Dewberry

MOBILE BAY NATIONAL ESTUARY PROGRAM

West Fowl River Watershed Management Plan

FINAL

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SCE

Executive Summary

The Mobile Bay National Estuary Program (MBNEP), in partnership with Mobile County Soil and Water Conservation District, contracted with Dewberry to develop the West Fowl River Watershed Management Plan (WMP). Dewberry brought together a team of highly qualified experts to develop this WMP and focused the plan around the six values identified in the MBNEP Comprehensive Conservation and Management Plan:

- **Water**: Environmental Science Associates
- **Coastlines**: South Coast Engineers
- **Access**: Dewberry
- **Fish**: Dauphin Island Sea Lab
- **Heritage**: Parker Martin Consulting Group
- **Resiliency**: Dewberry.

This WMP is organized into the following sections:

- **Section 1** provides an introduction to the plan and an overview of the purpose.
- **Section 2** describes the West Fowl River Watershed, providing background on characteristics and current conditions—including topography, hydrology, habitats, demographics, land use, etc.—to provide an understanding of current and historical conditions and insight into the problems of concern.
- **Section 3** evaluates the existing conditions within the Watershed and helps to focus management efforts to address the most pressing needs.
- **Section 4** identifies the critical areas and issues within the Watershed. These issues help shape the overall goals of the WMP and determine what information is needed to accurately define and address community concerns.
- **Section 5** discusses the goals and objectives used to guide the development of the management measures and also examines regulatory drivers and constraints to restoration.
- **Section 6** describes the conceptual management measures considered to address the challenges and features of this WMP.
- **Section 7** provides implementation strategies that include timelines, potential action items, and prospective partnerships to help facilitate the implementation of the identified management measures.
- **Section 8** discusses the regulatory framework of laws, regulations, and ordinances that pertained to water quality, stormwater management, erosion and sediment control, coastal zone issues, wetlands and other surface waters, and land disturbance activities, as under the jurisdiction of the Federal, State, and County governmental entities.
- **Section 9** presents a financial strategy, including available sources of funding (i.e., grants, partnerships, etc.) for restoration projects, and examines innovative mechanisms and alternatives for leveraging funding sources.
- **Section 10** details the public outreach and community involvement efforts needed for successful implementation of this WMP.
- **Section 11** outlines a monitoring program to evaluate the success of the management measures over the 10-year planning period.

THE WATERSHED

The West Fowl River Watershed covers approximately 20,489 acres (USGS 2013), is located in the Escatawpa River Basin, and forms in southern Mobile County. It comprises several named tributary systems including: Bayou Coden, Bayou Como, Bayou Jonas, Bayou Sullivan, Heron Bayou, the 'Narrows,' Negro Bayou, and West Fowl River. All of these named tributary systems receive drainage from multiple unnamed tributaries, a common trait of tidally-influenced coastal stream network systems. According to the National Hydrography Database (NHD) flowlines data (USGS 2013), the cumulative stream network system of the West Fowl River Watershed is approximately 112.2 miles long.

According to the National Land Cover Database 2011 (Homer et al., 2015), the land use and land cover within the West Fowl River Watershed is primarily characterized by four classifications: non-woody wetland (34%), woody wetland (39%), upland forest (13%) and urban (6%). These three classifications total 92% of the land use and land cover of the West Fowl River Watershed.

CRITICAL ISSUES AND AREAS

The WMP Team carefully listened to the community and stakeholders to gain insight into their issues, needs, and concerns. Throughout this extensive public outreach and engagement process, the WMP Team has encapsulated what they heard from the community into this common vision for the Watershed:

Vision: *To transform the river and its watershed into a healthy and vibrant community amenity that supports a robust habitat; provides increased public access; serves as an economic engine supporting the seafood and shipbuilding industries and ecotourism; and celebrates and preserves the rich culture and heritage of the area.*

In developing this plan, the WMP Team utilized a community-centered, comprehensive approach to watershed management planning. The WMP Team incorporated the U.S. Environmental Protection Agency (EPA)'s six steps in watershed planning with EPA's nine key watershed management elements into a broad overall watershed management approach for improvement and protection of the six things people value most about living along the Alabama coast (Water quality, Fish/Habitats, Environmental health and resiliency, Access, Culture and heritage, and Shorelines). The team also incorporated guidance from the MBNEP Comprehensive Conservation and Management Plan (CCMP), Clean Water Act Section 319, ADEM, as well as other regional planning initiatives. The goal was to establish a WMP that was founded on equitable and practical restoration and remediation alternatives. In developing this comprehensive, community-based approach, the WMP Team endeavored to provide a clear vision to guide the planning process while always keeping the end goal in view – restoring the ecological and cultural vitality of the Watershed and its community.

The critical areas and issues to address in restoration of the West Fowl River Watershed have been prioritized into the categories listed below.

- **Water quality** - Identifies actions to reduce point and non-point source pollution and remediate past effects of environmental degradation, thereby reducing outgoing pollutant loads into Portersville Bay, Mississippi Sound, and the Gulf of Mexico.

- **Fish/Habitat** - Identifies actions to reduce the incidence and impacts of invasive flora and fauna and improve habitats necessary to support healthy populations of fish and shellfish. Provides a strategy for conserving and restoring coastal habitat types; providing critical ecosystem services; and identified by the MBNEP's Science Advisory Committee (SAC) as most threatened by anthropogenic stressors. These habitat types: freshwater wetlands; streams, rivers and riparian buffers; and intertidal marshes and flats, were classified as most stressed from dredging and filling, fragmentation, and sedimentation, all related to land use change.
- **Access** - Characterizes existing opportunities for public access, recreation, and ecotourism and identifies potential sites to expand access to open spaces and waters within the watershed.
- **Heritage** – Identifies customary uses of biological resources and identifies actions to preserve culture, heritage and traditional ecological knowledge of the watershed
- **Coastlines** - Assesses shoreline conditions and identifies strategic areas for shoreline stabilization and fishery enhancements.
- **Resiliency** - Identifies vulnerabilities in the watershed from accelerated sea level rise, storm surge, temperature increases, and precipitation and improves watershed resiliency through adaptation strategies.

This comprehensive approach to watershed management will maximize benefits to upland agriculture, urban growth, seafood harvesting, boat building, and the overall quality of life for citizens in the watershed

RECOMMENDED MANAGEMENT MEASURES

The Watershed Management Team developed a list of recommended Management Measures to achieve the goals established for the West Fowl River Watershed (discussed in detail in Sections 6 and 7).

- Reduce nutrients and sediments in stormwater runoff
- Remove sanitary leaks, and illicit discharges into the river, bayous and tributaries
- Reduce the occurrence of nuisance and/ or exotic species with focus on the bayou
- Reduce the amount of trash in and entering the bayou and tributaries
- Promote habitat protection, conservation, and restoration
- Increase citizen access to coastal resources
- Promote tourism, ecotourism, and diversify the local economy
- Promote resiliency and adaptive management strategies
- Address Mobile County's comprehensive planning and development
- Promote environmental outreach and education

IMPLEMENTATION OF MANAGEMENT MEASURES

Momentum has been building over the years to transform the West Fowl River and its watershed into a healthy and vibrant community that supports robust habitat; provides increased public access; serves as an economic engine supporting the seafood and shipbuilding industry and ecotourism; and celebrates and preserves the rich culture and heritage of the area.

With the development of this WMP and the activities involved (i.e. public meetings, committee meetings), the timing is right to build upon the involvement of current audiences and invite more to participate in this work. The WPIT must develop a working coalition with local residents and organizations, townships, county, state, and federal agencies, as well as private industry.

Implementation of the West Fowl River Watershed Management Plan will require leadership and substantial funding. The initial leadership to begin implementation of the Watershed Management Plan will be provided and led by an appointed watershed coordinator position. Upon approval of the West Fowl River Watershed Management Plan, the watershed coordinator should begin immediately to implement the recommended management measures. Many of the management measures can be implemented concurrently as the necessary funding becomes available. To achieve maximum effectiveness, implementation efforts should monitor a variety of management measures and indicators, including but not limited to the following.

- acres of wetlands preserved
- acres of wetlands restored
- miles or acres of riparian buffer restored
- acres treated for invasive plant removal
- number of septic tanks inspected and serviced and/or taken out of service
- number of alternative on-site sewage disposal systems installed
- miles of livestock exclusion fencing installed
- number and type of agricultural Best Management Practices (BMPs) implemented,
- miles of waterway restoration
- additional investigations created to identify pollutant

In addition, a comprehensive watershed water monitoring system should be designed and implemented to accurately monitor trends in Watershed conditions and parameters. All monitoring activities should be conducted in accordance with the *Mobile Bay Subwatershed Restoration Monitoring Framework,* and state and federal Standard Operation Procedures (SOPs). A vital element of the Watershed Monitoring Program will be volunteer citizen participation to enable successful implementation and establish a sense of community ownership within the Watershed.

Acknowledgements

Development of the West Fowl River (WFR) Watershed Management Plan (WMP) was made possible by funding provided by the National Fish and Wildlife Foundation (NFWF) Gulf Environmental Benefit Fund (GEBF). The Mobile Bay National Estuary Program (MBNEP) was the recipient of this funding and partnered with the Mobile County Soil and Water Conservation District (MCSWCD) to select a consultant team to prepare the WMP.

Dewberry was selected to manage and prepare the WMP. Dewberry personnel were responsible for project management and leading the environmental health and resiliency, finance, management measures, implementation tasks, and public access opportunities in the watershed. The Dewberry Watershed Management Planning Team (WMP Team) consisted of the following firms: Environmental Science Associates (ESA) was the lead for water quality evaluations; South Coast Engineers led shoreline evaluations; Dauphin Island Sea Lab (DISL) led habitat assessments; and Parker Martin Consulting Group (PMCG) led the public outreach and culture and heritage tasks.

The WMP Team would like to acknowledge the following individuals for their insights and assistance in developing this WMP.

