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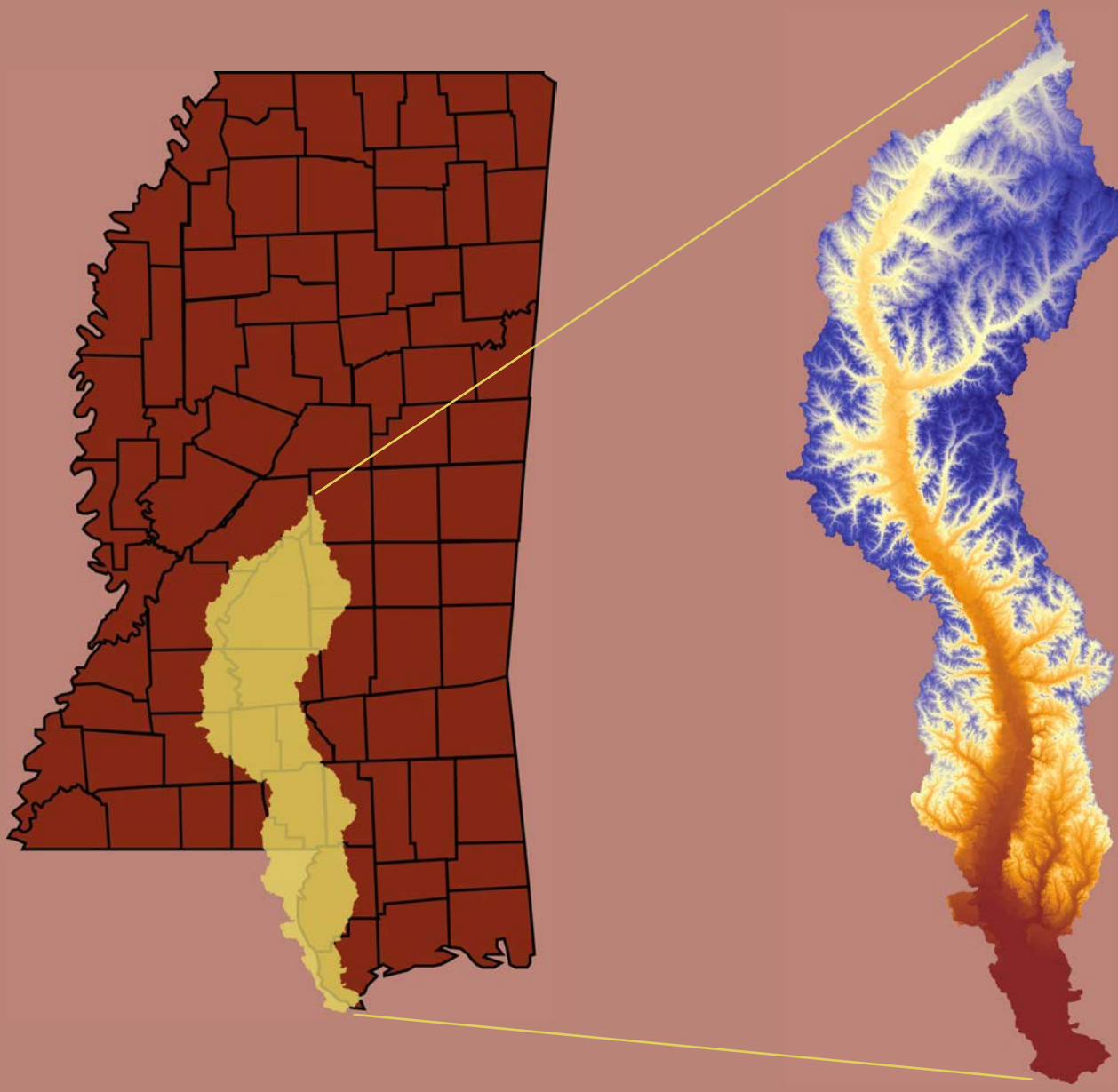
LOWER PEARL RIVER WATERSHED ASSESSMENT:

Preliminary Report



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Lower Pearl River Watershed Assessment: Preliminary Report

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Contents

Lower Pearl River Watershed Assessment: Preliminary Report

Description

The Lower Pearl River Watershed (LPRW) is the southern part of the Pearl River flowing out of the Ross Barnett Reservoir that eventually flows into the Gulf of Mexico. The watershed covers an area of approximately 12,500 square kilometers and contains areas of 19 counties in both Mississippi and Louisiana. The major tributary of the LPRW is the Strong River, which contributes flow just below Rankin County. The land uses of the LPRW are mainly composed of forests, wetlands, pastures, and urban areas. Most of the soils are classified as hydrologic soil group D and C and are mostly coarse-loamy in texture. The watershed is known for experiencing periodic flooding, and some of these floods have caused significant damage to infrastructure. In April 1979, the Great Easter Flood was one of the most devastating floods to ever occur in Mississippi. The floodwaters rose to almost 25 feet above the flood stage and caused $257 million in damage (MDEQ 2000). The LPRW currently suffers from water-quality deterioration due to pollutants including pathogens, pesticides, nutrients, and sediments. Pollutant transport is likely caused by poultry litter applications, beef and dairy cattle production, urban development, and agricultural practices (MDEQ 2013).

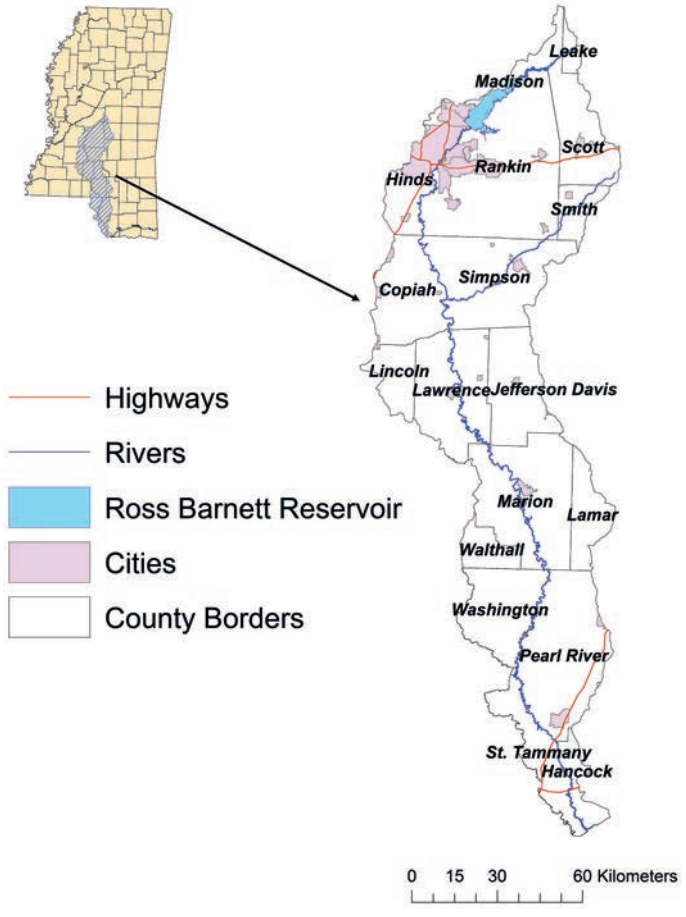

Figure 1. Location map of the Lower Pearl River Watershed in Mississippi.

