the southern ORB. Opportunities for expansion of oil and gas extraction exist in northern Louisiana as well.

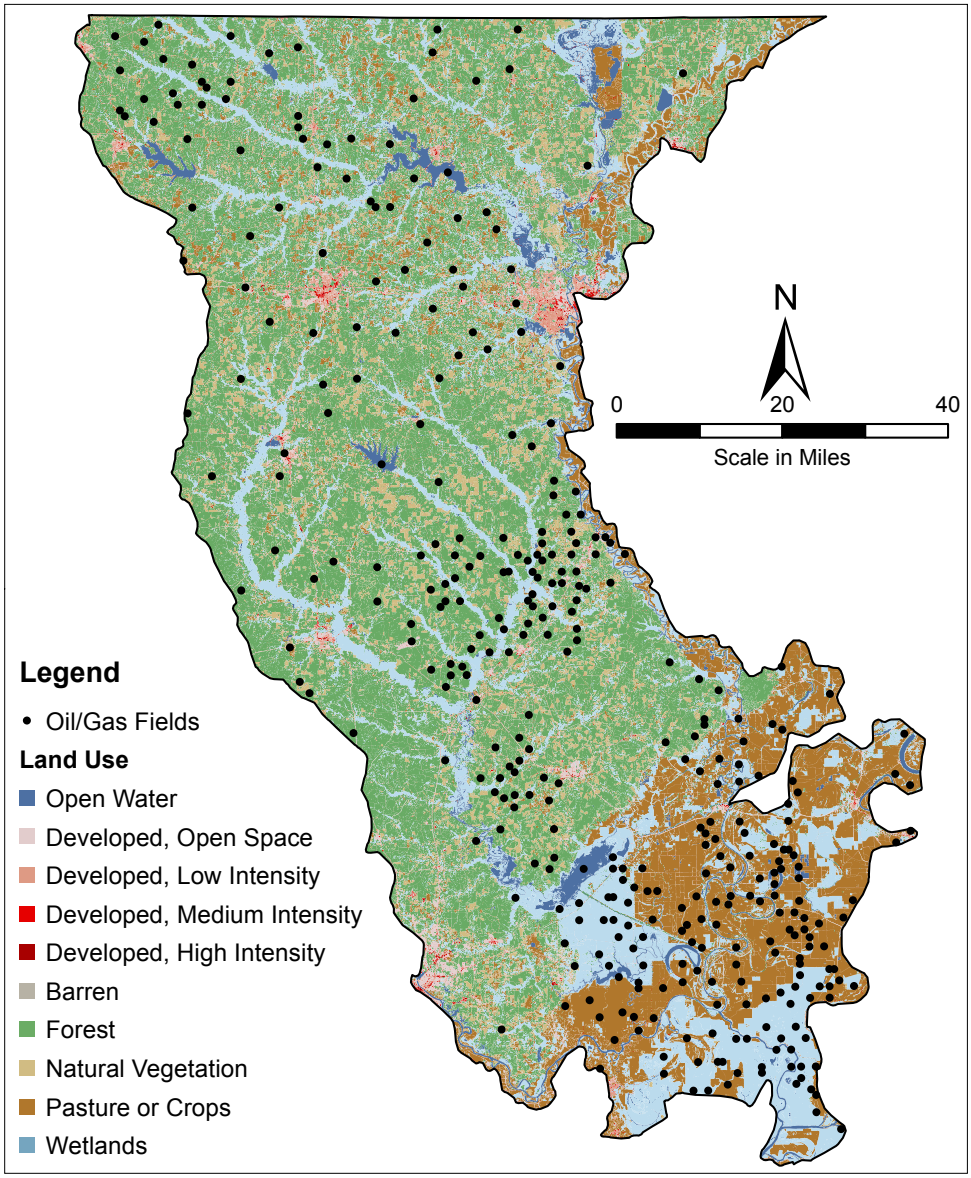
Between 2002 and 2005, timber product output in Louisiana increased 19 percent; however, a recent decrease in production of pulp and paper products in the ORB and the nation indicates that growth in this key industry is not certain.[7] Some growing economic sectors, particularly oil and gas extraction, could have substantial water supply needs as well as water treatment and disposal needs.

LAND USE AND LEGAL ENTITIES

Map 3 shows 2003 land uses in the ORB. The principal land use is forestry, though agriculture dominates the southeastern basin. Agricultural areas typically have significant water demand. Economic modeling for the 1992 to 2020 period indicates that forested land uses may decrease slightly in the ORB in the future, and that negligible change in urban land uses is expected.[8]

The ORB contains a substantial amount of land considered Prime Farmland by the Federal Natural Resources Conservation Service (NRCS).[10] The NRCS must be contacted regarding proposed irreversible conversion of any Prime Farmland for reservoir construction and water storage.

Oil and gas fields are present throughout the ORB, as shown in **Map 3**. Oil and gas drilling can require large amounts of water for extraction, which then needs to be disposed, either to surface water 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 ORB that may affect or be affected by water resources development.



Map 3. ORB Land Uses in 2003[9]

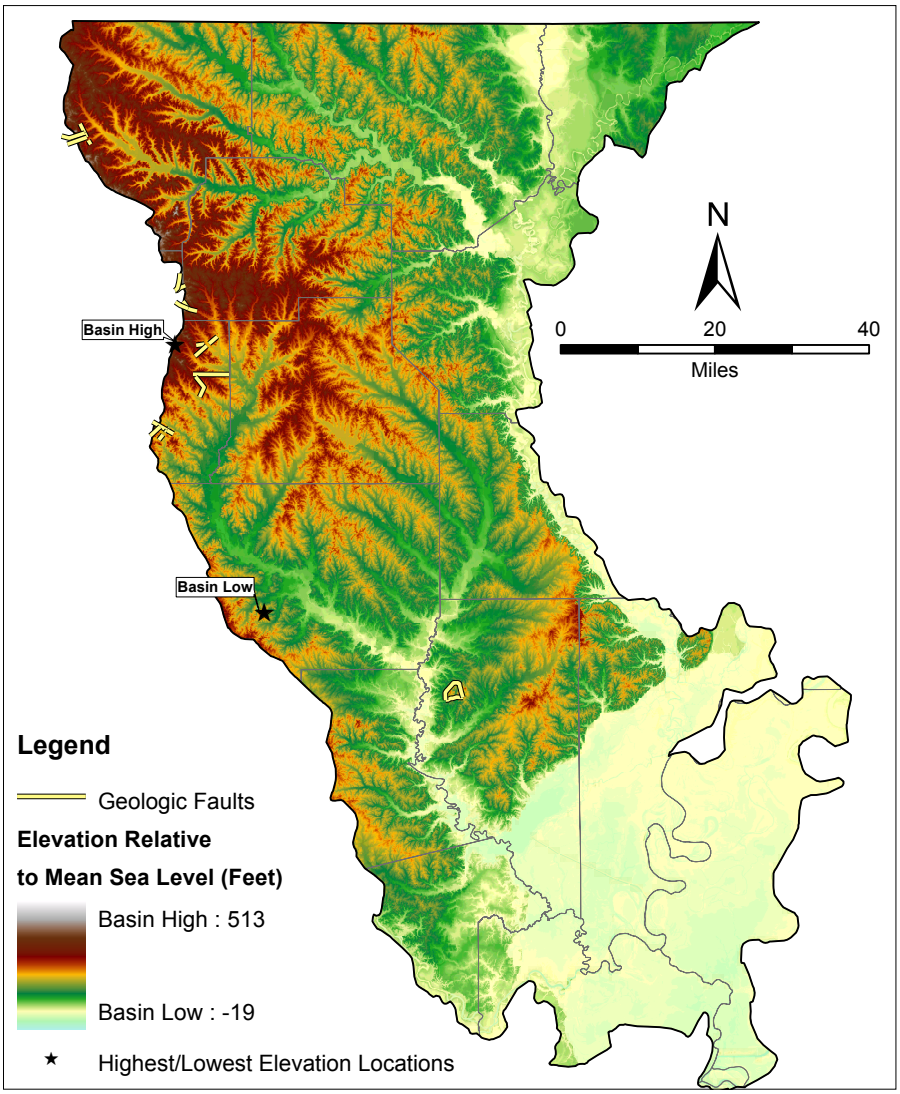
Table 2. ORB Water Resources Legal Entities

Legal Entity	Responsibilities
Coordinating and Development Corporation	Planning and development in Arkansas-Louisiana-Texas region
Kisatchie-Delta Regional Planning and Development District	Planning and development in central Louisiana
North Delta Regional Planning and Development District	Planning and development in northeast Louisiana
Red River Waterway District	Maintaining navigable waterways in the Red River
Sparta Ground Water Conservation District	Studying ways to put Sparta Aquifer groundwater to the highest beneficial use in terms of public welfare

ORB=Ouachita River Basin

PHYSIOGRAPHIC AND CLIMATIC INFORMATION

Map 4 shows general basin topography. The ORB is dominated by the Pine Hills physiographic region, which is characterized by undulating hills covered by pine and hardwood forests. Terrain in the southeastern ORB is relatively flat alluvial plains. The lowest elevation within the ORB is 19 feet below mean sea level, at the Winnfield Rock Quarry. The highest point, 513 feet above mean sea level, is in Bienville Parish, on the western basin boundary near Driskill Mountain. Geologic faults are located along the northwestern boundary of the ORB and in La Salle Parish.