West Fowl River Steering Committee

Douglas Ankersen, Oyster Farmer
Dorothy J. Beech, Homeowner
Chris Blankenship, Alabama Department of Conservation and Natural Resources (ADCNR)
Lori Bosarge, Homeowner and President, South Bay Community Alliance
Dr. Louis W. Buckalew, Homeowner
Patrick Burns, Chief, Alabama Port Vol. Fire Department
Michelle Clark, Oyster Farmer
Glenn Coffee, Homeowner and Environmental Activist
Chris Collier, Homeowner and Business Owner
Troy and Rebecca Cornelius, Oyster Farmer
Lorrie Dovin, Homeowner
Elizabeth Downing, Resident
Judy Haner, The Nature Conservancy
Connie Hamilton, Homeowner
Patric Harper, US Fish and Wildlife Service, Grand Bay Coastal Resources Center
Philip Hinesley, ADCNR
Johnny Johnson, Resident and Commercial Oyster Farmer
Regina Kollegger, Property Owner
Col. Roosevelt Lewis, Homeowner
Justin S. McDonald, USACE Mobile District
Shannon McGlynn, Alabama Department of Environmental Management (ADEM)
Christian Miller, MBNEP
Eliska Morgan, Alabama Gulf Coast Recovery Council
Cameron Morris, Dewberry
James Morris, Oyster Farmer and Crab Fisherman

David Rice, Master Boat Builders, Inc.
Dale Rivers, Resident
Tina Sanchez, Mobile County
Randy Shaneyfelt, ADEM
Gregory Spies, Resident and Land Surveyor
Roberta Swann, MBNEP
Cheryl Ulrich, Dewberry
Dr. Bill Walton, Auburn University Shellfish Lab
Chris Warn, Environmental Science Associates
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Dale Williams, Williams Fabrication
Estelle Wilson, Dewberry
Rosa Zirlott, Oyster Farmer
Victor Zirlott, Resident and Seafood Processor

The WMP Team would also like to acknowledge the following people who provided data, information, and assistance vital to the development of this WMP:

Craig Bryant PolyEngineering
Marlon Cook, Cook Hydrogeology, LLC
Doug Cote, Mobile Area Water and Sewer System (MAWSS)
Ron Davis, Mobile County Revenue Commission (MCRC)
Bentley Dearmon, NRCS
Carl Ferraro, ADCNR
Dan Irvin, Geological Survey of Alabama (GSA)
Jenny Jacobson, U.S. Army Corps of Engineers (USACE)
Steve Jones, GSA
Scott Kearney, City of Mobile
Jeremiah Kolb, ADCNR
Mike McClantoc, BLB Utility Board
Ashley Peters, ADCNR
Victoria Phaneuf, University of Arizona
Sylvia Raley, BLB Utility Board
Justin Rigdon, ADEM
Greg Ryland, CDG Engineers and Associates
Travis Short, Horizon Shipbuilding
Dr. Eric Sparks, MS-AL Sea Grant
Lynn Stewart, Alma Bryant High School
Jody Thompson, Auburn University
David Tidwell, GSA
Dr. Barry Vittor, Vittor and Associates, LLC
Dr. Bill Walton, Auburn University
Brad Williams, NRCS

The development of this WMP was a collaborative effort among the managing agencies (NFWF, MBNEP, MCSWCD), WMP Team, resource agencies, and the communities in and around the West Fowl River Watershed. The WMP Team sincerely appreciate everyone's passion and commitment to the betterment of the West Fowl River Watershed.

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ACAMP	Alabama Coastal Area Management Program Strategic Plan 2013-2018
ACNPCP	Alabama Coastal Nonpoint Pollution Control Program
ACES	Alabama Cooperative Extension System
ADCNR	Alabama Department of Conservation and Natural Resources
ADCNRSLD	Alabama Department of Conservation and Natural Resources -State Lands Division
ADECA	Alabama Department of Economic and Community Affairs
ADEM	Alabama Department of Environmental Management
AGCRC	Alabama Gulf Coast Recovery Council
ALEA	Alabama Law Enforcement Agency
ARWA	Alabama Rural Water Association
ACS	American Community Survey
AWW	Alabama Water Watch
BLB	Bayou La Batre
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
CELCP	Coastal and Estuarine Land Conservation Program
CIAP	Coastal Impact Assistance Program
CoNED	Coastal National Elevation Database
CTP	Coastal Training Program
CCMP	Comprehensive Conservation & Management Plan 2013-2018
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFU	Colony forming units
DISL	Dauphin Island Sea Lab
DOQQs	Digital Orthographic Quarter Quadrangles

DIN	Dissolved inorganic nitrogen
DHNRDAT	Deepwater Horizon Natural resources Damage Assessment Trustees
DIP	Dissolved inorganic phosphorous
ESA	Environmental Science Associates
ETJ	Extraterritorial Jurisdiction
FEMA	Federal Emergency Management Agency
GED	General Educational Development
GIS	Geographic information system
GSA	Geological Survey of Alabama
GEBF	Gulf Environmental Benefit Fund
GIWW	Gulf Intracoastal Waterway
GOMA	Gulf of Mexico Alliance
GOMESA	Gulf of Mexico Energy Security Act
IWD	Inverse Distance Weighting
IC	Impervious Cover
ICM	Impervious Cover Model
I & I	Inflow and Infiltration
IPCC	Intergovernmental Panel on Climate Change
HCRT	Habitat Conservation & Restoration Team
HUC	Hydrological Unit Code
LULC	Land Use and Land Cover
LQ	Local quotient
LLPI	Longleaf Pine Initiative
MEOWs	Maximum Envelopes of Water
MOMs	Maximum of MEOWs
MST	Microbial source tracking

MBNEP	Mobile Bay National Estuary Program
EMO2	Mobile Bay Version 3
MCSWCD	Mobile County Soils and Water Conservation District
MELC	Multi-Resolution Land Characteristics
MS4	Municipal Separate Stormwater Sewer System
NASA	National Aeronautics and Space Administration
NASS	National Agricultural Statistics Service
NFWF	National Fish and Wildlife Foundation
NFIP	National Flood Insurance Program
NHC	National Hurricane Center
NHD	National Hydrography Database
NLCD	National Land Cover Database
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination Systems
NPR	National Public Radio
NRPA	National Recreation and Park Association
NWS	National Weather Service
NWI	National Wetlands Inventory
NRDA	Natural Resource Damage Assessment
NAVD	North American Vertical Datum
NRCS	Natural Resources Conservation Service
PMCG	Parker Martin Consulting Group
POM	Particulate organic material
PALS	People Against A Littered State
PSGM	Prescott Spatial Growth Model

PIC	Project Implementation Committee
RL	Repetitive Loss
RCRA	Resource Conservation Recovery Act
RESTORE	Resources and Ecosystem Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act
SSO	Sanitary Sewer Overflow
SAC	Science Advisory Committee
SLR	Sea Level Rise
SRL	Severe Repetitive Loss
SCE	South Coast Engineers
SMCCDC	South Mobile County Community Development Corporation
SMCTA	South Mobile County Tourism Authority
SFHA	Special Flood Hazard Areas
SARA	Superfund Amendments and Reauthorization Act
SOP	Standard Operation Procedures
TNC	The Nature Conservancy
TMDL	Total Maximum Daily Load
TSS	Total suspended solids
SSO	Sanitary sewer overflows
SLAMM	Sea Levels Affecting Marches Model
SLOSH	Sea, Lake, Overland Surges from Hurricanes Model
UST	Underground Storage Tanks
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
DOI	U.S. Department of the Interior
EPA	U.S. Environmental Protection Agency

USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USCB	United States Census Bureau
ULI	Urban Land Institute
WFR	West Fowl River
FWS Next Steps	Vision for a Health Gulf of Mexico Watershed; Next Steps for a Healthy Gulf of Mexico Watershed
WWTF	Wastewater Treatment Facility
WERF	Water Environment Research Foundation
WMP	Watershed management plan
WMP	Team Watershed management planning team
WMTF	Watershed Management Task Force
WLFW	Working Lands for Wildlife

1 Introduction

1.1 Plan Purpose

The Mobile Bay National Estuary Program (MBNEP) received funding from the National Fish and Wildlife Foundation (NFWF) Gulf Environmental Benefit Fund (GEBF) to develop watershed management plans (WMPs) for several intertidal watersheds along the Alabama coast.

The West Fowl River Watershed was identified as one of the priority watersheds by the MBNEP Project Implementation Committee (PIC), and the MBNEP partnered with the Mobile County Soil and Water Conservation District (MCSWCD) to develop the West Fowl River WMP. The goal of the plan is to provide a roadmap for restoring and conserving the watershed and improving water and habitat quality in areas where resources could have been damaged by the Deepwater Horizon Oil Spill. This WMP charts a conceptual course for improving and protecting the things people value most about living along the Alabama coast as identified in the MBNEP Comprehensive Conservation and Management Plan (CCMP).

The West Fowl River WMP is centered on these six values and addresses the following:

- **Water**: Identifies actions to reduce point and non-point source pollution and remediate past effects of environmental degradation, thereby reducing outgoing pollutant loads into Portersville Bay, Mississippi Sound, and the Gulf of Mexico.
- **Coastlines**: Assesses shoreline conditions and identifies strategic areas for shoreline stabilization and fishery enhancements.
- **Access**: Characterizes existing opportunities for public access, recreation, and ecotourism and identifies potential sites to expand access to open spaces and waters within the watershed.
- **Fish**: Identifies actions to reduce the incidence and impacts of invasive flora and fauna and improve habitats necessary to support healthy populations of fish and shellfish. Provides a strategy for conserving and restoring coastal habitat types; providing critical ecosystem services; and identified by the MBNEP's Science Advisory Committee (SAC) as most threatened by anthropogenic stressors. These habitat types: freshwater wetlands; streams, rivers and riparian buffers; and intertidal marshes and flats, were

classified as most stressed from dredging and filling, fragmentation, and sedimentation, all related to land use change.

- **Heritage**: Characterizes customary uses of biological resources and identifies actions to preserve culture, heritage, and traditional ecological knowledge of the watershed.

- **Resiliency**: Identifies vulnerabilities in the watershed from accelerated sea level rise, storm surge, temperature increases, and precipitation and improves watershed resiliency through adaptation strategies.

The watershed management planning team (WMP Team) developed a community-centered, comprehensive approach to watershed management planning. This approach incorporated EPA's six steps in watershed planning with EPA's nine key watershed management elements into a broad overall watershed management approach for improvement and protection of the six things people value most about living along the Alabama coast. The WMP incorporates guidance from the MBNEP CCMP, Alabama Department of Environmental Management's (ADEM) 319 checklist, as well as other regional planning initiatives. The overall goal was to establish a plan that was founded on equitable, practical, and buildable restoration and remediation alternatives. In developing this comprehensive, community based approach, the WMP provides a clear vision to guide the planning process while always keeping the end goal in view – restoring the ecological and cultural vitality of the watershed and its community.

1.2 Period Addressed by the Plan

The scope and breadth of the recommended improvements from this WMP to restore water quality and habitat in West Fowl River will require significant time to implement. This WMP provides a 10-year framework to begin the implementation of recommended actions. This time frame is subject to change, depending on the availability of funds, success of recommended projects, and watershed response. As part of the recommended adaptive management approach, a review of the WMP recommendations should be performed every year, with an in-depth assessment every three to five years. This review should consider monitoring results from implemented projects and whether changes are warranted to the project type, scope, or area of implementation to achieve the stated goals and objectives of the WMP.