Overview of Water Quality Issues

The streams and tributaries of the LPRW are threatened by several potential pollutant sources, primarily nonpoint-source pollution (MDEQ 2000). In the LPRW, these nonpoint sources originate from fertilizer applications, livestock operations, and urban development (MDEQ 2000). In instances of extreme storm events, rainfall that flows overland can carry sediments, pathogens, nutrients, and pesticides throughout the watershed into the watershed's rivers and streams. Excessive transport of these pollutants is harmful to the watershed's surface water quality. Table 1 lists the main water-quality concerns of each tributary of the LPRW. Sedimentation is a major concern in the basin because it causes easier transport of other contaminants by allowing them to attach to the sediment particles. As a result, excess nitrogen and phosphorus can accumulate in water bodies, which can cause more water-quality problems such as eutrophication.

Table 1. Pollutants of concern in the various tributaries of the Pearl River within the watershed.

Water body name	Pollutants of concern
Bahala Creek	Biological impairment due to sediments, pathogens
Dabbs Creek	Biological impairment due to sediments, nutrients, organic enrichment / low dissolved oxygen
Eutacutachee Creek	Biological impairment due to sediments, nutrients, organic enrichment / low dissolved oxygen
Hanging Moss Creek	Biological impairment due to sediments, nutrients, organic enrichment / low dissolved oxygen
Little Creek	Pathogens
Mulatoo Bayou	Organic enrichment / low dissolved oxygen
Pelahatchie Creek	Sediments, pesticides, pathogens, nutrients
Silver Creek	Sediments, pathogens
Strong River	Biological impairment due to sediments, pathogens

[1]MDEQ 2013

Land Use

Anthropogenic and human activities occurring in various land uses throughout the basin can potentially affect water quality. Each land use can either improve or deteriorate water quality, depending on the management practices taking place. The primary land use in the LPRW is forestland, which is important for clean surface water because it can absorb rainfall to slow runoff, maintain water temperature, refill underground aquifers, and provide habitats for fish and wildlife (MDEQ 2000). Wetlands make up another major land use in the watershed that also serve to improve water quality by absorbing and filtering sediments and other contaminants. Pasturelands have cattle production and poultry litter application, while agricultural lands have fertilizer and pesticide applications as well as tillage operations (MDEQ 2000). These practices can be a threat to water quality, especially if they are not managed appropriately. Developing urban areas can also deteriorate water quality by allowing contaminated stormwater runoff to be easily transported to nearby streams.

Land Use Key — FRSD = Forest-Deciduous, FRSE = Forest-Evergreen, FRST = Forest-Mixed, PAST = Pasture, RNGB = Range-Brush, RNGE = Range-Grasses, SOYB = Soybean, URBN = Urban, URLD = Urban Low Density, URML = Urban Medium Density, URHD = Urban High Density, WETF = Wetlands-Forested, WETN = Wetlands-Nonforested, WATR = Water

Land Uses and Soil Types

Table 2. Model-generated subbasins, hydrologic response units (HRUs), land uses, and dominant soils in the watershed.

Subbasin	No. of HRUs	Major land uses	Dominant soil types	Dominant soil textures
1	36	FRSD, FRSE, FRST, RNGB, PAST, WETF	MS089, MS089, MS121	Columbus, Providence, Cascilla
2	28	SOYB, FRSD, FRSE, FRST, RNGB, PAST, WETF	MS121, MS123	Kipling, Urbo, Savannah, Cascilla
3	32	WATR, URBN, URLD, FRSD, FRSE, RNGB, PAST, WETF	MS089, MS121	Byram, Loring, Kipling, Columbus
4	25	URBN, URLD, URMD, FRSD, FRSE, RNGB, PAST, WETF	MS049, MS089, MS121	Loring, Byram, Cascilla, Smithdale
5	16	FRSD, FRSE, FRST, RNGB, PAST, WETF	MS121	Kipling, Urbo
6	25	URBN, URLD, URMD, URHD, WETF	MS049, MS121	Loring, Byram, Cascilla, Gillsburg
7	23	URBN, URLD, URMD, URHD, FRSD, WETF	MS049, MS121	Loring, Siwell, Tippo, Gillsburg, Guyton
8	47	URBN, URLD, FRSD, FRSE, FRST, RNGB, PAST, WETF	MS121	Providence, Smithdale, Oaklimeter, Tippah
9	26	URBN, URLD, FRSD, FRSE, FRST, RNGB, PAST, WETF	MS049, MS121	Loring, Cascilla, Bonn
10	70	FRSD, FRSE, FRST, RNGB, PAST, WETF	MS121	Smithdale, Providence, Oaklimeter, Gillsburg, Kirkville
11	22	FRSD, FRSE, FRST, RNGB, PAST, WETF	MS121, MS127, MS129	Smithdale, Kirkville
12	29	FRSD, FRSE, FRST, RNGB, PAST, WETF	MS049, MS127	Oaklimeter, Petal, Smithdale, Providence
13	11	FRSD, FRSE, FRST, RNGB, PAST, WETF	MS127	Smithdale, Savannah, Quitman
14	24	FRSD, FRSE, FRST, RNGB, PAST, WETF	MS029	Providence, Guyton
15	24	FRSD, FRSE, FRST, RNGB, PAST, WETF	MS029, MS077	Gillsburg, Providence, Guyton
16	15	FRSD, FRSE, FRST, RNGB, WETF	MS077	Cadeville, Guyton, Jena
17	17	FRSD, FRSE, FRST, RNGB, PAST, WETF	MS085, MS077, MS085	Guin, Cadeville, Ruston, Ora, Falaya
18	49	URBN, FRSD, FRSE, FRST, RNGB, PAST, WETF	MS077	Cadeville, Providence, Jena, Smithdale
19	43	URBN, FRSD, FRSE, FRST, RNGB, PAST, WETF	MS077	Providence, Smithdale, Cadeville, Jena
20	22	FRSD, FRSE, FRST, RNGB, PAST, WETF	MS065, MS077, MS127	Smithdale, Jena
21	37	URBN, FRSD, FRSE, FRST, RNGB, PAST, WETF	MS065	Ora, Ruston, Smithdale, Kirkville
22	20	FRSE, FRST, RNGB, PAST, WETF	MS077	Providence, Smithdale, Jena, Rosebloom
23	26	FRSE, FRST, RNGB, PAST, WETF	MS065, MS091	Smithdale, Ruston

Table 2 (continued). Model-generated subbasins, hydrologic response units (HRUs), land uses, and dominant soils in the watershed.