Map 4. ORB Topography[11]

Soils in the Pine Hills physiographic region are dominated by loamy, clayey, and shaley marine deposits, while soils in the lowlands south and east of Catahoula Lake are characterized as loamy and clayey low terraces and floodplains.[12]

Average annual rainfall throughout the ORB varies geographically from 50 to 70 inches per year, increasing from north to south.[13] **Figure 2** shows historical annual precipitation at Monroe, varying between about 40 and 70 inches per year, with a historical average of about 52 inches per year. Although rainfall and resulting runoff is plentiful in the ORB, the historical record shows that extended dry periods have occurred (e.g., 1961 to 1968), stressing surface water and groundwater supplies. Average annual temperature generally increases from north to south from 65 to 68 degrees Fahrenheit (°F) in the ORB. Average temperature at Monroe in the warmest month, July, is 94°F; average low temperature in the coldest month, January, is 33°F.[14]

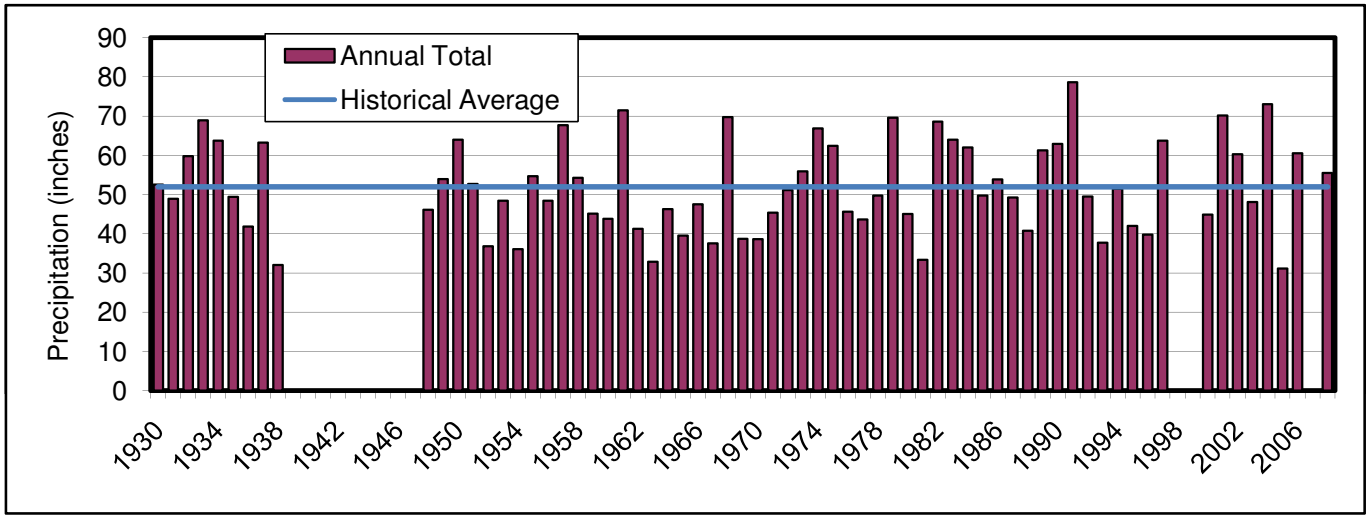


Figure 2. Historical Annual Precipitation at Monroe[15]

WATER USE

Water use in the ORB is summarized in **Table 3** by sector, water type, parish, and surface water body, 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 which do not entirely consume the withdrawn water and allow a large percentage of the water to be returned to a waterway. In 2005, total water use was about 300 million gallons per day (mgd) of a combination of surface water and groundwater. In 2005, power generation used the largest volume of surface water, totaling over 87 mgd, followed by industry and rice irrigation. Major industrial surface water uses in the ORB include manufacturing of paper products and chemicals. In particular, paper mills and several conventional power plants are located along the Ouachita River. In 2005, the general (non-rice) irrigation, public supply, aquaculture, and livestock sectors also used surface water. Ouachita Parish used the greatest quantity of surface water in 2005 (107 mgd), followed by Morehouse and Concordia parishes. The Monroe Water System uses over 11 mgd of surface water. The majority of surface water used in the ORB is withdrawn from the Ouachita River.

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 ORB (**Table 3**); actual groundwater use by parish may differ from this estimation. Most groundwater withdrawn in the ORB in 2005 was used for irrigation

and public supply. In fact, groundwater served as the sole water source in seven parishes in the ORB in 2005. The Mississippi Alluvial Aquifer is a major source of groundwater used for irrigation in several ORB parishes, particularly Morehouse Parish. The Greater Ouachita Water Company and the West Monroe Water System each used about 3 mgd of groundwater in 2005; many other municipal water systems used smaller amounts of groundwater.

Figure 3 shows trends in surface water and groundwater use in the ORB at 5-year intervals from 1990. Power generation and industrial surface water uses fluctuated during this 15-year period. Total irrigation surface water use increased from a low of about 9 mgd in 1990 to 25 mgd in 2005. Total irrigation uses of groundwater also increased from 32 mgd in 1990 to 83 mgd in 2005. Use of groundwater for public supply fluctuated over this period, while industrial and aquaculture groundwater uses decreased.

Table 3. ORB Water Use in 2005[16]

Sector	Surface Water (mgd)	Groundwater (mgd)
Aquaculture	0.7	5.2
General irrigation	7.5	31.3
Industry	42.1	12.5
Livestock	0.5	0.3
Power generation	87.3	0.0
Public supply	3.5	38.6
Rice irrigation	18.1	51.9
Rural domestic	0.0	1.7
TOTAL	159.6	141.7

Surface Water Body	Use (mgd)
Bayou Batholomew	27.3
Bayou Cocodrie	8.9
Big Creek	2.0
Cross Bayou	3.1
Marango Bend	1.5
Ouachita River	110.1
Other (not listed)	6.7
TOTAL	152.9

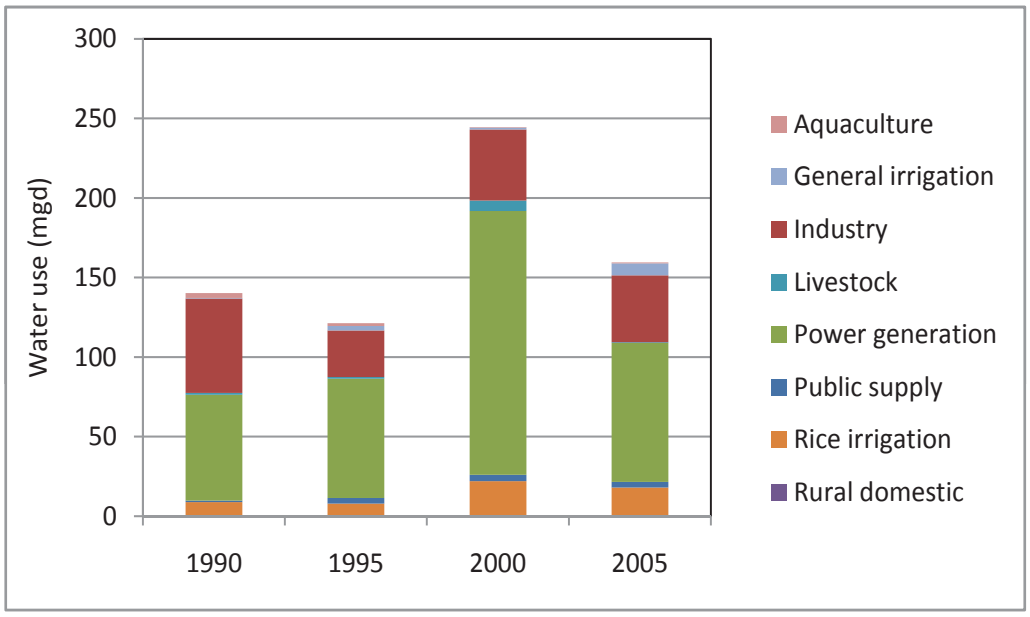
Parish	Surface Water (mgd)	Groundwater* (mgd)
Avoyelles	0.0	7.6
Bienville	0.0	1.6
Caldwell	0.0	1.9
Catahoula	4.5	19.0
Claiborne	0.0	2.2
Concordia	14.0	20.5
Grant	2.8	0.9
Jackson	0.0	2.0
La Salle	0.0	2.0
Lincoln	0.12	0.1
Morehouse	30.4	46.0
Ouachita	107.3	16.8
Rapides	0.0	12.6
Union	0.2	5.5
Winn	0.08	3.0
TOTAL	159.4	141.7