1.3 Watershed Management Planning Team

The MBNEP, in partnership with MCSWCD, contracted with Dewberry to develop the West Fowl River WMP. Dewberry brought together a team of highly qualified experts to develop this plan. The team was developed around the six values identified in the MBNEP CCMP:

- **Water**: Environmental Science Associates (ESA)
- **Coastlines**: South Coast Engineers (SCE)
- **Access**: Dewberry
- **Fish**: Dauphin Island Sea Lab (DISL)
- **Heritage**: Parker Martin Consulting Group (PMCG)
- **Resiliency**: Dewberry

The development of this plan involved sustained collaboration between the MBNEP; MCSWCD; NRCS; WMP Team; municipal, county, state, and federal officials; and local stakeholders and citizens. The WMP Team would like to acknowledge the following organizations for their continued support in the development and implementation of this WMP:

- Mobile Bay National Estuary Program (MBNEP)
- Mobile County Soil and Water Conservation District (MCSWCD)
- Natural Resources Conservation Service (NRCS)
- West Fowl River WMP Steering Committee
- Alabama Department of Conservation and Natural Resources (ADCNR)
- Alabama Department of Environmental Management (ADEM)
- US Fish and Wildlife Service (USFWS)
- The Nature Conservancy (TNC)
- Mobile County Revenue Commission
- US Army Corps of Engineers (USACE)
- US Geological Survey (USGS)
- US Department of the Interior (DOI)
- US Department of Agriculture (USDA)
- Federal Emergency Management Agency (FEMA)
- National Oceanic and Atmospheric Administration (NOAA)
- City of Mobile
- Geological Survey of Alabama (GSA)
- Alabama Marine Resources Division
- Mississippi-Alabama Sea Grant Consortium
- Auburn University
- South Mobile County Community Development Corporation (SMCCDC)

1.4 Document Overview

This WMP is organized into the following sections:

- **Section 2** describes the West Fowl River Watershed, providing background on characteristics and current conditions—including topography, hydrology, habitats, demographics, land use, etc.—to provide an understanding of current and historical conditions and insight into the problems of concern.
- **Section 3** evaluates the existing conditions within the Watershed and helps to focus management efforts to address the most pressing needs.
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- **Section 11** outlines a monitoring program to evaluate the success of the management measures over the 10-year planning period.

1.5 Public Participation

The challenge of engaging citizens in a watershed study is always complex. The outreach program was designed to be an integral part of the watershed management planning process—equally as important as the scientific assessments, if not more so. This program was centered on the principal of building a partnership with the community and local stakeholders and connecting with each community segment in an appropriate manner.

1.5.1 Stakeholder Outreach and Engagement

Early in the process, the WMP Team identified key community leaders and stakeholders to ensure successful participation by the maximum number of citizens within the watershed and surrounding areas. This included business owners, commercial fishermen, private landowners, environmental groups, school groups, church and civic groups, recreational water users, and the general citizenry. Partners, such as local, county, state, and federal agencies, were also identified and included in outreach efforts.

A major public awareness campaign was implemented to alert the citizens that a watershed management study was being undertaken and why the study would be important to each of them, their livelihoods, their communities, and the future of the region that they call “home.” Public participation was encouraged using electronic notices, media/press releases, and targeted announcements.

One-on-one interviews were conducted with key stakeholders identified as centers of influence within their groups/communities. Part of the interview process included identifying the most appropriate methods for reaching each of their constituent groups. A West Fowl River Watershed Steering Committee was then formed using these important community leaders as the nucleus.

Materials were developed and initially distributed by the identified centers-of-influence individuals to help encourage citizen participation and later distributed to the community at large.

1.5.2 Community Meetings

Community meetings were held with the intent to inform the citizenry relative to the function and processes of the watershed and obtain their input. Each meeting had a set of basic objectives. The focus for initial meetings was to introduce the concept of watersheds and why protecting the local watershed was critical to the economy and quality of life in the West Fowl River watershed for future generations. Participants were introduced to specifics of the WMP, including timelines and products. The goals were to realize the critical nature of individual responsibility and recognize the importance of their direct participation in protecting the quality and heritage of the local watershed.

Subsequent community meetings focused on identifying interim results of the assessment and obtaining feedback on prioritizing projects and identifying next steps. This feedback was used to create a consensus of current watershed conditions and define the local citizen vision, goals, and objectives for improvements.

Section 10 presents further information on the community participation and stakeholder engagement program. The WMP Team endeavored to keep the community engaged and informed of milestones and accomplishments. Citizens were continuously encouraged to participate in community meetings, surveys, and engagement activities throughout the watershed management planning process.

2.0 Watershed Description

The West Fowl River Watershed covers approximately 20,489 acres in south Mobile County (USGS 2013). The Watershed comprises unincorporated areas of Mobile County (Alabama Port, Bayou Coden, Delchamps, Heron Bay, and Mon Louis), with a small portion of the western end of the Watershed located within the jurisdictional boundary of the City of Bayou La Batre.

2.1 Physical and Natural Setting

The West Fowl River Watershed is located in the Escatawpa River Basin and forms in southern Mobile County. It comprises several named tributary systems including: Bayou Coden, Bayou Como, Bayou Jonas, Bayou Sullivan, Heron Bayou, the 'Narrows,' Negro Bayou, and West Fowl River. All of these named tributary systems receive drainage from multiple unnamed tributaries, a common trait of tidally-influenced coastal stream network systems. According to the National Hydrography Database (NHD) flowlines data (USGS 2013), the cumulative stream network system of the West Fowl River Watershed is approximately 112.2 miles long.

West Fowl River, the largest tributary in the West Fowl River Watershed, is a shallow, tidally-influenced river that receives drainage from Bayou Jonas, the 'Narrows,' and multiple unnamed tributaries. West Fowl River was originally known by the name 'Fowl River' which is thought to have been named by the original French colonists who referred to it as the 'Riviere aux Poules' (Ware 1982). It is unknown when Fowl River was first specified into 'East Fowl River' and 'West Fowl River', but this nomenclature reflects the knowledge that a portion of Fowl River system flows north and east entering into Mobile Bay (East Fowl River), while the southern portion, south of the 'Narrows,' typically flows south and west (West Fowl River) and enters into the Mississippi Sound through Fowl River Bay and Portersville Bay. The total length of West Fowl River contained within the Watershed boundary is 4.6 miles (USGS 2013) and has use classifications of Swimming & Other Whole Body Water-Contact Sports and Fish & Wildlife (ADEM 2014). Bayou Coden is 2.3 miles long and has a use classification of Fish & Wildlife (ADEM 2014).

2.1.1 Watershed Boundary

The West Fowl River Watershed is located in Mobile County, Alabama and is defined by the U.S. Geological Survey (USGS) 12-digit hydrologic unit code (HUC) HUC 031700090103 (USGS 2013). USGS HUC cataloging units represent the geographic area for parts of all surface drainage basins and are effective for evaluating and managing water resources at the local level (Exum *et al.* 2005). However, water network systems found within the area defined by the USGS HUC-12 boundaries have the potential to receive surface flows from areas outside the defined boundary, as HUCs at any hierarchical level are not synonymous with true "watersheds" (Exum *et al.* 2005). For the purposes of this watershed management plan (WMP), the defined boundary for the West Fowl River Watershed is the HUC-12 boundary established by the National Hydrography Database (NHD), USGS (2013) (**Figure 2.1**).

Draining a total area of 20,489 acres (32 square miles), the West Fowl River Watershed receives its name from its largest tributary, West Fowl River. This waterbody is considered to be the major stream in the Watershed and receives flows from Bayou Jonas, the 'Narrows,' and numerous unnamed canals, ditches, waterway connections, and artificial features (USGS 2013). West Fowl River typically flows south and westerly into Fowl River Bay and Portersville Bay, located in the northern Mississippi Sound of coastal Alabama, but because it is tidally-influenced, West Fowl River is known to occasionally reverse and flow north and easterly through the 'Narrows' to East Fowl River, ultimately draining into Mobile Bay.

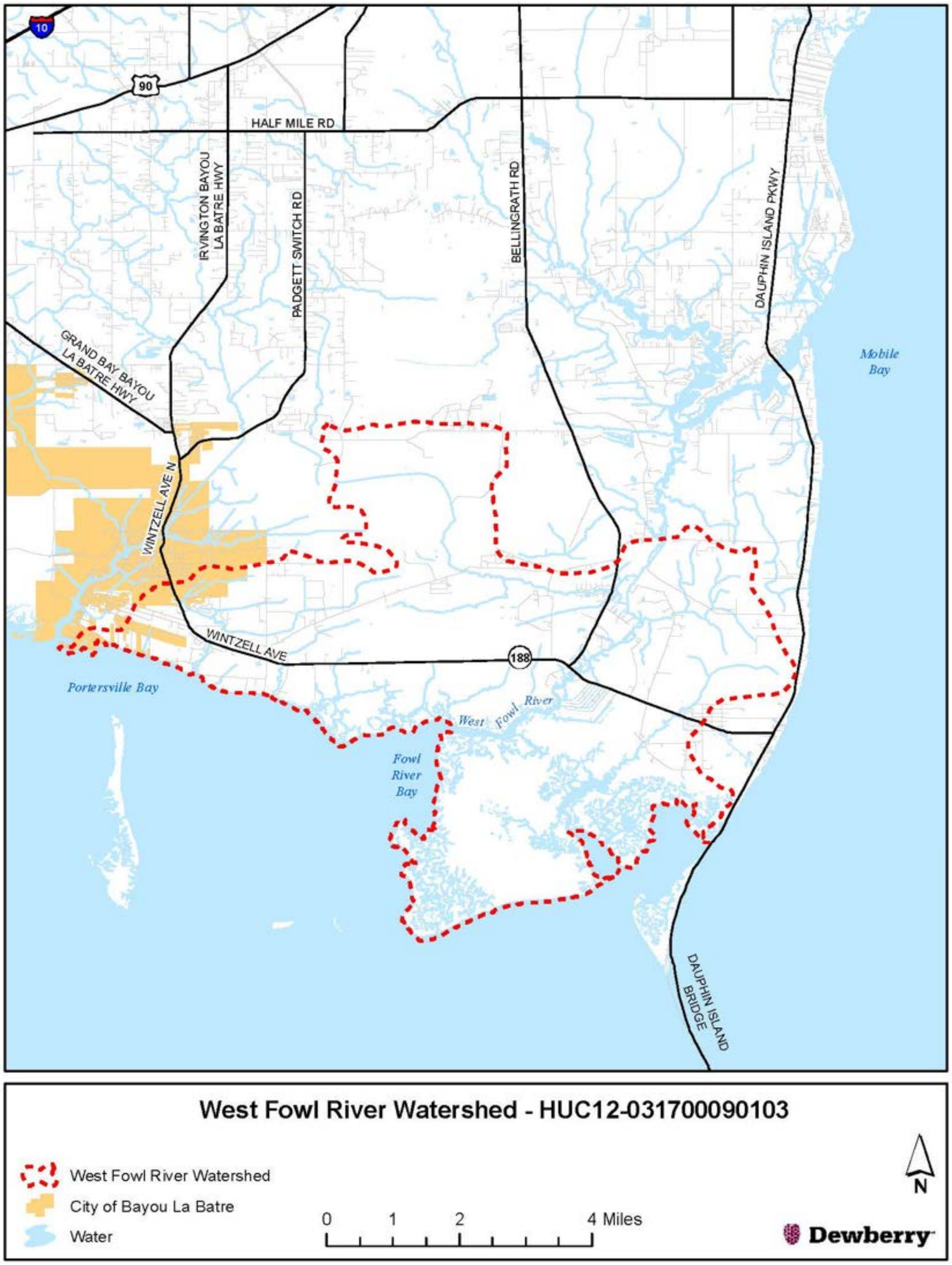


Figure 2.1 West Fowl River Watershed Boundary

2.1.2 Hydrology and Climate

2.1.2.1 Surface Water Resources

The West Fowl River Watershed is located in the Escatawpa River Basin and drains areas of southern Mobile County. The total surface drainage area of the Watershed is approximately 32 square miles. Surface waters within the Watershed empty into Fowl River Bay, Portersville Bay, Mississippi Sound, and the Gulf of Mexico. The general tidal pattern along the northern Gulf is diurnal, with one high and one low tide occurring in a 24-hour period. During periods of rainfall, natural flow in the Watershed comes from runoff, while during periods of drought, it functions as a tidal system, and the primary source of water is from Mississippi Sound. The exception to this generality within the Watershed is Bayou Jonas, which data show is the only water network system in the Watershed which is not tidally controlled (Marlon Cook Report TBP). Wind and tidal action influence water movement in the Watershed, and at times the Watershed can become stagnant, a similar scenario to the Bayou La Batre Watershed (USACE 2012).