Subbasin	No. of HRUs	Major land uses	Dominant soil types	Dominant soil textures
24	15	FRSE, FRST, RNGB, PAST, WETF	MS077, MS065, MS091	Smithdale, Ruston, Jena
25	38	URBN, FRSE, FRST, RNGB, PAST, WETF	MS091	Ruston, Savannah, Smithdale
26	26	FRSE, FRST, RNGB, PAST, WETF	MS091	Smithdale, Ruston, Jena
27	44	FRSE, FRST, RNGB, PAST, WETF	MS091	Falkner, Ruston, Smithdale, Bibb, Cascilla, Jena
28	29	FRSE, RNGB, PAST, WETF	MS073	Freest, McLaurin, Trebloc
29	11	FRSE, RNGB, PAST, WETF	MS091	Petal, Smithdale, Ruston, Cascilla
30	24	URBN, FRSE, RNGB, PAST, WETF	LA117, MS147	Ruston, Savannah, Arkabutla, Ouachita
31	10	WATR, WETF	MS109, LA117	Arkabutla
32	67	RNGE, URBN, FRSE, RNGB, PAST, WETF	LA117	Ruston, Savannah, Smithdale, Arkabutla, Ouachita
33	20	WATR, FRSE, PAST, WETF	MS109, LA117	Arkabutla, Myatt, Ouachita, Prentiss, Savannah, Bassfield, Cahaba
34	15	FRSE, RNGB, PAST, WETF	MS109	McLaurin, Smithdale, Malbis, Arkabutla
35	13	FRSE, RNGB, PAST, WETF	MS109	Malbis, Smithton
36	21	URBN, FRSE, RNGB, PAST, WETF	MS109	Ruston, Malbis, Smithdale, Dorovan, Smithton
37	7	FRSE, RNGB, WETF	LA103	Myatt, Prentiss, Stough, Arkabutla
38	7	URBN, FRSE, RNGB, WETF	MS109, MS045, LA103	Escambia, Smithton, Atmore, Arkabutla,
39	18	URBN, URLD, FRSE, WETF, WETN	LA103	Myatt, Prentiss, Stough, Abita, Guyton, Arat, Larose
40	11	WATR, WETN	LA103	Larose
41	22	WATR, URBN, FRSE, RNGB, WETF, WETN	MS045, LA103	Atmore, Beauregard, Guyton, Clovelly, Larose, Handsboro

Land Use Map

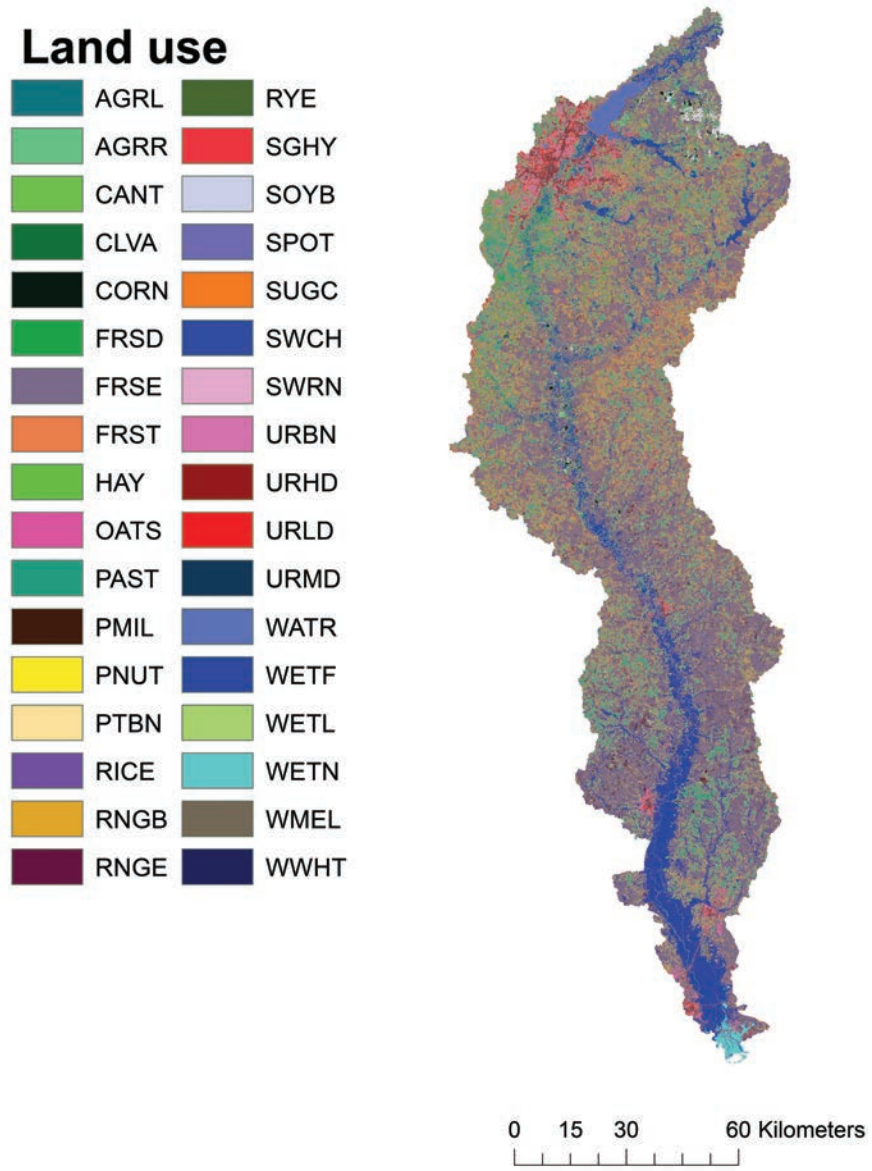

Figure 2. Distribution of land uses within the watershed.