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

ORB=Ouachita River Basin

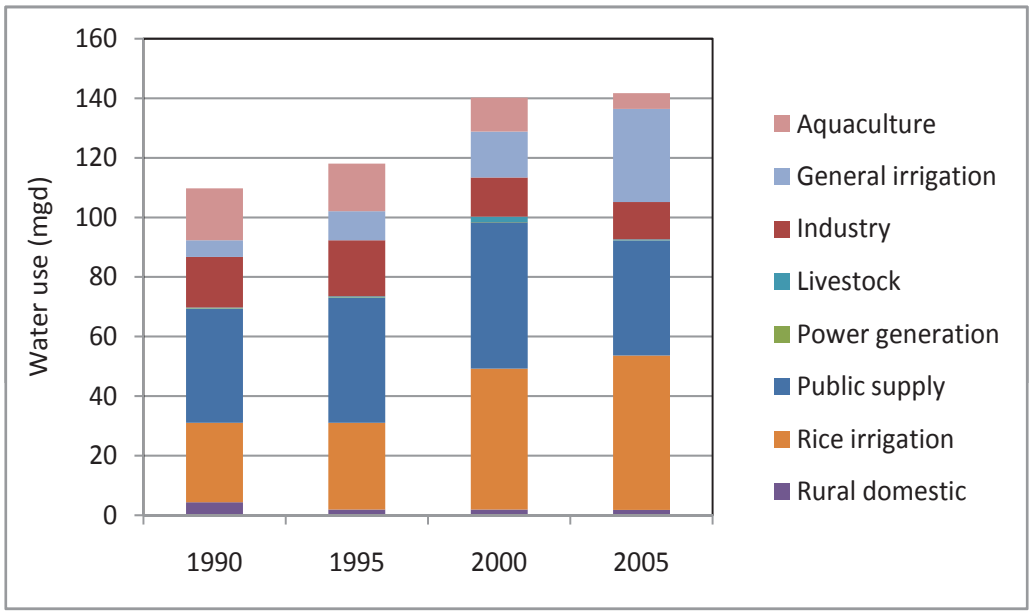
mgd=million gallons per day

Recent Historical Surface Water Use



mgd=million gallons per day

Recent Historical Groundwater Use



mgd=million gallons per day

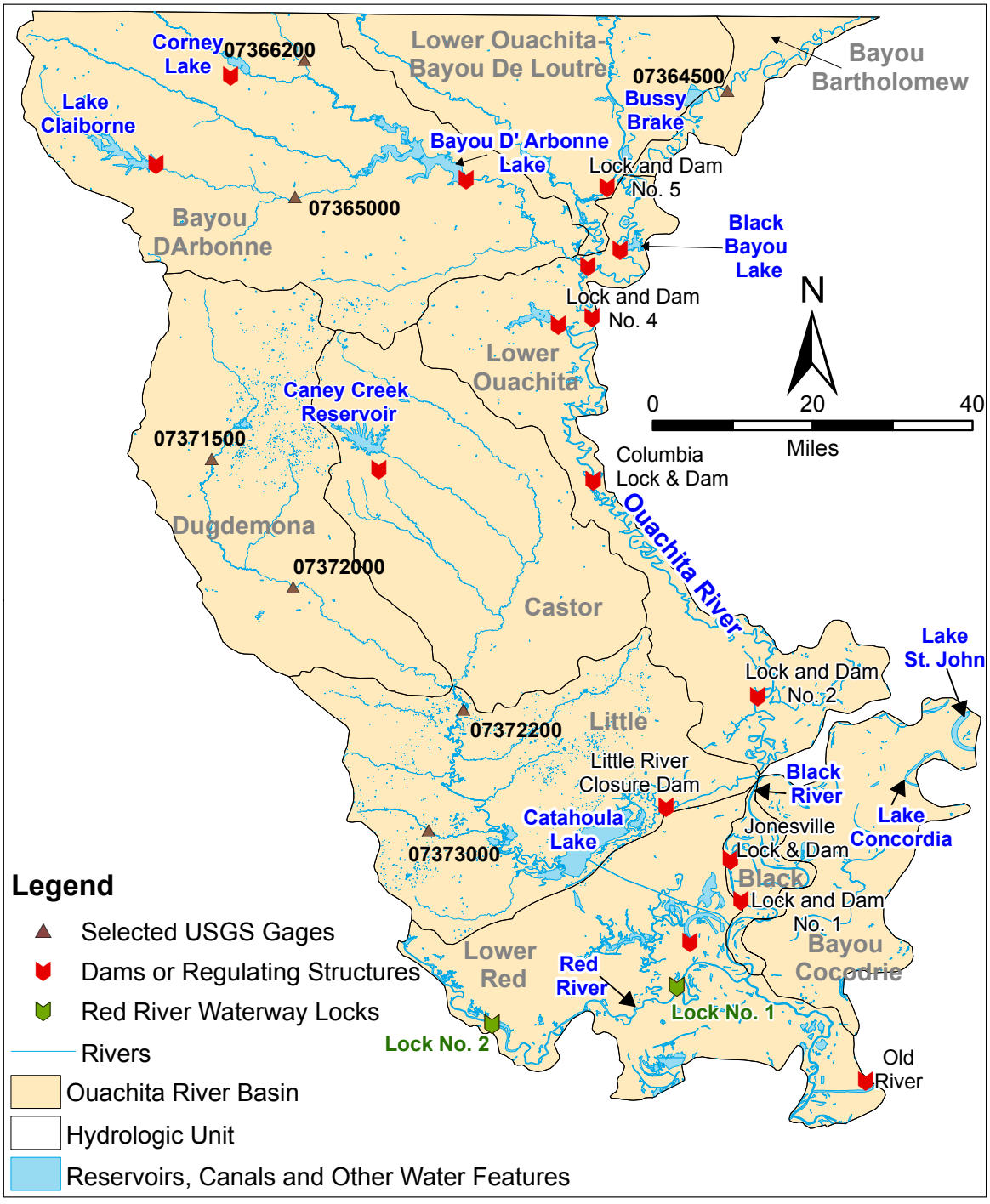
Figure 3. Trends in Water Use in ORB by Sector[17]

Per capita water use in 2005 (based on reported rural domestic and public supply uses by parish and population) for ORB parishes varied from 133 gallons per capita (person) per day (gpcd) in Jackson Parish to 220 gpcd in Union Parish.[16] It is not clear why per capita water use varies so widely. Primary water demand concerns in the ORB are related to municipal and industrial needs near Monroe.[2] Efforts to encourage water conservation in Northern Louisiana, such as the "Reduce the Use" campaign led by the Louisiana State University AgCenter, have been undertaken.

Currently, oil and gas extraction represents a small fraction of water use in Louisiana (less than 3 mgd).[16] However, oil and gas development is on the rise in northern Louisiana, including in the ORB, and could increase local water demand in the future.

SURFACE WATER

Primary surface water features in the ORB include streams, bayous, rivers, lakes, and reservoirs including the Ouachita River, Red River, Bayou D'Arbonne Lake, and Black Bayou Lake, as shown in **Map 5**. **Map 5** also shows the nine subwatersheds, or hydrologic units, in the ORB delineated by the U. S. Geological Survey (USGS), and stream gages referenced in this report.



Map 5. Surface Water Features[18]

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.[19] Some gages within the ORB only measure stage, with undefined stage-discharge relationships. Streamflow statistics for selected ORB gages with long-term streamflow records are summarized in **Table 4**. Streamflow in the Ouachita River is regulated by five reservoirs in Arkansas and a series of navigation locks and dams. Streamflow data for the Ouachita River are only available for the part of the year when river stage is below bankfull.

Table 4. Streamflow Characteristics for Selected Gages[20]

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[21]	10	50	90
Ouachita River near AR-LA State Line (07364100)	10,787	1958 –Present	NA[a]	NA	190[b] 9/13/1971	NA	NA	NA	NA
Dugdemona River near Joyce, LA (07372050)	730	2001 –Present	787[c]	28,700 12/16/2001	0.45 8/28/2007	0.53[d]	2,530	146	7.2
Dugdemona River near Jonesboro (07371500)	355	1938 –1996	430.9[e]	41,500 12/28/1982	0.40 8/31/1954	NA	NA	NA	NA
Little Corney Bayou near Lillie, LA (07366200)	208	1956 –Present	211	24,000 6/9/1974	0 Several	0.06	544	48	3.8
Little River near Rochelle, LA (07372200)	1,899	1957 –Present	2,259[f]	108,000 12/29/1982	8.8 9/6/2000	16	NA	NA	NA
Big Creek at Pollock, LA (07373000)	51	1942 –Present	64	23,500 4/29/1953	3.4 9/5/2000	8.4	95	29	13

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

[a] Discharge only recorded for a limited range of gage height. Average flow not available.
[b] Minimum daily discharge.
[c] For water years 2003 –2007.
[d] Annual 7-day minimum.
[e] Based on Annual Mean for water years 1939 –1995.
[f] Average Discharge for period of record 1928 – 1996, 1998 – present.

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 cfs, typically have extended periods of low flows. For example, Little Corney Bayou and the Dugdemona River both have very low 7Q10 flows (**Table 4**); these streams would not be good candidates for reliable water supplies without construction of storage reservoirs. Peak flows, including the maximum instantaneous discharge, and the streamflow exceeded by only 10 percent of flows, are useful for characterizing flooding and high-flow conditions on a stream.

Monthly average streamflows are shown in **Figure 4** for gages where historical data are available. These gages show a seasonal runoff pattern, with highest flows occurring in winter and spring and very little runoff occurring in late summer and early fall. With this seasonal pattern, reservoir storage is needed to make water available for year-round uses, such as municipal and industrial supplies.

The ORB contains 751 miles of streams designated under Louisiana's Natural and Scenic River System (shown in **Map 2**), as created by the Louisiana Natural and Scenic River Act. These waterways are protected by a permit process and certain restrictions, including prohibitions against channelization, impoundment construction, and channel realignment.[22]

Published characteristics of major lakes and reservoirs in the ORB are summarized in **Table 5**. Dependable yield listed in the table for these impoundments is generally the maximum annual water supply available from the water body, with the understanding that lower yields will occur according with a given frequency, such as every 20 years.[23]

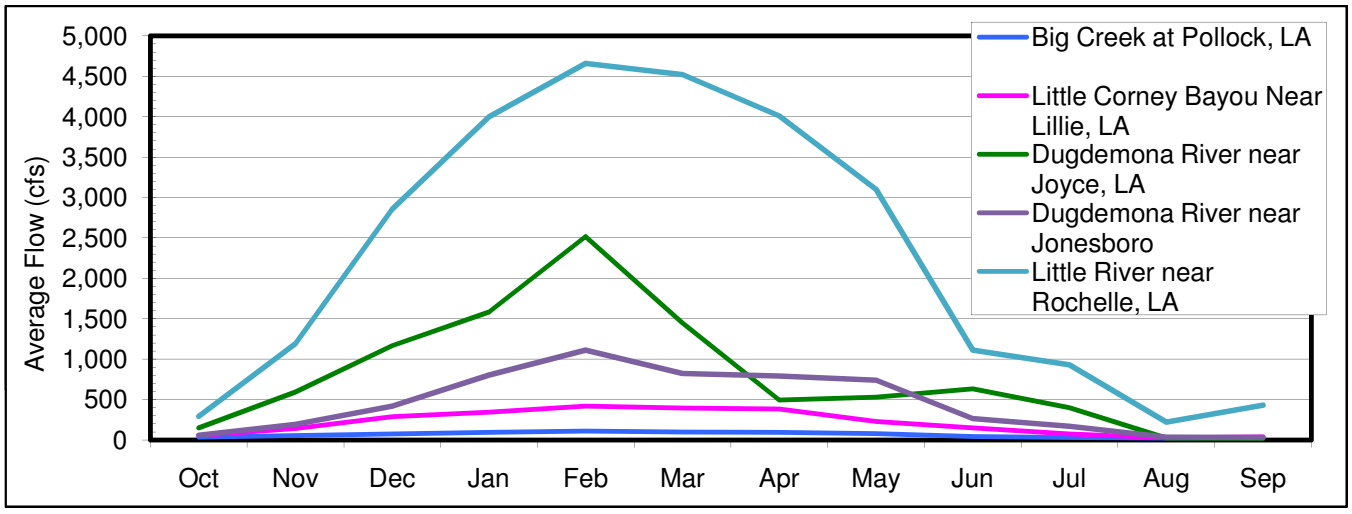


Figure 4. Historical Monthly Average Streamflow for Selected Gages[20]