2.1.2.2 Groundwater Resources

The principal sources of groundwater in Mobile County are the Miocene-Pliocene and alluvial aquifers. The Miocene-Pliocene aquifer consists of sediments belonging to the Miocene Series undifferentiated and the Citronelle Formation of Pliocene age. Although the Miocene and Pliocene sediments are separate geologic units in southern Alabama, they are grouped together as one aquifer because the geologic contact between the units is difficult to determine, and the units are often hydraulically connected. A coastal alluvial aquifer underlies the flood plain deposits adjacent to the Mobile River delta, Mobile Bay, and coastal Mississippi. The alluvial aquifer consists of Quaternary-age channel and flood-plain deposits bordering Mobile River (USACE 1988).

Both aquifers are accessible to direct recharge through direct infiltration from rainfall and periodic freshwater inundation. The surface level of the Miocene-Pliocene aquifer ranges from 50-100 feet below ground and extends to depths ranging from 1000-2000 feet. The coastal-alluvial aquifer is relatively thin, and extends from the ground surface to about 150 feet. A transition to saline water often occurs to the south. Some aquifers in the southern part of Mobile County have salinities that exceed 6.5%. Within Mobile County, there are no sole source aquifers designated pursuant to Section 1424 (3) of the Safe Drinking Water Act (PL93-523, amended by P295-190) (Vittor and Assoc. 2007).

2.1.2.3 Climate

The Watershed is located in a humid, subtropical climate region and is characterized by temperate winters and long, hot summers with rainfall that is fairly evenly distributed throughout the year. Annual temperatures range from below freezing to over 100 degrees Fahrenheit, with a normal mean annual temperature of 68 degrees Fahrenheit along the coast (USACE 2014). Average annual precipitation is 68.1 inches (Summersell 2008). Summer temperatures are generally warm, being moderated by sea breezes, and are influenced to a considerable extent by the mild water temperatures of the Gulf of Mexico. Prevailing southerly winds provide moisture for high humidity from May through September. Winter temperatures are relatively mild, and are greatly influenced by seasonal cold fronts. The area averages 15-20 cold fronts per year, occurring from October through March. The cold fronts bring cold air and strong, predominantly northerly winds with speeds that can exceed 25 to 30 knots (Vittor and Assoc. 2007). **Table 2.1** presents the monthly climate statistics for the area.

Table 2.1: Monthly Climate Statistics for Mobile County (1981-2010)

Month	Maximum Temperature (Deg. F)	Minimum Temperature (Deg. F)	Average Temperature (Deg. F)	Precipitation (Inches)
January	60.8	40.0	50.4	5.65
February	64.4	43.3	53.8	5.12
March	71.2	49.1	60.2	6.14
April	77.5	55.4	66.4	4.79
May	84.5	63.7	74.1	5.14
June	89.2	70.4	79.8	6.11
July	91.0	72.7	81.8	7.25
August	90.7	72.6	81.6	6.96
September	87.0	68.0	77.5	5.11
October	79.2	57.6	68.4	3.69
November	70.6	48.6	59.6	5.13
December	62.7	42.2	52.4	5.06
Annual	77.4	57.0	67.2	66.15

Source: NWS 2016a

Hurricanes and tropical storms occur regularly in the Gulf of Mexico, bringing heavy rains, wind, and coastal flooding. Hurricane season runs from June 1st to November 30th. One of the more recent hurricanes that caused significant damage in the Watershed was Hurricane Katrina on August 29, 2005.

During the last century, coastal Alabama suffered from the effects of many hurricanes; although not an exhaustive list, the following 18 hurricanes impacted the area (NWS 2016b):

- Category 3 - Unnamed hurricane in July 1916;
- Category 3 - Unnamed hurricane in October 1916;
- Category 3 - Unnamed hurricane in September 1926;
- Category 2 - Hurricane Baker in August 1950;
- Category 5 - Hurricane Camille in August 1969;
- Category 3 - Hurricane Frederic in September 1979;
- Category 3 - Hurricane Elena in 1985;
- Category 2 - Hurricane Erin in August 1995;
- Category 3 - Hurricane Opal in October 1995;
- Category 1 - Hurricane Danny in July 1997;
- Category 2 - Hurricane George in 1998;
- Category 3 - Hurricane Ivan in September 2004;
- Category 1 - Hurricane Cindy in July 2005;
- Category 3 - Hurricane Dennis in July 2005;

- Category 3 - Hurricane Katrina in August 2005;
- Category 4 - Hurricane Gustav in September 2008;
- Category 4 - Hurricane Ike in September 2008;
- Category 1 - Hurricane Isaac in August 2012.
- Category 1 – Hurricane Nate in October 2017

2.1.2.4 Rainfall and Flooding

Receiving an average of 68.1 inches of rain per year, this is one of the wettest areas in the nation (NWS 2016a). Rainfall typically comes with cold fronts that move through the region during the winter months or from air-mass thunderstorms more prevalent in the summer months. **Table 2.1** in the previous section provides monthly and annual average rainfall statistics.

The area is also susceptible to extreme weather events that can cause intense rainfall and flooding. Hurricane Danny deposited 43 inches of rainfall in a 24-hour period in portions of Mobile County in 1997. Due to the area's low elevation, soil characteristics, and tidal flux, lowland and wetland flooding occurs frequently in specific areas of the Watershed. In addition to flooding caused by intense rainfall, the area is also vulnerable to flooding from storm surges. Storm surges from Hurricane Katrina in the West Fowl River area were 12 to 14 feet, and many homes were engulfed by the flood waters (NWS 2016c).

2.1.3 Topography and Floodplains

The West Fowl River Watershed is classified as primarily coastal lowlands, with upper areas of the Watershed lying within the Southern Pine Hills physiographic district. Elevations range from sea level to about 40 feet in elevation (**Figure 2.2**)

Flood zones are commonly used to identify areas of risk in floodplain management. Flood zones and flood hazard areas are identified by the Federal Emergency Management Agency (FEMA). FEMA identifies an area of special risk as a Special Flood Hazard Area (SFHA). SFHAs are defined as areas that will be inundated by a flood event having a one-percent chance of being equaled or exceeded in any given year. During the span of a 30-year mortgage, a home in the one-percent annual chance floodplain has a 26% chance of being flooded at least once during those 30 years (USGS 2010). The one-percent annual chance flood is also referred to as the base flood or 100-year flood (FEMA 2016).

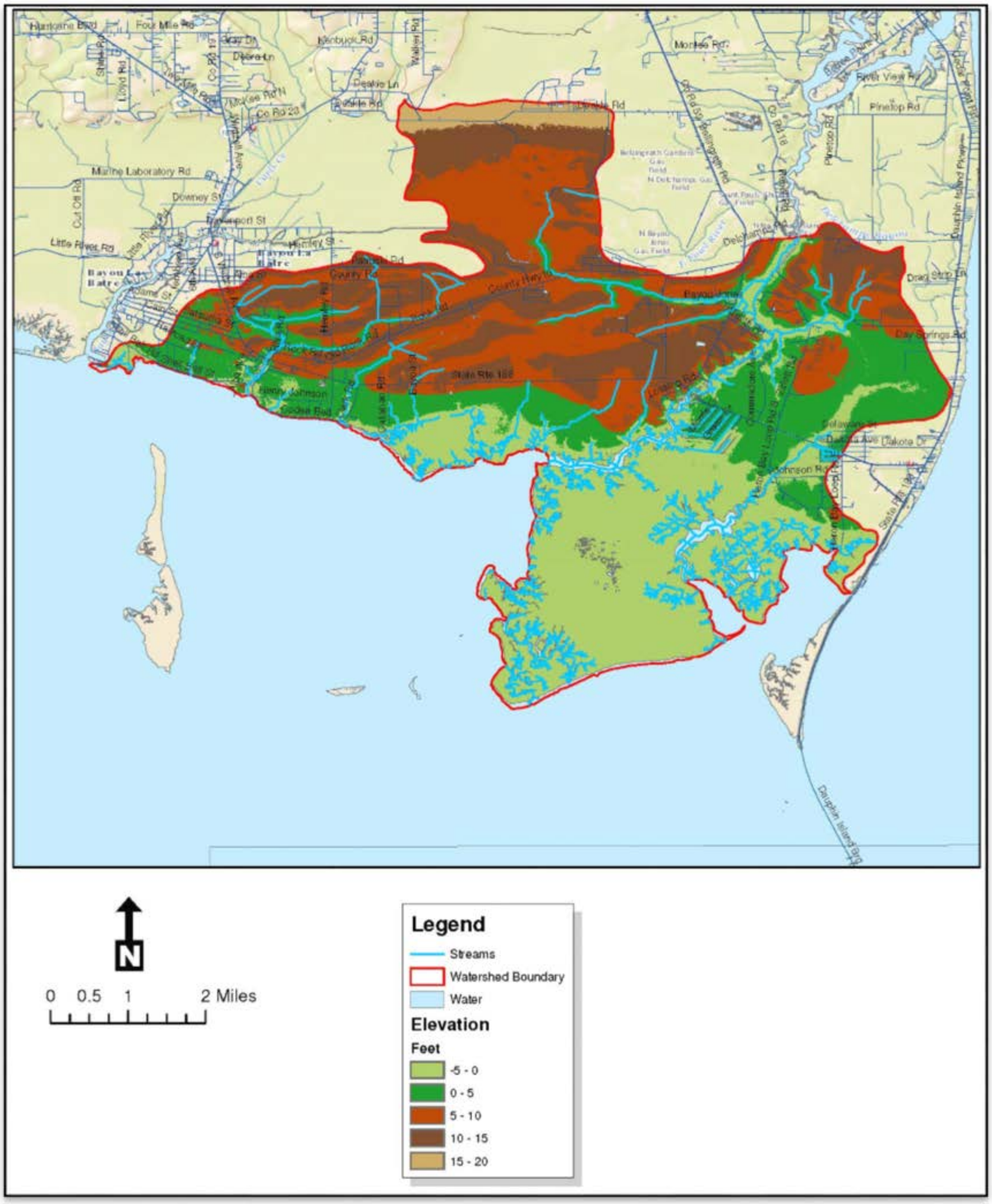


Figure 2.2 West Fowl River Watershed Elevation

Much of the lower portion of the West Fowl River Watershed is identified as FEMA Flood Zone VE, which indicates a one-percent annual chance flood hazard area with storm-induced velocity wave action. Much of the area to the east of the West Fowl River and around Bayou Coden is located in FEMA Flood Zone AE, which indicates a one-percent annual chance flood hazard area. Most of the upper Watershed is identified as being in minimal flood hazard Zone X, with only those areas within the tributaries' immediate floodplain designated as Zone AE. (**Figure 2.3**).