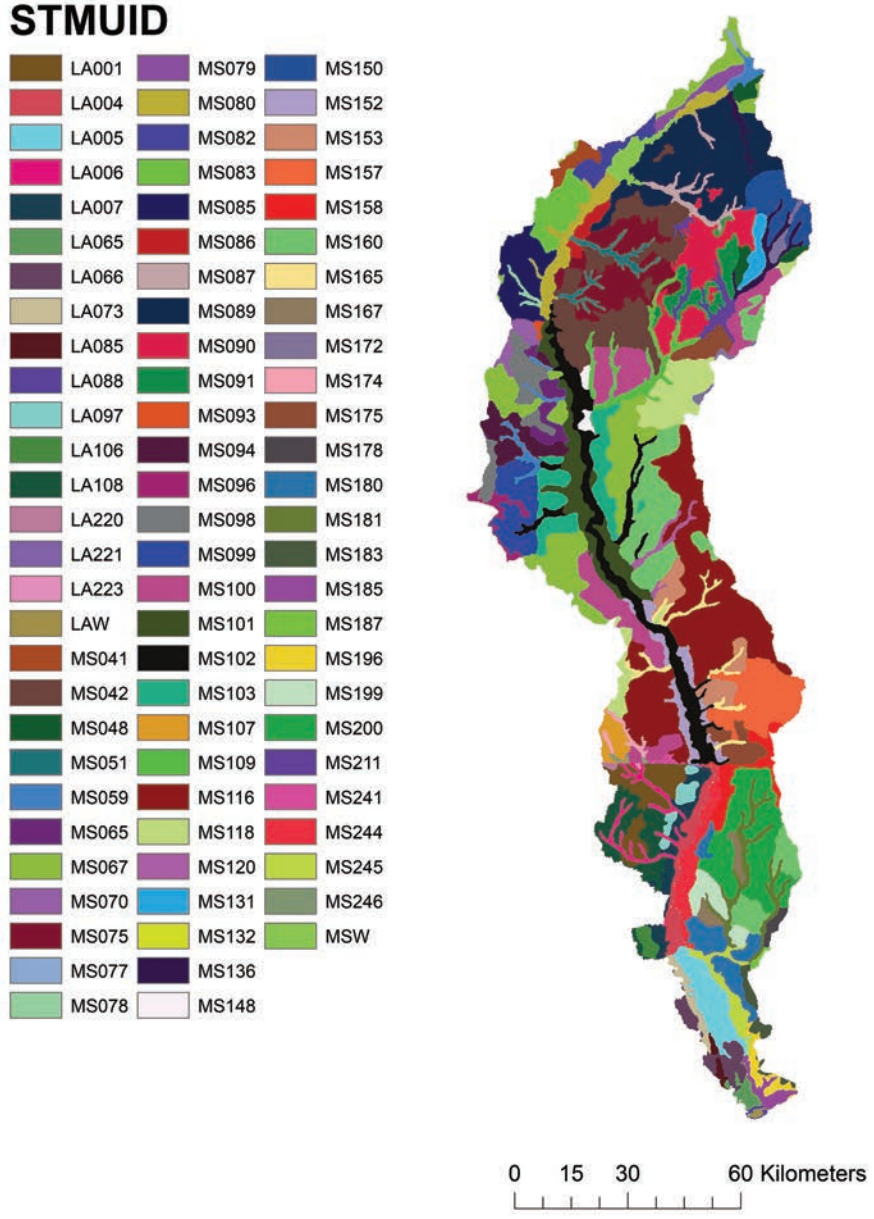

Figure 3. Distribution of state soil map unit ID (STMUID) within the watershed.

SUBBASINS

Subbasins Map

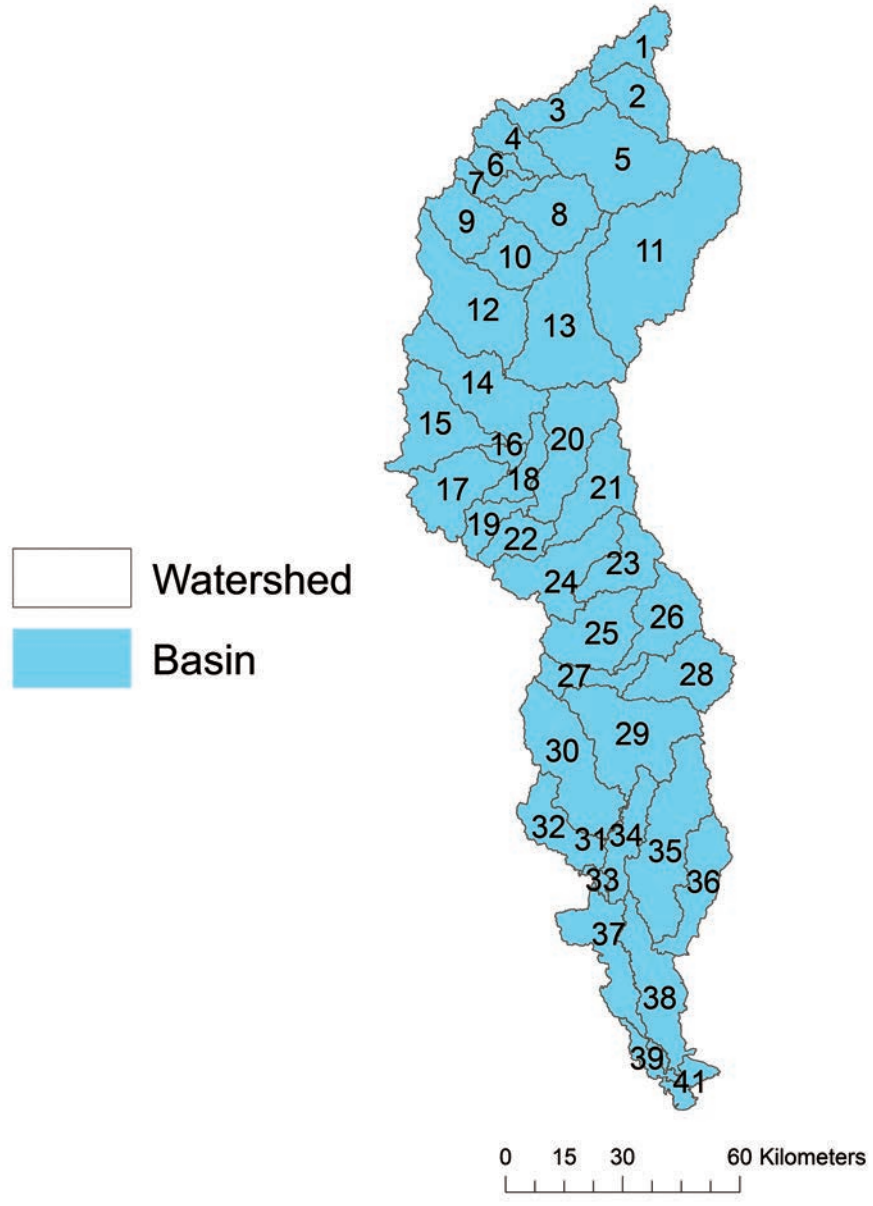

Figure 4. Map of the watershed subbasins (41) used during preliminary study.

Subbasin Area and Elevation

Table 3. Watershed subbasin area and average elevation.