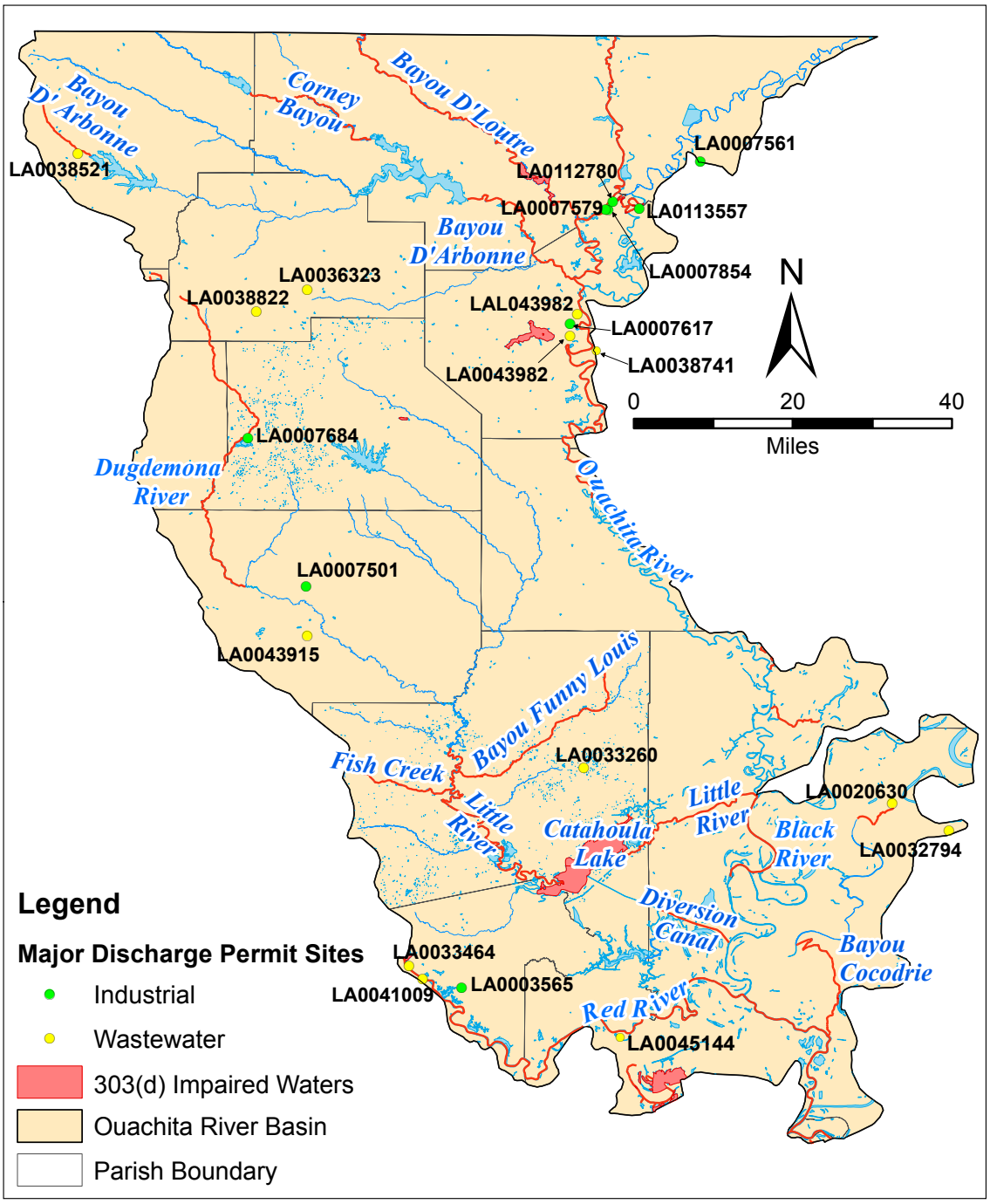
Table 5. Characteristics of Major Lakes and Reservoirs in the ORB[24]

Name	Surface Area (acres)	Volume (acre-feet)	Dependable Yield (mgd)
Bayou D'Arbonne Lake	15,250	130,000	80
Lake Claiborne	6,400	100,000	62
Lake St. John	2,120	NA	NA
Lake Concordia	1,050	NA	NA
Corney Lake	1,944	7,500	NA
Bussy Brake	1,860	NA	NA
Caney Creek Reservoir	4,674	79,600	NA
Catahoula Lake	15,664	NA	NA

mgd=million gallons per day
NA=not available
ORB=Ouachita River 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.[25] In these cases, designated uses of the water bodies, such as fish and wildlife propagation, recreation, or drinking water supply may be impaired. Stream and lake sub-segments in the ORB on the 2006 303(d) list are shown in **Map 6**. 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. ORB Impaired Waters from 303(d) List and Major Permitted Discharge Sites[26]

Table 6. Summary of ORB Surface Water Quality Impairments[25]

Impaired Use	Sub-segments
Fish & wildlife propagation	159
Primary contact recreation	15
Outstanding natural resource	9
Secondary contact recreation	3
Limited aquatic life & wildlife	3
Drinking water supply	2

DWS=drinking water supply
FWP=fish and wildlife propagation
LAL=limited aquatic life and wildlife
ONR=outstanding natural resource
PCR=primary contact recreation (swimming)
SCR=secondary contact recreation (boating)
ORB=Ouachita River Basin

Parameter Causing Impairment (affected use)	Sub-segments
Mercury (FWP)	42
Dissolved Oxygen (FWP and LAL)	38
Turbidity (FWP and ONR)	28
Fecal coliform (PCR and SCR)	18
Suspended solids (FWP and ONR)	11
Nutrients (FWP)	10
Low pH (FWP)	6
Sedimentation/siltation (FWP and ONR)	5
Dissolved solids (FWP)	5
DDT (insecticide) (FWP)	5
Carbofuran (insecticide) (FWP)	4
Sulfates (FWP)	3
Dioxin (FWP and LAL)	3
Toxaphene (insecticide) (FWP)	2
Color (DWS)	2
Chloride (FWP)	2
Methyl Parathion (insecticide) (FWP)	1
Atrazine (herbicide) (FWP)	1
Non-native aquatic plants (FWP)	1
Oil and grease (FWP)	1

Table 6 summarizes the number of stream and lake sub-segments in the ORB that are on the 2006 303(d) list, and identifies impaired uses and parameters causing impairment. Many key streams and lakes in the ORB have water quality impairments, mainly for fish and wildlife propagation. Mercury in fish tissue, leading to fish consumption advisories, is the most common parameter causing impairment. The Louisiana Department of Environmental Quality (LDEQ) has been investigating the mercury problem throughout the state since fish tissue data from the Ouachita River first resulted in a fish consumption advisory in 1992.[27] Dissolved oxygen and turbidity are also common causes of impairment for aquatic life. The presence of bacteria, as indicated by fecal coliform, affects recreational uses of some surface waters in the ORB.

In the ORB, runoff and return flows from agricultural areas are common suspected causes of impairment for parameters including nutrients, herbicides, and turbidity. Dioxin listings have been attributed to industrial point source discharges, potentially paper mills. USGS noted that river-regulating structures, such as locks, cause water to pool, leading to low dissolved oxygen conditions.[28]

Permitted Surface Water Discharges

The Louisiana Department of Environmental Quality (LEDQ) 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 are summarized **Table 8**. Additional information on all dischargers in Louisiana can be obtained from LDEQ through their public records request process.[29]

The city of Alexandria (located just outside the ORB) has the largest municipal discharge at 22 mgd, followed by Monroe at 12 mgd. Industrial dischargers include power facilities, industrial chemical facilities, and paper mills; each has a permitted discharge of less than 10 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 ORB[30]

Discharger (Permit Number)	Permitted Flow (mgd)	Receiving Water	Parish
Alexandria, City of (LA0041009)	22.0	Red River	Rapides
Bastrop, City of (main plant) (LA0020443)	4.0	Tisdale Brake/Staulkinghead Creek	Morehouse
Ferriday, Town of (LA0020630)	1.6	Cocodrie Bayou	Concordia
Grambling, Town of	50-600	50-500 700 (large capacity)	25-100
(LA0038822)	0.4	Redwine Creek/Dugdemona River	Lincoln
Homer, Town of (LA0038521)	1.3	Bayou D'Arbonne/Lake Claiborne	Claiborne
Jena, Town of (LA0033260)	1.4	Hemphill Creek/Catahoula Lake	La Salle
Monroe, City of (LA0038741)	12.0	Ouachita River	Ouachita
Pineville, City of (LA0033464)	5.5	Red River	Rapides
Ruston, City of – Northside STP (LA0036323)	4.0	Colvin Creek, Cypress Creek, Bayou D'Arbonne	Lincoln
Vidalia, Town of (LA0032794)	1.5	Vidalia Canal/Mississippi River	Concordia
City of West Monroe, City of (LA0043982)	5.3	Ouachita River	Ouachita
Winnfield, City of (LA0043915)	1.4	Creosote Branch	Winn