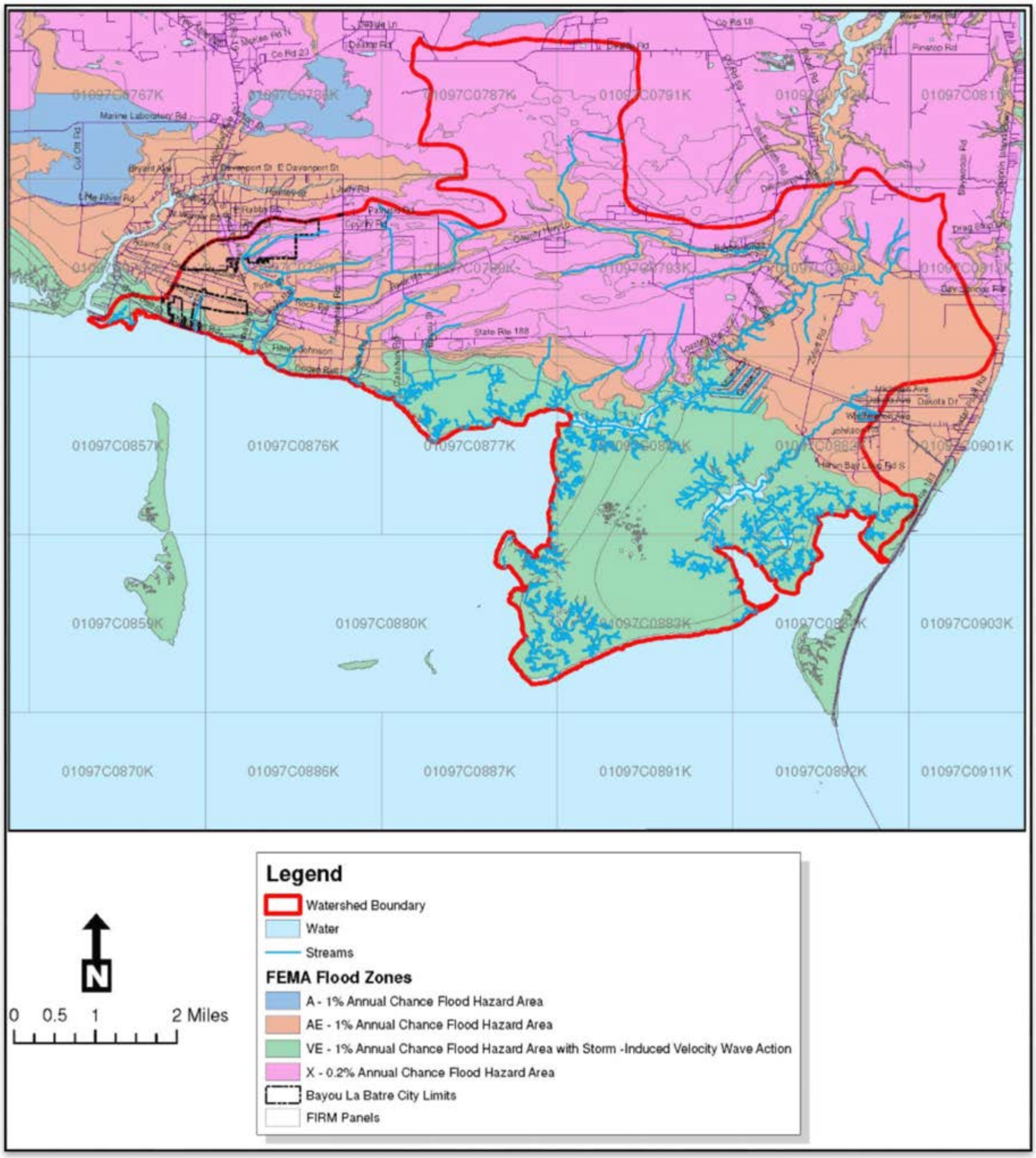


Figure 2.3 FEMA Hazard Zones in the West Fowl River Watershed

2.1.3.1 Geology

The West Fowl River Watershed is underlain by consolidated and unconsolidated sediments that range in age from Holocene to Miocene. Miocene sediments that outcrop in the coastal area consist of consolidated light gray to variegated and mottled consolidated clays inter-bedded with sand and gravel zones. The Pliocene-age Citronelle Formation overlies the Miocene deposits. The Citronelle Formation consists predominately of reddish brown to orange and yellow gravelly sand. Semi-consolidated to unconsolidated sediments of Pleistocene and Holocene age overlay the Citronelle Formation in Mississippi Sound (USACE 2014).

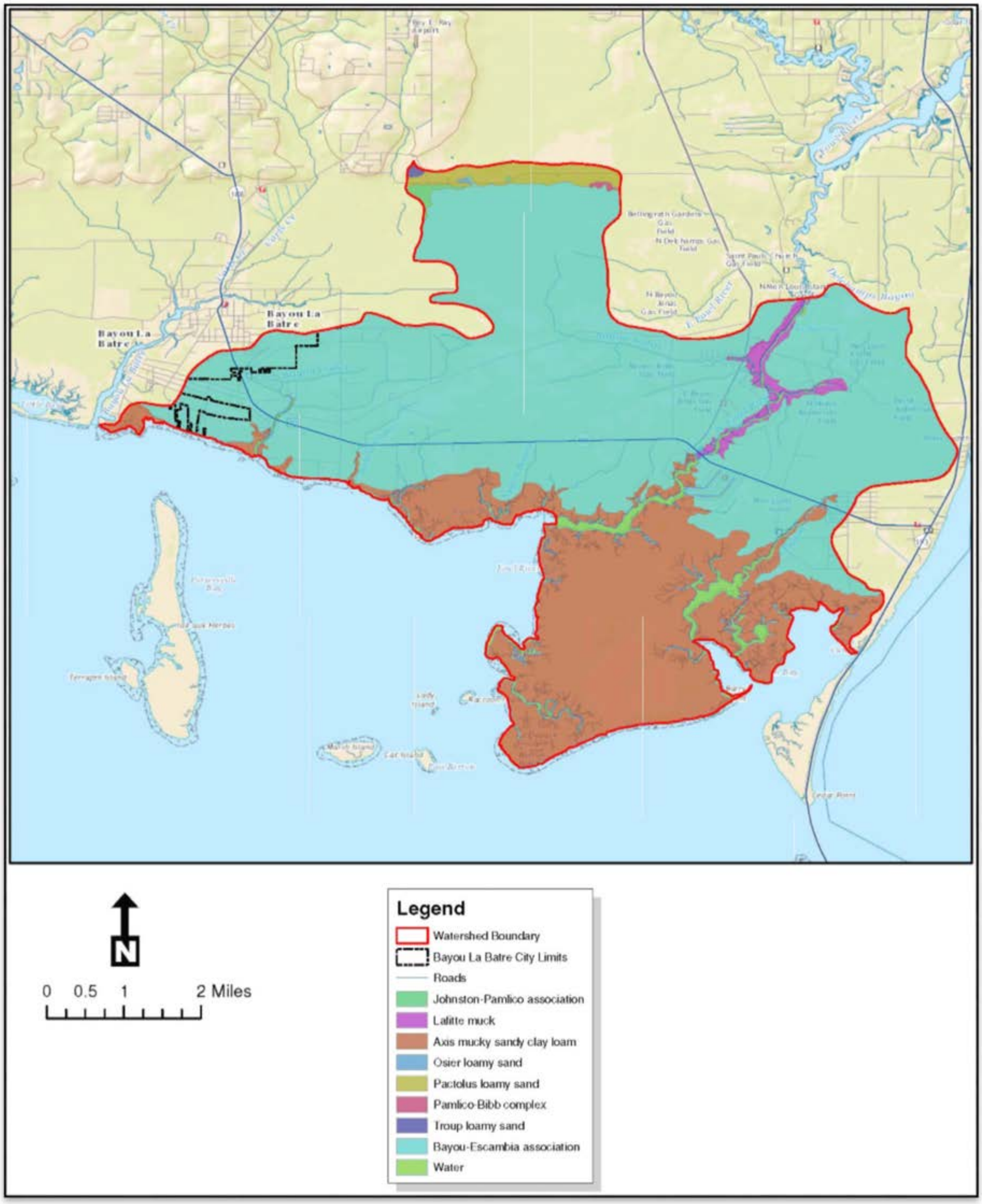


Figure 2.4 Soils in the West Fowl River Watershed

2.1.3.2 Soils

Soils within the Watershed consist of varying associations. There are two primary soil associations (associations with greater than 10% watershed coverage) identified in the Watershed: the Axis mucky sandy clay loam (26.7%) and the Bayou-Escambia association (66.3%) (**Table 2.2**). The lower portion of the Watershed primarily consists of Axis mucky sandy clay loam while the upper portion of the Watershed is primarily the Bayou-Escambia association (**Figure 2.4).**

Table 2.2 Soils in the West Fowl River Watershed

Category	Square Feet	Acres	Square Miles	Percentage of Watershed
Axis mucky sandy clay loam	238,268,844	5,469.9	8.55	26.7%
Bayou-Escambia association	592,112,387	13,593	21.20	66.3%
Johnston-Pamlico association	287,496	6.6	0.01	0.03%
Pamlico-Bibb complex	596,772	13.7	0.02	0.06%
Troup loamy sand	592,416	13.6	0.02	0.06%
Lafitte muck	11,639,232	267.2	0.42	1.3%
Osier loamy sand	217,800	5.0	0.01	0.02%
Pactolus loamy sand	14,226,696	326.6	0.51	1.6%
Water	34,560,504	793.4	1.24	3.87%

2.1.3.3 Sediments

Sediments within the West Fowl River Watershed consist primarily of inorganic clays of high plasticity, poorly-graded sands, sand-clay mixtures, sand-silt mixtures, and inorganic clays of low to medium plasticity (USACE 2008). Soils adjacent to the Watersheds' waterbodies formed on loamy marine sediments and are considered poorly drained and moderately-slowly permeable (Vittor *et al.* 1987).