Subbasin	Area (ha)	Avg. elevation (m)	Subbasin	Area (ha)	Avg. elevation (m)
1	18742	99	21	34860	115
2	21104	105	22	16023	86
3	21429	97	23	25045	98
4	16474	99	24	40413	92
5	63844	114	25	35972	75
6	8914	94	26	30234	89
7	11280	94	27	15613	78
8	33742	110	28	33925	85
9	24144	93	29	58768	60
10	22883	104	30	52221	73
11	110110	124	31	51	22
12	58345	97	32	25737	60
13	67941	111	33	2944	18
14	50398	99	34	21282	35
15	39817	107	35	59985	55
16	5389	70	36	29354	52
17	34226	110	37	34401	12
18	14799	89	38	37370	9
19	13613	103	39	7522	2
20	43212	125	40	70	0
			41	9070	1

U.S. Geological Survey (USGS)

USGS Gage Station Locations

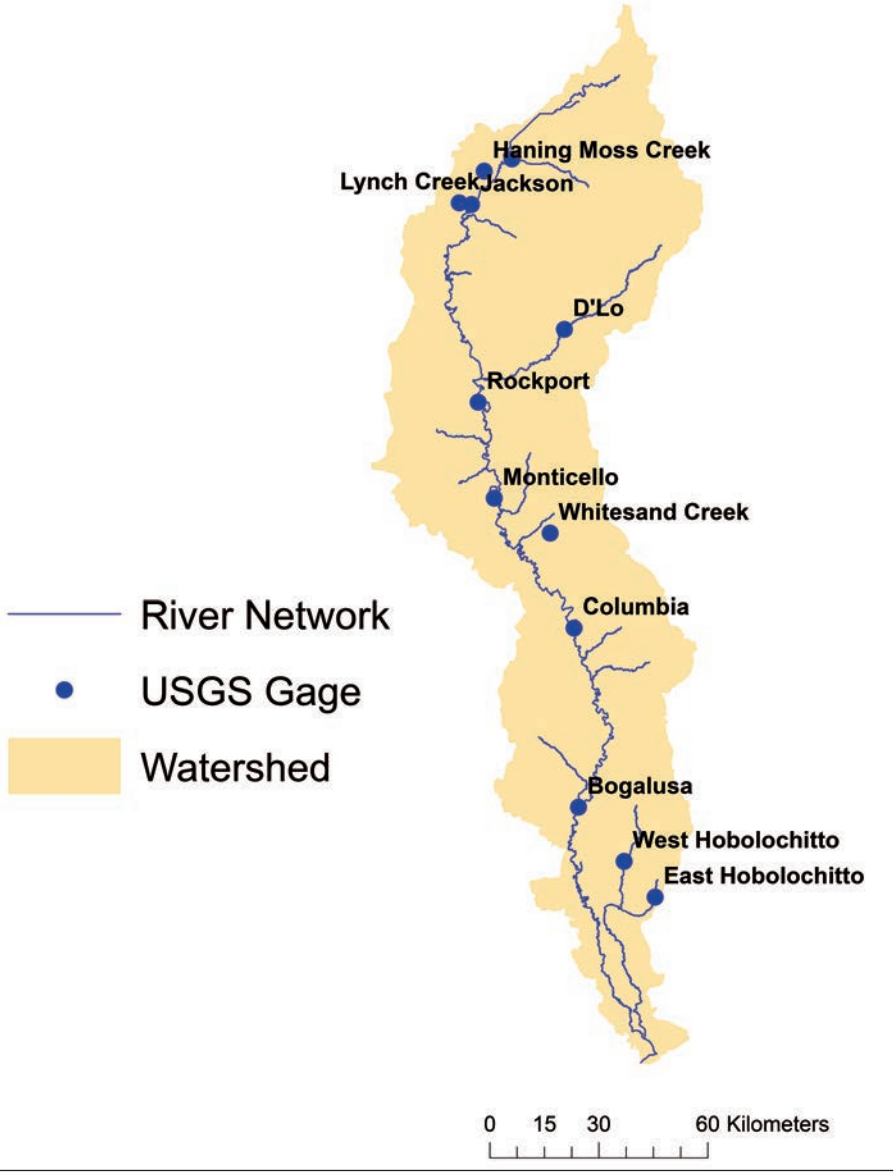

Figure 5. Distribution of the USGS gage stations within the watershed.

Table 4. Name and coordinates of the USGS gage stations in the watershed.

Name	Latitude	Longitude	Name	Latitude	Longitude
Haning Moss Creek	32.365°	-90.145°	Monticello	31.553°	-90.088°
Lynch Creek	32.285°	-90.215°	Whitesand Creek	31.471°	-89.924°
Jackson	32.281°	-90.179°	Columbia	31.238°	-89.847°
Ross Barnett Reservoir	32.398°	-90.065°	East Hobolochitto	30.574°	-89.595°
Rockport	31.791°	-90.143°	West Hobolochitto	30.661°	-89.686°
D'Lo	31.978°	-89.898°	Bogalusa	30.793°	-89.821°