Information presented in this table is directly from USEPA (2009a). For detailed explanation, this reference should be consulted.
mgd=million gallons per day
ORB=Ouachita River Basin
STP=sewage treatment plant

Table 8. Major Industrial Discharge Permits in the ORB[30]

Discharger (Permit Number)	Permitted Flow (mgd)	Receiving Water	Parish	Type of Discharge
Angus Chemical Co. (LA007854)	5.9	Ouachita River	Ouachita River	Ouachita
Entergy Louisiana LLC (Sterlington Plant) (LA007579)	5.8	Ouachita River	Ouachita River	Ouachita
Perryville Power Station (LA0113557)	6.5	Ouachita River	Ouachita River	Ouachita
Graphics Packaging West Monroe (LA007617)	6.8	Ouachita River	Ouachita River	Ouachita
Ouachita Power LLC Sterlington (LA0112780)	NA	Ouachita River	Ouachita River	Ouachita
International Paper Co. – Bastrop (LA007561)	6.2	Staulkinghead Creek	Staulkinghead Creek	Morehouse
Smurfit-Stone Container – Hodge Mill (LA0007684)	8.5	Dugdemona River	Dugdemona River	Jackson
Arclin Canada, Dynea (Winnfield) (LA0007501)	10.0	Ouachita River	Ouachita River	Winn
International Paper – Pineville Kraft Mill (LA0003565)	2.1	Red River	Red River	Rapides

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
ORB=Ouachita River Basin

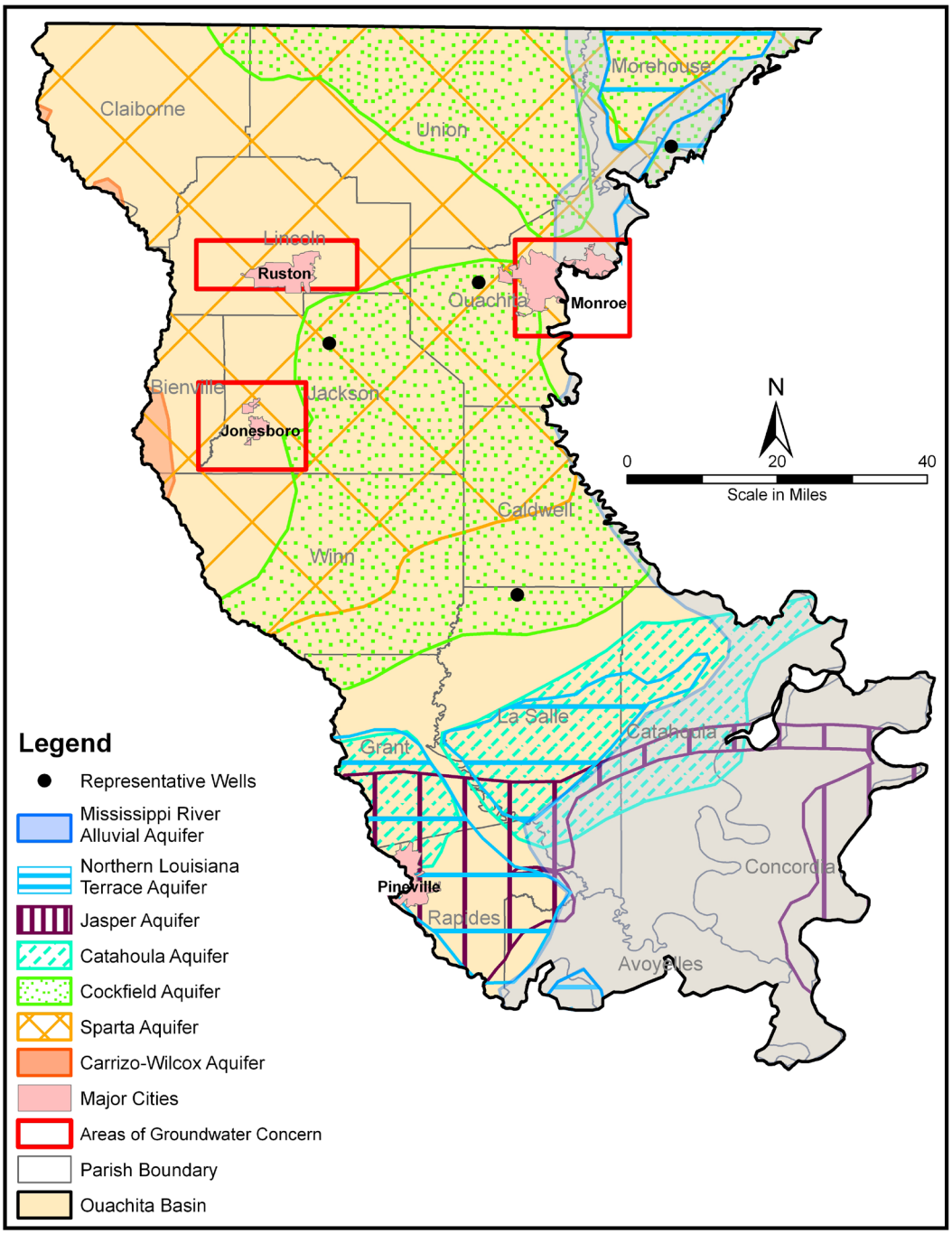
GROUNDWATER

As discussed previously, groundwater is extensively used in a variety of sectors in the ORB, and the State has registered about 2,550 water wells in the ORB.[19] The following major aquifers underlie portions of the ORB:

- Mississippi River Alluvial Aquifer
- Northern Louisiana Terrace Aquifers
- Jasper Aquifer
- Catahoula Aquifer
- Cockfield Aquifer
- Sparta Aquifer
- Carrizo-Wilcox Aquifer

Major aquifers in the ORB are shown in **Map 7**. Aquifer areas overlap because the aquifers occur at different depths. Characteristics of the major aquifers are summarized in **Table 9**.

Although the Jasper and Carrizo-Wilcox aquifers extend into the ORB, they are not heavily used in the basin and are not discussed in this report. Historical data do not extend past 2002 for wells recently drilled in the Catahoula Aquifer in the ORB, making evaluation of long-term groundwater level trends infeasible for this aquifer.



Map 7. Spatial Extent of Major ORB Aquifers[31]

Table 9. Overview of ORB 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) [19]
Mississippi River Alluvial	50 – 500	500 – 4000 7000 (Large Capacity)	10 – 530	5 – 90	8 – 29
Northern Louisiana Terrace	25 – 240	100 – 1700	150 – 270	1 – 50	10 – 70
Jasper	50 – 2400	40 – 800 3000 (large capacity)	20 – 260	2 – 30	NA
Catahoula	50 – 450	50 – 400	20 – 260	2 – 30	40 – 135
Cockfield	50 – 600	50 – 500 700 (large capacity)	25 – 100	1.5 – 7.5	55 – 75
Sparta	50 – 700	100 – 1800	25 – 100	1.5 – 7.5	65 – 300
Carrizo-Wilcox	50 – 850	30 – 150 400 (large capacity)	2 – 40	0.5 – 4	NA

gpm=gallons per minute
gal/min/ft=gallons per minute per foot
NA=not available
ORB=Ouachita River Basin

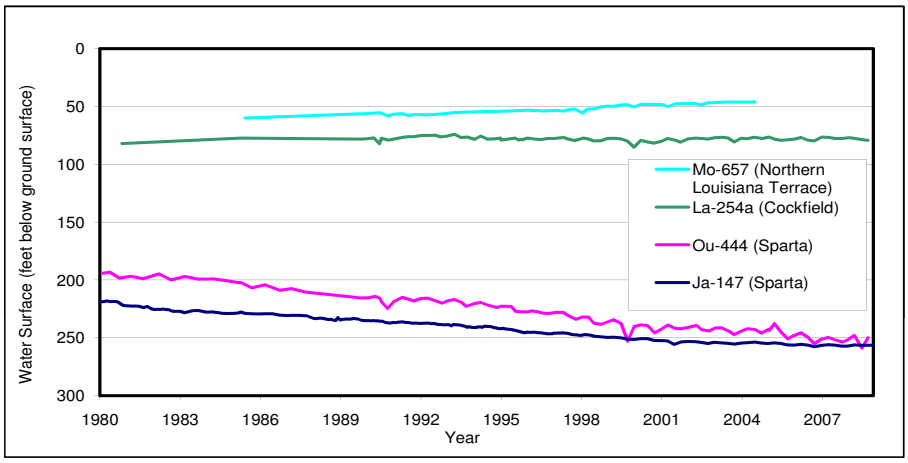


Figure 5. Historical Trends in ORB Groundwater Levels[19]

Figure 5 shows historical groundwater levels in the most heavily used aquifers in the ORB. Historical data from Wells Ja-147 and Ou-444 (**Figure 5**), completed in the Sparta Aquifer in Jackson and Ouachita parishes, respectively, show that groundwater levels decreased by 30 to 50 feet from 1980 to present in the eastern Sparta Aquifer underlying the ORB. The Sparta Aquifer has been pumped extensively across the basin for public supply and industrial use. Long-term pumping of large amounts of groundwater can reduce the volume of groundwater in aquifer storage and cause localized areas of significant decline in groundwater levels, resulting in decreased well yields. Eventually, this can lead to subsidence, the irreversible loss of aquifer storage capacity. Since the mid-1990s, declining water levels in the Sparta Aquifer in southern Arkansas and northern Louisiana have been problematic, leading to a declaration by the Louisiana Department of Natural Resources (LDNR) Commissioner of Conservation (Commissioner) of three Areas of Groundwater Concern in the Sparta Aquifer (**Map 7**).[32] An Area of Groundwater Concern is an area in which, under current use and normal hydrologic conditions, an aquifer is not being managed sustainably. This may be attributed to saltwater intrusion, groundwater level decline, or subsidence, resulting in unacceptable environmental, economic, social, or health impacts, or causing serious adverse impact to an aquifer. This designation requires that the following remedial actions must be taken in the area:

- An aggressive water conservation education program must be conducted
- Owners of non-domestic wells must submit monthly water use reports
- Alternative sources of potable water should be pursued to reduce groundwater use

Implementation of these actions has reduced groundwater use, and groundwater levels have increased in recent years, particularly in the portion of the Sparta Aquifer underlying

Arkansas. Furthermore, a joint study was conducted between the USGS and the Sparta Ground Water Convservation District to monitor groundwater levels and groundwater quality, as well as to develop a groundwater model. The Commissioner also authorized investigation of potential saltwater intrusion into the Sparta Aquifer.[19]

Historical data from Well La-254a, completed in the Cockfield Aquifer in La Salle Parish, indicates that groundwater levels have remained stable since 1980 (**Figure 5**). Historical data from Well Mo-657, completed in the Northern Louisiana Terrace Aquifer in Morehouse Parish, indicate that groundwater levels increased from 1984 to 2005. Given that these two aquifers occur at shallow depths, groundwater level fluctuations are likely in response to seasonal rainfall patterns.