2.1.4 Vegetation and Wildlife

Coastal Alabama supports one of the largest varieties of plant and wildlife species in the state. Habitats in the area include coastal maritime forests, forested wetlands, emergent wetlands, submerged aquatic vegetation, streams, tidal creeks, tidal flats, brackish-salt marshes, scrub/shrub wetlands, beaches, mudflats, and estuarine, marine and open-water benthic habitats. These areas are home to a diverse, resilient, and environmentally-significant group of species, including some considered threatened and endangered (USACE 2014).

2.1.4.1 Vegetation

Naturally-occurring vegetative communities within the Watershed are typical of those found adjacent to Mississippi Sound in the northern Gulf of Mexico.

Terrestrial uplands dominate higher-ground areas that are not normally subject to riverine flooding or tidal inundation and typically consist of a variety of pine and scrub oaks. Natural upland vegetation complexes found in the area include longleaf pine-oaks, moist pinelands, bay forests, monoculture pine, maritime strand, and beach dune associations. The most dominant upland association is longleaf pine-oaks. This complex is well-adapted to the dry, sandy sites in the coastal plain region (USACE 2014). Longleaf pine (*Pinus palustris*) is the dominant species in this habitat. Other species occurring in the community include southern red oak (*Quercus falcata*), laurel oak (*Q. laurifolia*), live oak (*Q. virginiana*), southern magnolia (*Magnolia grandiflora*), flowering dogwood (*Cornus florida*), persimmon (*Diospyros virginiana*), winged sumac (*Rhus copallina*), sparkleberry (*Vaccinium arboreum*), and broomsedge (*Andropogon* spp.) (USACE 2014). Shrubby plants (sumac, huckleberry, gallberry) can be found in the understory along with associated herbs and grasses (Vittor and Assoc. 2007).

Maritime forests cover the middle portion of the Watershed. These forests predominantly contain slash pine (*Pinus elliottii*) with an understory of saw palmetto (*Serenoa repens*) and wax myrtle (*Myrica cerifera*) (USACE 2014). This area has a higher water table than the longleaf pine-oaks community. This strip of moist pinelands divides the longleaf pine-oak forests and coastal swamps. Sedges, grasses, and other herbaceous plants grow in the understory area (USACE 2014).

The forest area transitions when entering sandy areas near the coast. Terrestrial grasses make up the majority of the groundcover and include broomsedge (*Andropogon virginicus*), switchgrass (*Panicum virgatum*), and warty panicgrass (*Panicum verrucosum*). Non-native cogongrass (*Imperata cylindrica*) occurs in scattered patches in the Watershed (Vittor and Assoc. 2007). The coastal and lowland waterways in the Watershed are fringed with marsh grasses such as black-needlerush (*Juncus roemerianus*) and smooth cordgrass (*Spartina alterniflora*) (USACE 2014).

2.1.4.2 Wildlife

Coastal faunal assemblages within the Watershed include a variety of amphibians, reptiles, birds, and mammals. These animals occur in all habitats found within the system and utilize various aspects of West Fowl River, its tributaries, and surrounding lands.

Mammals found within the Watershed and surrounding area include marsupials, moles, shrews, bats, armadillos, rabbits, rodents, carnivores, and hoofed mammals (USACE 2014). Mammals occur within all the Watershed's habitats, while the long leaf pine-oaks community and the pine savannah community support populations of white-tailed deer and smaller mammals such as opossum, raccoon, armadillo, cottontail rabbit, gray squirrel, and fox (Vittor and Assoc. 2007). Mammals, such as the marsh rabbit, cotton rat, swamp rabbit, and river otter are also common in the Watershed (USACE 2014).

Reptiles and amphibians found in the area include snakes, turtles, lizards, toads, frogs, salamanders, and crocodilians. There is a great diversity of reptiles including 23 species of turtles, 10 species of lizards, 39 species of snakes, and the alligator. Eighteen species of salamanders and 22 species of frogs and toads are also found in the coastal area (USACE 2014).

Due to the location of the Watershed along the coast, the area supports many populations of transient and resident birds. Migratory birds can be observed during the spring and fall, while permanent residents such as ospreys, gulls, and pelicans can be seen year round. Over 300 species of birds have been recorded as migratory or permanent residents within the area, with several species breeding in the area (USACE 2014). Shorebirds include osprey, great blue heron, great egret, piping plover, sandpiper, gulls, brown and white pelicans, American oystercatcher, and terns (USACE 2014).

2.1.4.3 Protected Species

Table 2.3 presents species identified by the U.S. Fish and Wildlife service as threatened, endangered, or in recovery in Mobile County. All of these species are potentially found within the West Fowl River Watershed and surrounding area.

Table 2.3 Federally Protected Species Documented from Mobile County, Alabama

Group	Name	Status
Birds	Bald eagle *(Haliaeetus leucocephalus)*	R
	Wood stork (*Mycteria americana)*	T
	Piping plover (*Charadrius melodus)*	T
	Red knot (*Calidris canutus rufa*)	T
Clams	Alabama heelsplitter (*Potamilus inflatus*)	T
	Southern clubshell (*Pleurobema decisum*)	E
Fish	Alabama sturgeon (*Scaphirhynchus suttkusi*)	E
	Atlantic sturgeon—Gulf subspecies (*Acipenser oxyrinchus)*	T
Mammals	West Indian manatee (*Trichechus manatus)*	E
Reptiles	Hawksbill sea turtle (Eretmochelys)	E
	Leatherback sea turtle (Dermochelys coriacea)	E
	Kemp's ridley sea turtle (*Lepidochelys kempii)*	E
	Loggerhead sea turtle (*Caretta caretta)*	T
	Alabama red-bellied turtle (*Pseudemys alabamensis)*	E
	Eastern indigo snake *(Drymarchon corais couperi)*	T
	Black pine snake *(Pituophis melanoleucus lodingi)*	T
	Gopher tortoise *(Gopherus polyphemus)*	T

R = Recovery, T = Threatened, E = Endangered. Source: USFWS 2016

2.1.4.4 Sensitive Areas

The West Fowl River Watershed contains some potentially sensitive areas for vegetation and wildlife. Adjacent coastal areas have been deemed critical habitat for Atlantic sturgeon (gulf subspecies, *Acipenser oxyrinchus*) and piping plover (*Charadrius melodus*), and the area is vital to numerous species of migratory birds. Much of the Watershed contains wetlands typical along the Alabama coast. These wetlands provide many ecosystem services necessary to sustain viable habitat and support the region both functionally and economically.

2.1.4.5 Exotic/ Invasive Species

Non-native invasive species can significantly impact natural systems and ecosystem function. Invasive plants can be fast growing and spread quickly, outcompeting native vegetation. Invasive animals can often find only limited local competition for food and no natural predators in the local area. The following invasive species presented in **Table 2.4** are potentially found within the Watershed and surrounding areas.

Table 2.4 Invasive Species in Coastal Alabama

	Species
Animals	Asian clam (*Corbicula spp.*)
	Asian tiger shrimp (*Penaeus monodon*)
	Giant apple snail (*Pomacea maculata*)
	Wild hogs (*Sus scrofa*)
	Nutria (*Myocaster coypus*)
Plants	Chinese tallow (*Triadeca sebifera*)
	Chinese privet (*Ligustrum sinense*)
	Chinese wisteria (*Wisteria sinensis*)
	Alligatorweed (*Alternanthera philoxeroides*)
	Persian Silk Tree/ Mimosa Tree (*Albizia julibrissin*)
	Air potato (*Dioscorea bulbifera*)
	Water hyacinth (*Eichhornia crassippies*)
	Cogon grass (*Imperata cylindrica*)
	Salvinia (*Salvinia spp.*)
	Kudzu (*Pueraria spp.*)
	Eurasian watermilfoil (*Myriophyllum spicatum*)
	Common reed (*Phragmites australis*)
	Japanese honeysuckle (*Lonicera japonica*)
	Japanese climbing fern (*Lygodium japonicum*)
	Golden bamboo (*phyllostachys aurea*)
	Phragmites (*Phragmites australis*)
	Torpedo grass (*Panicum repens*)

2.2 Land Use and Land Cover

Land use describes how people use the landscape (farming, forestry, residential development, commercial development, etc.), while land cover describes the landscape or surface of the land (water, wetlands, forest, impervious surfaces, etc.). Changes in land use and land cover (LULC) are used to assess and explain past, current, or future trends and consequences altered landscapes have on ecosystems at local, regional, or global scales.

Understanding LULC changes for landscapes at the watershed level is important because differing land covers and land uses can significantly impact local water resources, including sediment and pollutant loads of streams as well as stormwater runoff velocities, volumes, and timing within watersheds. The following sections describe and evaluate LULC trends within the West Fowl River Watershed to provide insight into the type, location, and extent of LULC changes over time.

The original LULC datasets of interest for this watershed management plan (WMP) were clipped to the 12-digit HUC watershed boundary, as defined in **Section 2.1.** This data-editing process facilitated the uniform assessment of the spatial data and information such that differing sources and years of data could be compared. However, despite all efforts to assess and interpret spatial data through a uniform process, discrepancies among the various LULC datasets still exist. For example, quantitative information presented in the following sections regarding total land area (acres) from different sources over the years does not match each other or the total acreage for the watershed as defined in **Section 2.1.** This discrepancy is suggested to be the result of different mapping and remote sensing technologies used over the years by various sources. Other potential discrepancies are described in the following sections.

2.2.1 Historic Land Use and Land Cover

In 2008, the NASA Stennis Space Center led an effort with multiple Gulf of Mexico Alliance (GOMA) partners, including the MBNEP, to use remote sensing imagery to investigate LULC changes for Mobile and Baldwin counties from 1974 to 2008 (Spruce *et al.* 2009). This study focused on a regional analysis of urban expansion at the watershed level using Landsat images for the following years: 1974, 1979, 1984, 1988, 1991, 1996, 2001, 2005, and 2008. The LULC change analysis considered a modified Anderson Level I classification system that included: barren, non-woody wetland, open water, upland herbaceous, upland forest, urban, and woody wetland. This classification scheme is used throughout the LULC sections for consistency among dataset comparison in this WMP.

Historical LULC analyses from the years 1974 and 2008 are presented for the West Fowl River Watershed (**Figure 2.5**) and are summarized in **Table 2.5** (Spruce *et al.* 2009). As previously noted, there is a discrepancy in the total area (acres) shown in **Table 2.5** for the years 1974 and 2008. This is the result of differing Landsat techniques used to derive the data at different time periods. For example, the 1974 data were sampled at a 60-meter resolution and processed into a four-channel data stack of visible and near infrared bands, while the 2008 data were acquired at a 30-meter resolution and processed into a six-channel data stack of visible, near-infrared, and shortwave infrared reflectance bands (Spruce *et al.* 2009). More information on the accuracy and development of the 2008 NASA LULC products can be found in Spruce *et al.* (2009) or Ellis *et al.* (2008).