SLOPE

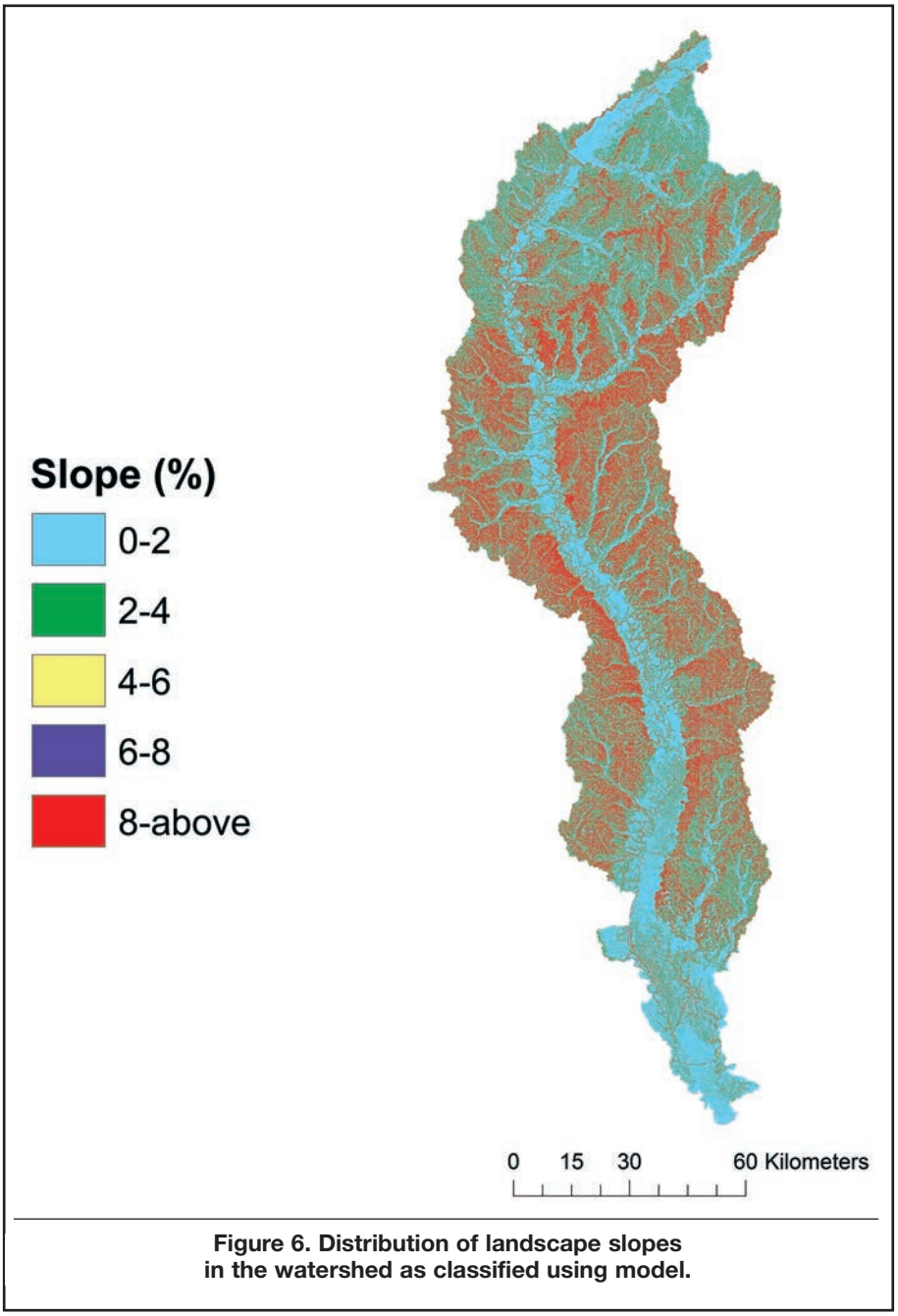

Figure 6. Distribution of landscape slopes in the watershed as classified using model.

Major River Network

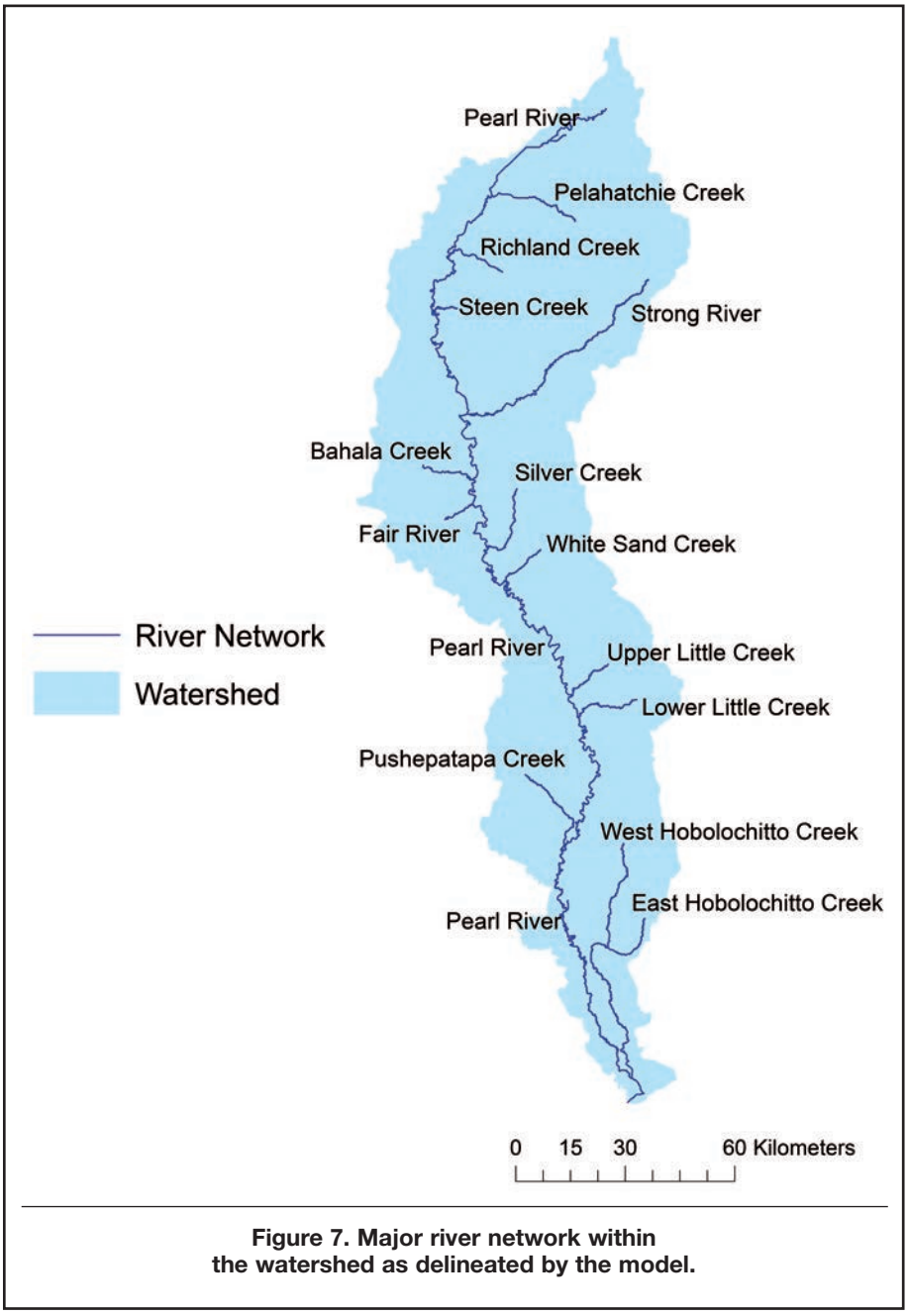

Figure 7. Major river network within the watershed as delineated by the model.