The Mississippi River Alluvial Aquifer is primarily used for irrigation and aquaculture in the ORB.[16] The Mississippi River Alluvial aquifer is hydraulically connected with the Mississippi River and its major streams, and is recharged by direct infiltration of rainfall, lateral and upward movement of water from adjacent and underlying aquifers, and overbank stream flooding. Groundwater levels fluctuate seasonally in response to precipitation and river stage.[34] Because of rapid recharge from overlying surface water, this aquifer does not show long-term groundwater level decline.

Groundwater Quality

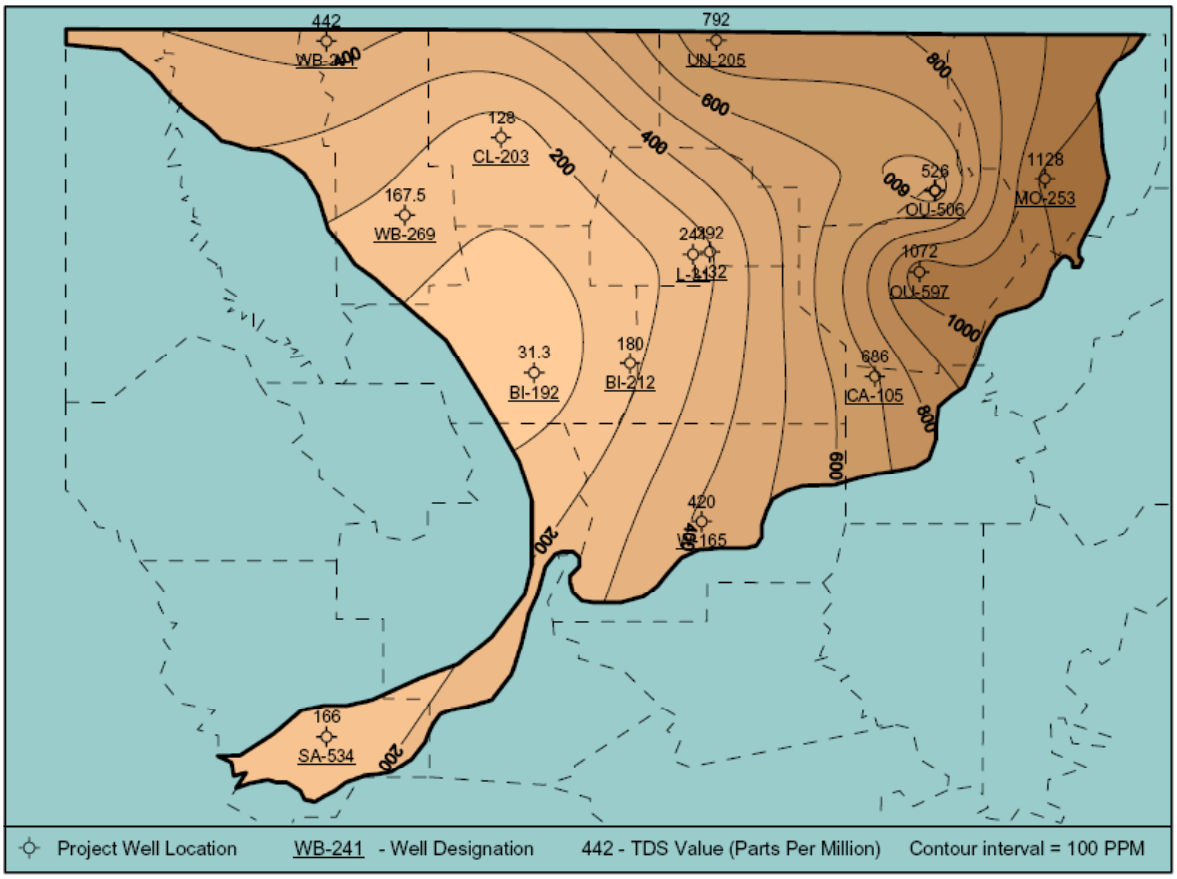
Groundwater quality issues identified in the 2005 and 2006 LDEQ Baseline Monitoring Program reports are summarized by aquifer in **Table 10**.[35] Groundwater quality tends to be sufficient for most purposes in the ORB. Water in five wells in the Mississippi River Alluvial Aquifer exceeded the Federal primary drinking water standard for arsenic in 2006; however, none of these wells are located in the ORB. None of the other wells tested in the major ORB aquifers exceeded Federal primary drinking water standards. As shown in **Table 10**, some wells in the major ORB aquifers exceed secondary standards for pH, total dissolved solids (TDS), color, chloride, and iron.

Groundwater quality is highly spatially variable within the Sparta aquifer. Contours of TDS concentration in the Sparta Aquifer in Map 8 show variation from less than 100 parts per million (ppm) in the western aquifer to over 1,000 ppm in the eastern aquifer. Elevated TDS concentrations can render groundwater less suitable for drinking water supply and irrigation.

Table 10. Secondary Drinking Water Standards Exceedences in Major ORB Aquifers[36]

Aquifer	pH	TDS	Color	Chloride	Iron
Mississippi River Alluvial	■	■	■		■
Northern Louisiana Terrace	■	■		■	■
Jasper: Williamson Creek Carnahan Bayou	■	■	■ ■		■
Catahoula					■
Cockfield	■	■	■		■
Sparta	■	■	■	■	■
Carrizo-Wilcox		■	■		■

X = One or more wells exceeded the secondary standard
TDS=total dissolved solids
ORB=Ouachita River Basin



Map 8. Total Dissolved Solids Concentration in the Sparta Aquifer in the ORB[37]

FLOODING

Rivers and bayous of the ORB are subject to periodic flooding, mainly due to heavy rainfall. Flood-inducing rains may occur during any month of the year in Louisiana, but are less likely during the dry fall months and are most frequent during late winter and early spring.

Eight of the parishes located in the ORB (Caldwell, Catahoula, Concordia, Grant, Lincoln, Ouachita, Rapides, and Union) 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 in a parish; 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 are available as digital geographic information system layers and detailed maps and reports can be obtained from FEMA.[38]

The Ouachita River is subject to frequent flooding that inundates large areas because of backwater flooding of its tributaries.[39,40] Major flooding occurred in the ORB in 1991, during the rainiest April on record for southern Arkansas, Louisiana, and Mississippi. During these floods, high water levels in the Ouachita and Black rivers inundated hundreds of thousands of acres.

The upper Red River is regulated by Denison Dam and Texarkana Dam, both located in Arkansas. Despite the presence of these dams, heavy rains can cause major floods on the lower Red River in Louisiana.[13]

Low-lying alluvial plain areas, particularly in Catahoula Parish, are subject to both backwater and headwater flooding. In the ORB, backwater flooding is caused by the Mississippi and Red rivers in this area almost every year, usually in early spring, and is extensive approximately every 3 years.[41]

After a major flood in 1927, a number of flood control projects were authorized for construction. The various authorizations culminated in a comprehensive project for the entire

basin.[3] Flood control projects located within the ORB include the following:

- Ouachita River and Tributaries Project – This project is a comprehensive plan for flood control, hydropower, and other improvements for the Ouachita River and tributaries. The project provides varying degrees of flood protection to a large area of the ORB, including floodwalls and levees. Levees extend from Bastrop, along the south bank of Bayou Bartholomew and the east bank of the Ouachita River, to the vicinity of Sandy Bayou, approximately 74 miles downstream from Monroe.
- Chauvin Bayou Project – This project consists of a 250 cfs pumping plant, located adjacent to Chauvin Bayou at the Ouachita River levee, and a water control structure in Canal L-11.
- Old River Control Structure – This structure helps control floodwaters on the lower Mississippi River and is located on the southeastern boundary of the ORB.[28]

USGS estimated flood flow magnitudes for different return periods at streamflow gages throughout the State. Gages within the ORB where substantial historical data have been measured are listed in **Table 11**, along with their estimated peak discharges for various recurrence intervals. The USGS analysis is only valid for rural, unregulated waterways. Also included in **Table 11** are peak flood discharges estimated for design purposes in the FISs.