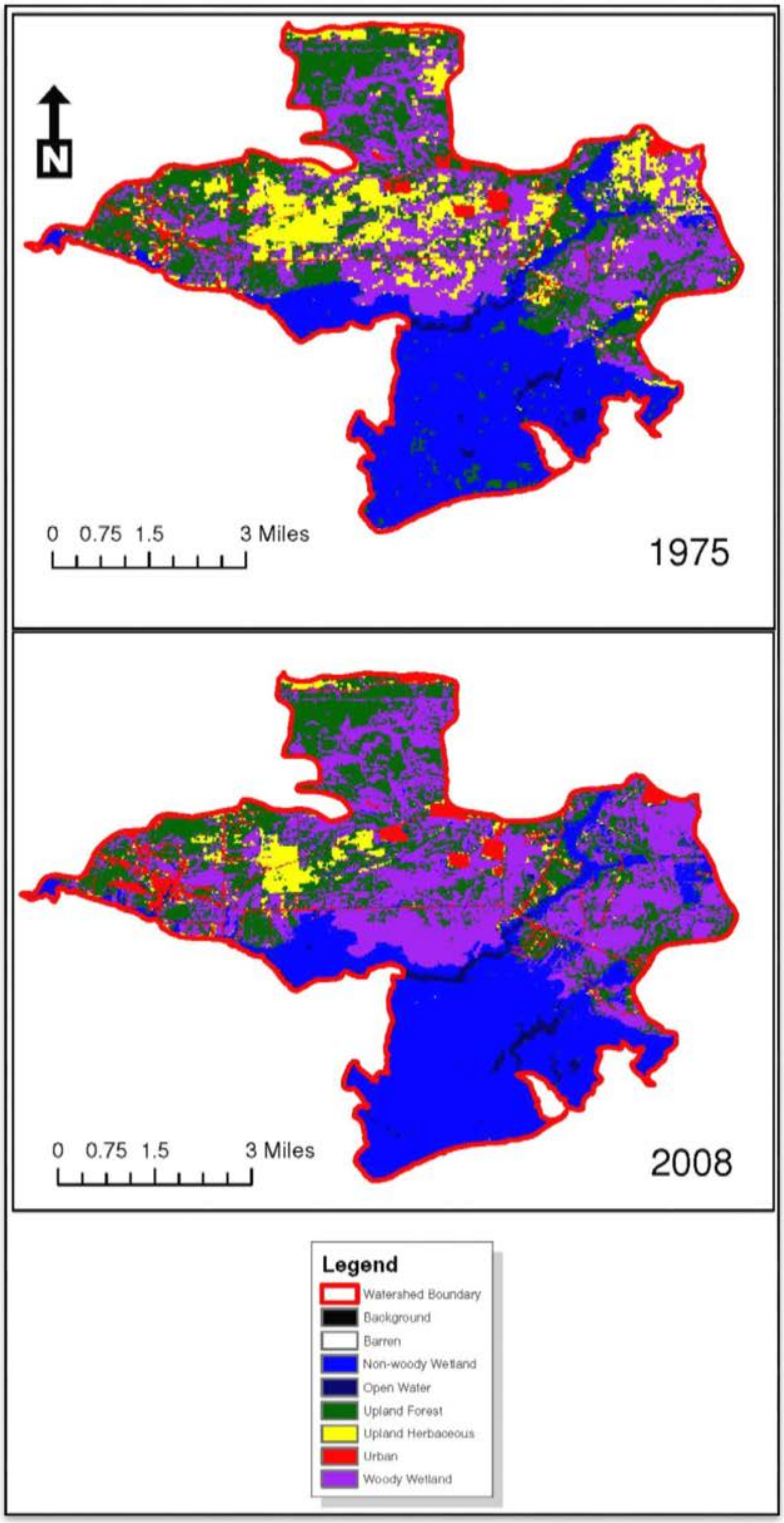


Figure 2.5 LULC Change from 1974 to 2008 (Spruce et al. 2009).

Table 2.5 West Fowl River Watershed LULC from 1974 to 2008 (Spruce et al. 2009)

Class Name	1974		2008	
	Total Area (Acres)	Percent %	Total Area (Acres)	Percent %
Open Water	322.8	1.58%	535.4	2.62%
Barren	5.8	0.03%	13.9	0.07%
Upland Herbaceous	2650.3	12.95%	687.7	3.36%
Non-Woody Wetland	6313.0	30.84%	6625.6	32.37%
Upland Forest	5366.2	26.22%	5097.2	24.90%
Woody Wetland	5150.0	25.16%	6456.9	31.54%
Urban	653.6	3.19%	1046.9	5.11%
Background	6.5	0.03%	6.1	0.03%
Total	20,468.19	100 %	20,469.75	100 %

Figure 2.5 graphically presents historical LULC for the West Fowl River Watershed in 1974 and 2008. From 1974 to 2008, the West Fowl River Watershed experienced slight increases in urbanization from approximately 3.2% to approximately 5.1%, accompanied by increases in woody wetlands from approximately 25.2% to 31.5% (Spruce *et al.* 2009). The most notable change in LULC within the Watershed over the 34-year time period was the decline in upland herbaceous (agricultural land) from approximately 13% to 3.4% of the Watershed area (Spruce *et al.* 2009). The effects of increased urbanization on the Watershed is further addressed in **Section 2.2.10**

2.2.2 Current Land Use and Land Cover

Current land cover for the West Fowl River Watershed is shown in **Figure 2.6** and **Table 2.6**, which present the 2011 National Land Cover Database (NLCD) Land Cover data clipped to the Watershed's 12-digit HUC boundary (see **Section 2.1**) (Homer *et al.* 2015). The 2011 NCLD is the most up-to-date iteration of the NLCD and features Landsat-based, 30-meter resolution, land cover data for the contiguous United States (Jin *et al.* 2013). The NLCD was developed by the Multi-Resolution Land Characteristics (MRLC) Consortium, which is a partnership led by the USGS between various federal agencies. For consistency of reporting and comparing LULC datasets within this WMP, the classification scheme of the NLCD 2011 data herein is presented according to its reclassification to the LULC scheme provided by Spruce *et al.* (2009) (see **Section 2.2.1**). **Table 2.7** shows the original NLCD 2011 classification scheme and its simplification to the scheme of historical datasets developed by Spruce *et al.* (2009) (see **Section 2.2.1**).

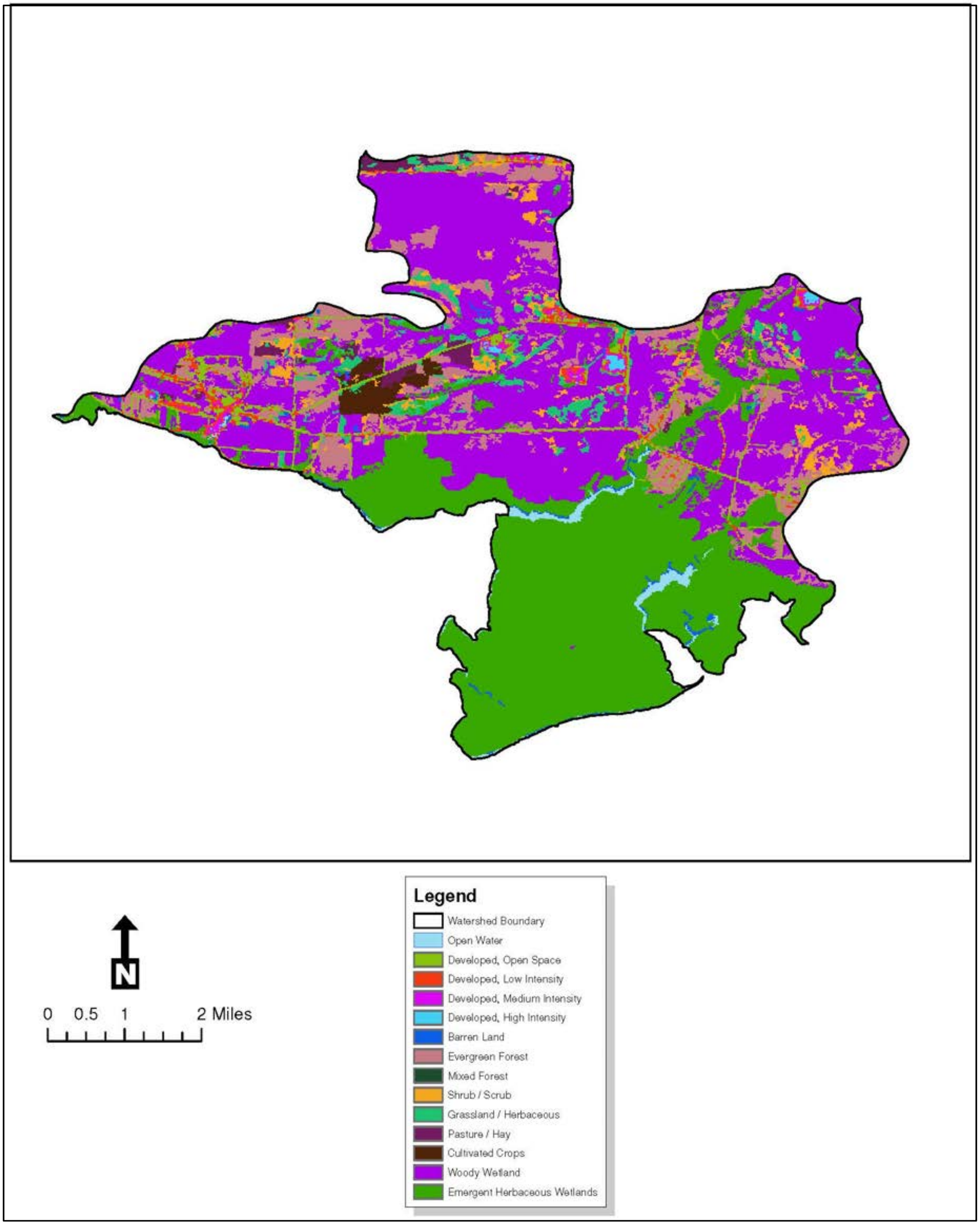


Figure 2.6 Current LULC in the West Fowl River Watershed

Table 2.6 Approximate Total Land Use for the West Fowl River Watershed According to Reclassified NLCD 2011 Land Use Data Clipped to the Watershed boundary

Class Name	2011	
	Total Area (Acres)	Percent (%)
Open Water	242.98	1.19
Barren	155.21	0.76
Upland Herbaceous	1,104.30	5.39
Non-Woody Wetland	7,002.76	34.19
Upland Forest	2,703.01	13.20
Woody Wetland	7,967.83	38.90
Urban	1,305.11	6.37
Total	20,481.20	100%

Table 2.7 Remapping Land Use Land Cover Classes of 2011 National Land Cover Database to the Classification Scheme of Spruce et al. (2009)

2011 NLCD Land Use Land Cover Classification	Simplified Classification
Developed, Open Space Developed, Low Intensity Developed, Medium Intensity Developed, High Intensity	Urban
Grassland/Herbaceous Pasture/Hay Cultivated Crops	Upland Herbaceous
Deciduous Forest Evergreen Forest Mixed Forest Scrub/Shrub	Upland Woods
Woody Wetlands	Woody Wetland
Emergent Herbaceous Wetlands	Non-Woody Wetland
Open Water	Open Water
Barren Land (Rock/Sand/Clay)	Barren

2.2.3 Fisheries

Commercial fishing, aquaculture, and processing industries are vital to the West Fowl River Watershed. Shrimp, oysters, crabs, and finfish are the area's primary seafood products. The Alabama Department of Conservation and Natural Resources – Marine Resources Division (ADCNR-MRD) manages Alabama's marine resources and oversees the planting of oyster reefs, many of which occur in the Watershed. ADCNR-MRD has docmented a decrease in reef productivity recently due to changes in environmental conditions. Oyster landings have been below the 697K pound average (1990-2007) since 2008 and remain low. Brown shrimp landings in 2011 and 2012 were well below the 4.2 million pound average (2001-2010), and blue crab landings were also below average in 2011 and 2012. (ADEM 2014).