Rain Gage

Rain Gage Locations

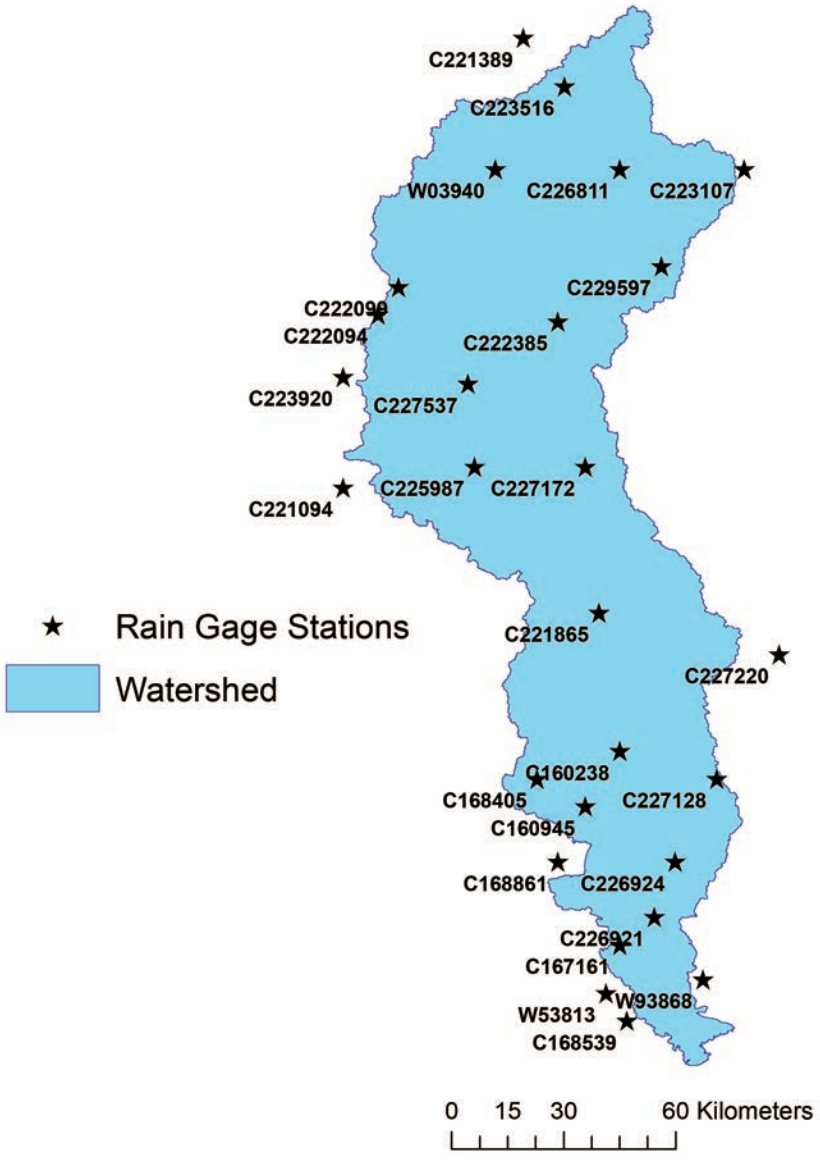

Figure 8. Distribution of the 21 rain gages used in the preliminary study of the watershed.

Rain Gage by Subbasin

Table 5. Location of rain gage stations for each subbasin assigned by the model.

Subbasin	Station	Station name	Subbasin	Station	Station name
1	C223516	Goshen Springs	22	C225987	Monticello
2	C223516	Goshen Springs	23	C221865	Columbia
3	C223516	Goshen Springs	24	C221865	Columbia
4	W03940	Jackson International Airport	25	C221865	Columbia
5	C226811	Pelahatchie	26	C221865	Columbia
6	W03940	Jackson International Airport	27	C221865	Columbia
7	W03940	Jackson International Airport	28	C227220	Purvis
8	W03940	Jackson International Airport	29	C160238	Angie
9	C222099	Crystal Springs	30	C168405	Sheridan
10	C222099	Crystal Springs	31	C160945	Bogalusa
11	C229597	White Oak	32	C168405	Sheridan
12	C222099	Crystal Springs	33	C168861	Sun
13	C222385	D'Lo	34	C160945	Bogalusa
14	C227537	Rockport	35	C227128	Poplarville
15	C223920	Hazlehurst	36	C227128	Poplarville
16	C225987	Monticello	37	C167161	Pearl River
17	C225987	Monticello	38	C226921	Picayune
18	C225987	Monticello	39	C168539	Slidell
19	C225987	Monticello	40	C168539	Slidell
20	C227172	Prentiss	41	W93868	Bay Saint Louis
21	C227172	Prentiss			

Table 6. Coordinates and elevations of the rain gage locations used by the model.

Station	Station name	Elevation (m)	Latitude	Longitude
C160238	Angie	40	30.917	-89.783
C160945	Bogalusa	31	30.783	-89.867
C167161	Pearl River	9	30.450	-89.783
C168405	Sheridan	101	30.850	-89.983
C168539	Slidell	3	30.267	-89.767
C168861	Sun	23	30.650	-89.933
C221865	Columbia	47	31.250	-89.833
C222099	Crystal Springs	113	32.033	-90.317
C222385	D'Lo	102	31.950	-89.933
C223516	Goshen Springs	98	32.517	-89.917
C223920	Hazlehurst	183	31.817	-90.450
C225987	Monticello	63	31.600	-90.133
C226811	Pelahatchie	113	32.317	-89.783
C226921	Picayune	18	30.517	-89.700
C227128	Poplarville	95	30.850	-89.550
C227172	Prentiss	104	31.600	-89.867
C227220	Purvis	115	31.150	-89.400
C227537	Rockport	61	31.800	-90.150
C229597	White Oak	137	32.083	-89.683
W03940	Jackson International Airport	95	32.317	-90.083
W93868	Bay Saint Louis	9	30.367	-89.583