Table 11. Estimated Peak Flow Discharges of ORB Streams[42]

Source	Location		Flood Magnitude (cfs)			
	Gage Number	Name	2-year	10-year	100-year	500-year
USGS	07366200	Little Corney Bayou near Lillie	3,700	10,400	22,400	32,700
	07364500	Bayou Bartholomew near Beekman	7,260	10,500	13,500	15,100
	07365000	Bayou D'Arbonne near Dubach	6,280	16,400	35,300	51,500
	07371500	Dugdemona River near Jonesboro	6,820	18,700	40,900	60,400
	07372000	Dugdemona River near Winnfield	7,700	20,800	42,200	59,500
	07372200	Little River near Rochelle	21,200	56,800	110,700	155,300
	07373000	Big Creek at Pollock	2,880	11,400	33,000	57,500
FIS	Hurricane Creek at mouth		NA	12,389	18,594	23,883
	Cross Bayou at confluence with Bayou Cocodrie		NA	4,640	5,240	6,670
	Middle Fork Bayou D'Arbonne at Highway 80		NA	10,241	20,019	30,445
	Bayou Rigolette at Rapides Parish line		NA	NA	10,260	NA
	Flagon Bayou at Flagon Creek Road		NA	NA	6,424	NA
	Clear Creek upstream from Hardwater Lake		NA	NA	10,200	NA
	Bayou D'Arbonne Lake at State Routes 15 and 33		NA	52,302	109,094	177,303
	Corney Bayou at mouth		NA	30,571	63,018	100,618
	Ouachita River at Highway 80		NA	77,300	109,000	131,000
	Stowe Creek at State Route 15		NA	10,991	25,797	44,063

ORB=Ouachita River Basin
cfs=cubic feet per second
FIS=Flood Insurance Studies
LA=Louisiana
NA=not available
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 resource facilities, as regulated by Federal and State permitting requirements.

Habitat and Wildlife

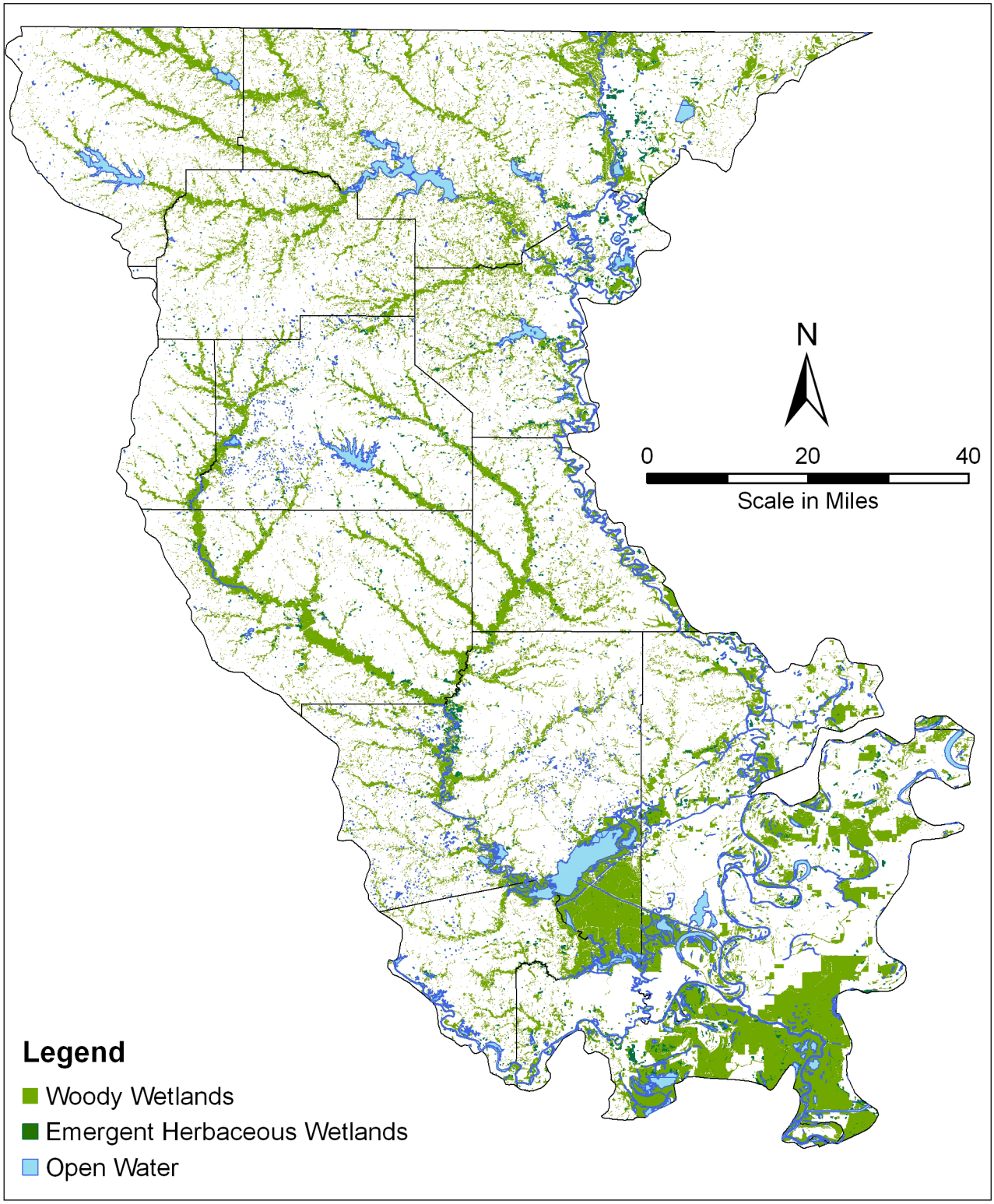
The ORB includes parts of the Mississippi River Alluvial Plain and South Central Plains ecoregions.[43] Each ecoregion contains a range of habitats, some of which are associated with species of conservation concern. The Louisiana Wildlife Action Plan prioritizes particular terrestrial habitat types within each ecoregion for conservation.[22]

Terrestrial species Federally listed as threatened or endangered that may reside in the ORB are the Louisiana black bear, red-cockaded woodpecker, Louisiana pine snake, interior least tern, brown pelican, pallid sturgeon, and piping plover.[44] The Endangered Species Act gives U.S. Fish and Wildlife Service (USFWS) the authority to protect listed species and their habitat. USFWS has not completed mapping of critical habitat areas in the ORB.[45]

Aquatic habitats in the ORB support about 118 species of freshwater fishes, 49 species of mussels, and 19 species of crawfish.[21] State species of concern in the ORB consist of 2 crustacean, 4 freshwater fish, 16 mussel, and 2 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 ORB containing surface waters important for conservation of the pink mucket pearly mussel, which is a 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 the U.S. Army Corps of Engineers (USACE). **Map 9** shows areas of wetlands in the ORB. About 19 percent of the ORB surface area, or 1,452 square miles, is woody wetlands (i.e., areas where forest or shrubland vegetation accounts for most of the cover, and the soil is periodically saturated or inundated). Less than 1 percent is emergent herbaceous wetlands wetlands (i.e., areas where perennial herbaceous vegetation accounts for most of the cover, and the soil is periodically saturated or inundated).

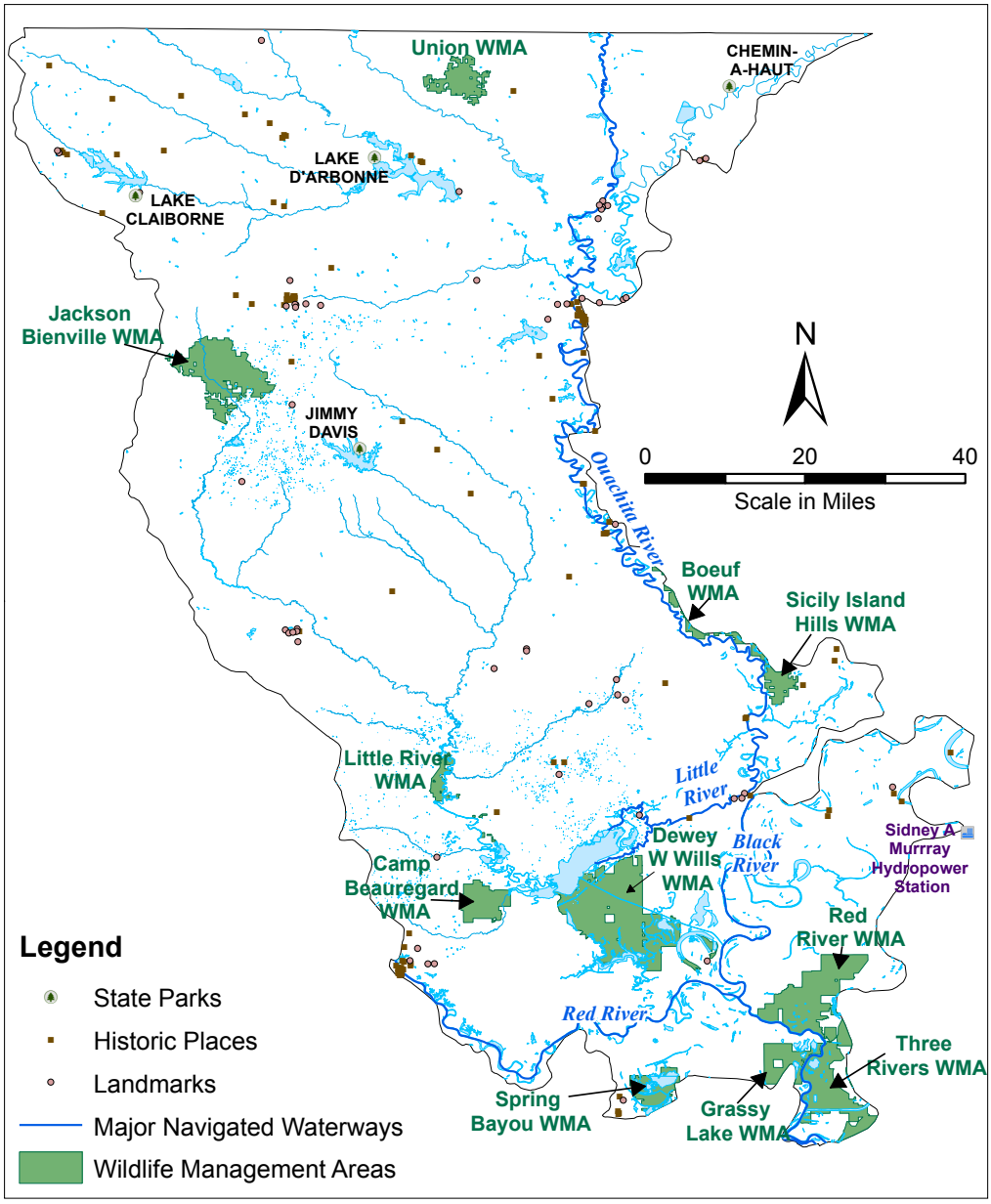


Map 9. Wetlands in the ORB[30]

Cultural Resources

Information on cultural resources and issues is provided by parish-level organizations. Prehistoric (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). Featured historic sites in the basin include churches, ferry crossings, lakes, post offices, and schools. There are 127 historic points and 9 historic regions in the ORB, as shown in **Map 10**. Generalized locations of known cultural resources that could affect reservoir siting or operations are available from the NRHP. Six archaeological sites are listed in the NRHP. These sites are located in Avoyelles, Caldwell, Catahoula, Concordia, and Lincoln Parishes.[49] Additional information on cultural resources in the ORB is available from the LCRT, Office of Cultural Development, Division of Historic Preservation.