Hydrologic Soil Group

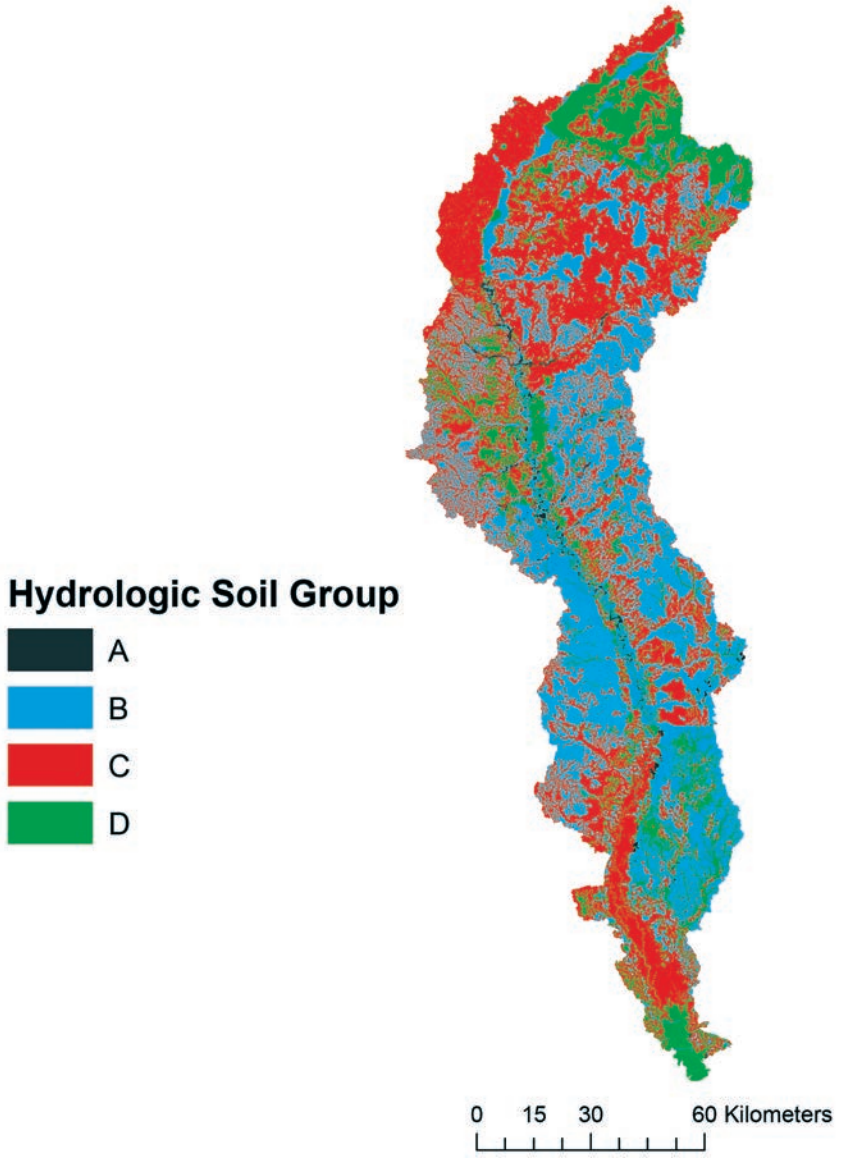

Figure 9. Distribution of hydrologic soil groups within the watershed used by the model. Note: Group B = moderately low runoff potential when very wet; Group C = moderately high runoff potential when very wet; and Group D = high runoff potential when very wet.

Elevation

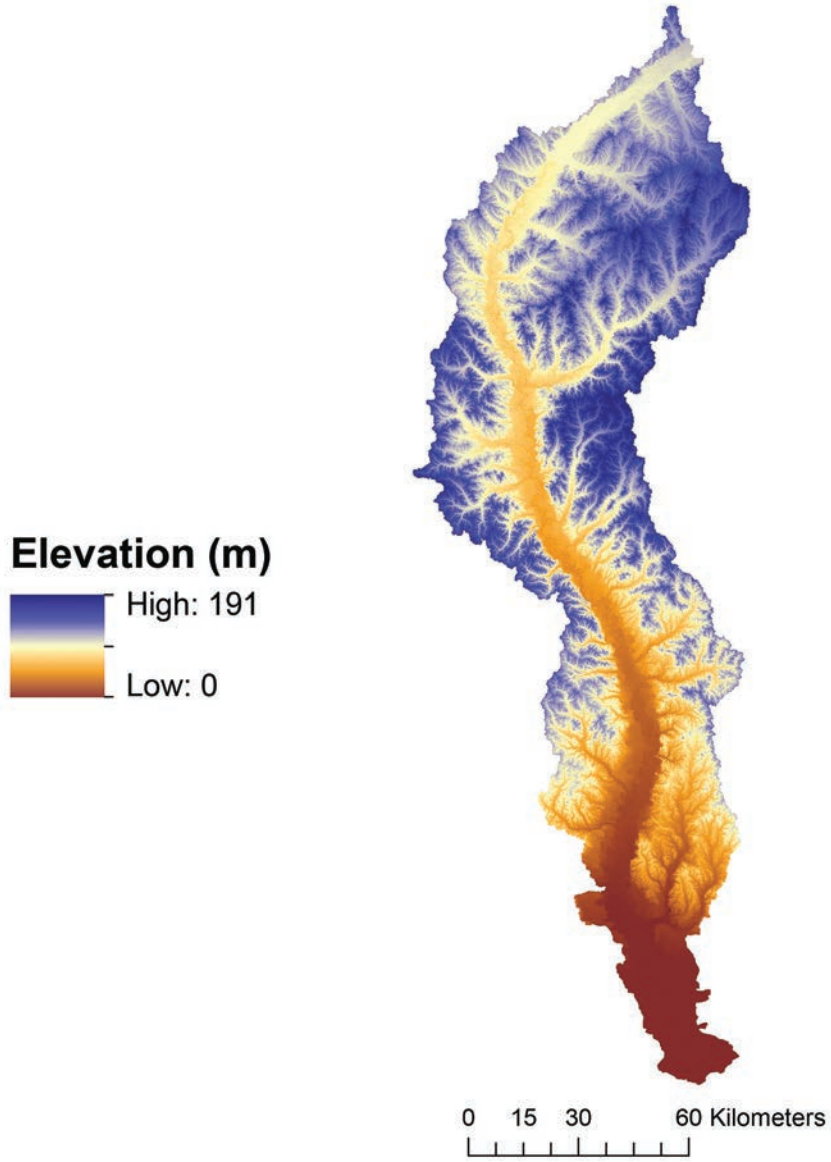

Figure 10. Distribution of elevation ranges within the watershed as determined by the model.

CITIES

Figure 11. Distribution of local cities around the watershed.

Beef Cows

There are 19 counties in the LPRW. Each county has its own unique beef-cow population. Table 7 shows the beef-cow population of each county from 2000 to 2012 (USDA/NASS 2012).

Table 7. Long-term annual average (2000-12) beef cow populations of the counties.

County	Beef cows	County	Beef cows
Copiah	11,625	Pearl River	11,354
Hancock	4,177	Rankin	11,438
Hinds	17,800	Scott	11,325
Jefferson Davis	8,008	Simpson	10,554
Lamar	9,575	Smith	11,854
Lawrence	6,446	Walthall	10,454
Lincoln	10,869	St. Tammany Parish	5,850
Madison	9,967	Washington Parish	11,100

Population by County

Table 8. Estimated populations of each county.[1]

County	Population	County	Population
Copiah	28,955	Pearl River	55,295
Hancock	45,255	Rankin	145,165
Hinds	248,643	Scott	28,250
Jefferson Davis	12,032	Simpson	27,374
Lamar	57,786	Smith	16,345
Lawrence	12,551	Walthall	15,100
Lincoln	34,900	St. Tammany Parish	239,453
Madison	98,468	Washington Parish	46,670
Marion	26,442		

[1]United States Census Bureau, 2012.

Preliminary Results/Discussion

This research evaluated the spatially and temporally variable streamflow responses of the LPRW using the Soil and Water Assessment Tool (SWAT) model. The SWAT model was successfully calibrated and validated for monthly streamflow using monthly streamflow data from four USGS gage stations. Preliminary results of the calibrated and validated SWAT model determined reasonable performance for mean monthly stream flow. However, measured water quality data, such as sediment, total nitrogen, and total phosphorus, are needed in order to further calibrate the model for water quality.

Based on SWAT preliminary simulation results, the water yields from the watershed subbasins were spatially and temporally variable, which was dependent on the topography, land-use conditions, and weather conditions of the watershed. Future research will involve calibrating the model for sediment and nutrient loading to study the combined impacts of management practices and future climate change on water quality. This study will ultimately be used to assist watershed managers to prioritize their best management practice implementation efforts to focus on the most impaired watershed subbasins.

Acknowledgments

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