The two Federally recognized Native American tribes in the ORB are the Jena Band of Choctaw and the Tunica-Biloxi Indians. The only State-recognized tribe in the ORB is the Louisiana Choctaw Tribe.[51] Potentially affected Native American tribes must be notified of any proposed reservoir plans.



Map 10. Cultural and Recreational Resources and Navigable Waterways in the ORB[50]

RECREATION, NAVIGATION, AND HYDROPOWER

Water resource development projects, particularly surface water reservoirs, can provide opportunities for creating and maintaining regional recreation resources. Water bodies in the ORB, especially the Ouachita River, are widely used for water-oriented recreation.[28] USACE has provided many recreation facilities in the ORB, such as boat launch ramps and cooking grills in 17 areas along the Ouachita River.[3] Eleven Wildlife Management Areas are present in the ORB; these areas serve as hunting and camping grounds for the general public. Specific recreational resources of regional value are shown in **Map 10**. They are distributed throughout the ORB, but are most highly concentrated in the southern basin and along the Ouachita River.

Navigable waterways are important to State and regional economies, and would have to be maintained by any future water development projects. Three major interconnected navigable waterways, the Ouachita, Black, and Red rivers, are located within the ORB (**Table 12**). The Ouachita-Black River system flows into the Red River, which ultimately flows into the Atchafalaya River. This system is linked to the Mississippi River through the Old River Control Structure. Navigational improvements to the Ouachita-Black River system date back to 1926. A system of locks on the Ouachita River facilitates navigation (see **Map 4**). Fish and wildlife features of the Ouachita-Black River navigation project include the Catahoula Diversion Channel and Control Structure, Little River Closure Dam, and a wildlife refuge near Bayou D'Arbonne. These features allow water level regulation and provide a resting and feeding area for migratory waterfowl.[3]

Two ports are located on the Ouachita River. The port at West Monroe accommodated total traffic of 866,400 tons in 2006, with containers as the primary cargo.[52] A second port on the Ouachita River, located 6 miles north of Columbia, accommodated total annual traffic of 100,000 tons in 2003, primarily cottonseed and grain.[53]

The Sidney Murray Hydropower plant is located at the southeastern boundary of the ORB (**Map 9**). It is a 192 megawatt (MW) generating station located just north of the Old River Control Structure. The U.S. Department of Energy has identified several potential sites for small hydropower projects (power between 1 MW and 30 MW) and microhydropower projects (less than 100 kilowatts) at several locations within the ORB including on the Ouachita River, Bayou D'Arbonne, and Corney Bayou.[55] Proposed reservoir projects in the ORB should evaluate the potential for hydroelectric energy generation.

Table 12. Summary of Navigable Waterways in the ORB

River	Outflow	Navigable Depth (feet)[54]	Navigable Length (miles)
Black River (added to Ouachita River)*	Red River	9	237
Little River	Black River	9	54.5
Red River	Atchafalaya River	9	93.2

*The Black and Ouachita rivers are contiguous and therefore their navigable lengths are added together.
ORB=Ouachita River Basin

INTERBASIN AND INTERSTATE ISSUES

Both surface water and groundwater resources in the ORB are shared with neighboring states and therefore, interstate issues must be considered during development of these shared water resources.

The Sparta Aquifer extends across the border with Arkansas. The most pronounced drawdown in the aquifer has occurred in Union County, Arkansas, immediately adjacent to the Arkansas-Louisiana State line. Use of the Sparta Aquifer has additionally resulted in water quality issues in some parts of Arkansas. Along with the declaration by the LDNR Commissioner of Conservation of three Areas of Groundwater Concern in the Sparta Aquifer in Louisiana, the Arkansas Natural Resources Commission has designated five southern and six mid-Arkansas counties as Critical Ground-Water Areas.[32] A 50 percent reduction in Louisiana's use would likely stabilize, and potentially recharge, the Sparta Aquifer.[56] Both Louisiana and Arkansas continue to look for solutions to stabilize Sparta Aquifer groundwater levels.

Flows in the Ouachita and Red rivers are highly regulated by dams upstream from Louisiana State boundaries. The Red River Compact (Compact) is an interstate agreement entered into by the states of Louisiana, Oklahoma, Texas, and Arkansas with the consent of the U.S. Congress that provides for distribution of the waters of the Red River Basin, including the waters of the ORB.[57] The principal purposes of the Compact are the following:

- To promote interstate comity and remove causes of controversy between each affected states by governing the use, control, and distribution of the interstate waters of the Red River and its tributaries.
- To provide an equitable apportionment among the signatory states of the water of the Red River and its tributaries.
- To promote an active program for the control and alleviation of natural deterioration and pollution of the waters of the Red River Basin and to provide for enforcement of the laws related thereto.
- To provide the means for an active program for the conservation of water, protection of lives and property from floods, improvement of water quality, development of navigation, and regulation of flows in the Red River Basin.
- To provide a basis for state or joint state planning and action by ascertaining and identifying each state's share in the interstate waters of the Red River Basin and the apportionment thereof.

SUMMARY OF 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 ORB 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 ORB are shown in **Table 13**, and are discussed below in general order of need, from high-level needs (colored red) to low-level needs (colored green). All water resources categories were evaluated as having high-level or medium-level needs in the ORB.

Because of a long-term decline in the Sparta Aquifer, the major aquifer in the ORB, groundwater supply was evaluated as the only high-level need in the basin. Declining water levels in portions of the Sparta Aquifer threaten the sustainability of potable water supplies for several communities in the ORB. Sparta Aquifer issues are complicated because the aquifer extends into Arkansas; therefore, water development and management activities in one state can affect the other. Furthermore, the possibility of expanded oil and gas production could further stress regional groundwater resources. Designation of three Areas of Groundwater Concern and adoption of associated management strategies as specified by LDNR, including aggressive water conservation programs and investigation of alternative water sources, have resulted in observable groundwater level rises. However, the possible extent of future aquifer recovery is unclear.

Surface water supply and quality were ranked as medium-level needs. Most surface water flows in the ORB in late summer and fall range from only 2 to 19 percent of annual average flow (on the Dugdemona River near Joyce and the Little River near Rochelle, respectively). This makes development of surface water supply for municipal and industrial uses challenging without storage. Some reaches of surface water are designated as having impaired water quality in the ORB. Common constituents causing impairments are mercury, dissolved oxygen, and turbidity. Although most of these impairments are related to aquatic habitat, two impairments for color affect usability for drinking water purposes. Surface water quality is expected to deteriorate with increasing development and population growth.

Flood control was ranked as a medium-level need. Areas of potential flooding are present in the ORB, particularly on the Mississippi, Ouachita, Black, and Red rivers. Flood control and floodplain management measures are needed to protect existing land uses and minimize future flood damages. This need will likely continue to have similar importance in the future.

Environmental protection and enhancement was ranked as a medium-level need with increasing importance in the future. Several environmental issues threaten the protection of existing water resources and/or constrain future development of additional water supplies, including wetland and naturally vegetated areas that cover 74 percent of the basin; seasonal lack of streamflow, which threatens the viability of fisheries; one aquatic and several terrestrial threatened and endangered species; and surface water quality degradation that has led the State to designate many key lakes and stream sub-segments as impaired water bodies subject to environmental regulations.

Recreation was evaluated as a medium-level need. Four major water bodies, including the Mississippi River, two wildlife refuges with direct water access, and two State parks, provide adequate recreational opportunities for demands placed by the ORB population.

Navigation was ranked as a medium-level need with increasing importance in the future. Two major ports in the ORB currently accommodate 1.7 million tons of cargo per year. In 2008, the Ouachita River Valley Association requested $10 million for dredging and maintenance of the Ouachita and Black rivers in both Louisiana and Arkansas.

Table 13. Assessed Water Resources Needs in the ORB

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

ORB = Ouachita River 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
ATVB	Atchafalaya-Teche-Vermilion Basin
cfs	cubic feet per second
Commissioner	Louisiana Department of Natural Resources Commissioner of Conservation
Compact	Red River Compact
DOTD	Louisiana Department of Transportation and Development
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
gpcd	gallons per capita per day
LCRT	Louisiana Department of Culture, Recreation, and Tourism
LCWCS	Louisiana Comprehensive Wildlife Conservation Strategy
LDEQ	Louisiana Department of Environmental Quality
LDNR	Louisiana Department of Natural Resources
mgd	million gallons per day
MW	megawatt
NFIP	National Flood Insurance Program
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWIS	National Water Information System
ORB	Ouachita River Basin
ppm	parts per million
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

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