2.2.4 Wetlands

According to 2011 NLCD data, wetlands make up roughly 73% of the total watershed area, with woody wetlands comprising nearly 7,968 acres or 38.9% and non-woody wetlands comprising nearly 7,003 acres or 34.2% (**Table 2.6**). Homer *et al.* (2015) provides definitions for woody wetland and non-woody wetland (emergent herbaceous wetlands) classifications given by the 2011 NLCD. Generally, wetlands are classified as areas where the soil or substrate is periodically saturated with or covered with water.

Areas along the coastline and most of the area between Fowl River Bay and Heron Bay consist of tidally-influenced salt marsh dominated by smooth cordgrass (*Spartina alterniflora*) and black needlerush (*Juncus roemerianus*). Forested wetland areas found in close proximity to West Fowl River and its tributaries comprise the rest of the wetland area. These areas are generally upland forest which undergo periodic inundation as the result of mild-to-severe flooding.

2.2.5 Forested Areas

According to the 2011 NLCD data, forests (upland woods) comprise 13.2% of the total Watershed area or 2,703.01 acres (**Table 2.6**). The upland woods classification for forests collectively represents three land cover classifications: evergreen forest, mixed forest, and scrub/shrub, as defined by Homer *et al.* (2015). Evergreen forest comprises 10.54% of the total watershed area or 2,158.64 acres; mixed forest comprises 0.01% of the total watershed area or 2.46 acres; and scrub/shrub comprises 2.65% of the total watershed area or 541.91 acres.

2.2.6 Agricultural Lands

The 2011 NLCD data describes agriculture lands (upland herbaceous) as comprising only 5.4% of the Watershed or 1,104 total acres (**Table 2.6**). Lands used for farming and agricultural practices are primarily found in the northwestern portion of the Watershed. The main crops found in the Watershed are a rotation of cotton and peanuts, with occasional fields of corn and/or soybeans. The majority of agricultural producers plant a cover crop after conventional tillage; fall forages are planted into permanent pastures for winter grazing (NRCS 2016).

2.2.7 Open Space

According to the NLCD 2011, nearly 90.2 % of the Watershed is comprised of undeveloped and open space areas that include wetlands, forested areas, and developed, open space (Homer *et al.* 2015). **Table 2.8** below quantifies each of these classifications. **Figure 2.7** follows with a graphical presentation of the total open space areas within the Watershed.

Table 2.8 West Fowl River Watershed Open Space Areas (NLCD 2011)

	Total Area (acres)	Total Area (%)
Wetlands		
Non-Woody Wetlands (Emergent Herbaceous Wetlands)	7,002.76	34.2
Woody Wetlands	7,967.83	38.9
Forested Areas		
Evergreen Forest	2,158.64	10.5
Mixed Forest	2.46	0.0
Shrub/ Scrub	541.91	2.6
Developed, Open Space		
Developed, Open Space	803.86	3.9
Total Watershed Open Space (wetlands, forested areas, and developed, open space):	18,476.63	90.2

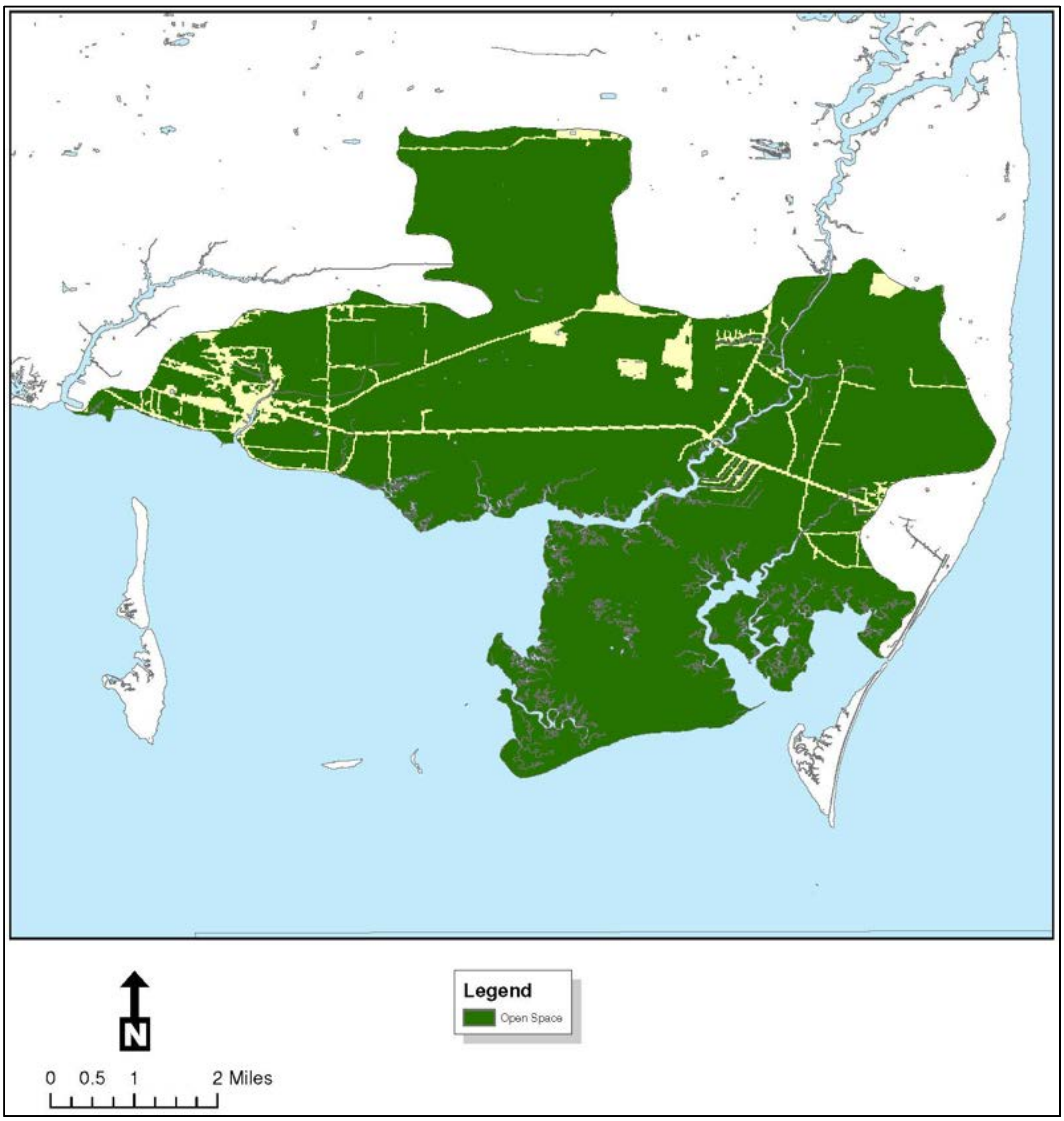


Figure 2.7 West Fowl River Watershed Open Space Areas (NLCD 2011)

2.2.8 Recreation

The West Fowl River Watershed is primarily a rather unspoiled delta habitat with numerous bayous, tributaries, and canals. The area enjoys a very low population density that has, until recently, resulted in minimal pressure on the environment. A vast majority of the residents chose the area for their permanent residency or as a second home refuge because of its natural beauty and immediate access to waterways. A substantial number of watershed stakeholders live along one of these waterways and have immediate access to the water via their own docks, boatlifts or ramps. Others have relatively easy access to the waterways using private access points provided by other stakeholders or privately-owned landings such as Jemison Heron Bay Landing or Bayou Coden Landing. The state owned Delta Port Marina, located south of Highway 188, provides a fishing pier, an ADA-compliant kayak launch, a covered pavilion, and a double boat ramp. Cedar Point Landing, located on the southeast edge of the West Fowl River Watershed, offers access to the waters of Mobile Bay.

While access for such activities as boating, fishing, canoeing/kayaking are minimally available, structured areas for hiking, cycling, camping, birding, picnicking and swimming are not available. There are no public parks within the Watershed. The public Bayfront Park, located on Dauphin Island Parkway, provides a location for family style recreation but must be shared with regional residents from other areas and Dauphin Island tourists/visitors.

2.2.9 Developed Areas

Developed areas account for 2.4% of the total area of the West Fowl River Watershed. These developed areas are primarily low-intensity development which mainly consist of single family housing units. Medium and high-intensity development make up a much smaller percentage of the overall watershed, and specific percentages are presented in **Table 2.9.**

Table 2.9 West Fowl River Watershed Developed Areas (NLCD 2011)

Percent Developed (from LULC 2011 Dataset)	Total Watershed Area (Acres)	Total Watershed Area (%)
Developed, Low-Intensity (imperviousness from 20 - 49%)	334.64	1.6%
Developed, Medium-Intensity (imperviousness from 50 - 79%)	118.02	0.6%
Developed, High-Intensity (imperviousness > 79%)	48.59	0.2%
Total	**501.25**	**2.4 %**

The highest-percentages of development are found near major roadways and along West Fowl River (**Figure 2.9**). Developed land cover for the Watershed is further investigated in **Section 2.2.10** in terms of impervious surface cover, which is a useful indicator for understanding the impact of development on urbanizing watersheds. Urban land type is important when considering stressors to watershed health. It also helps determine what best management practices (BMPs) should be employed to improve or preserve water resources within watersheds.

2.2.10 Impervious Cover

Impervious cover (IC) is a collective term used to describe all hard surfaces (i.e. rooftops, driveways, roads, parking lots, patios, compacted soils, etc.) that allow little to no water infiltration into the soil. By restricting the infiltration of water, IC fundamentally alters the hydrology of urban watersheds by generating increased stormwater runoff and reducing the amount of rainfall that soaks into the ground. As a result, IC is often used to explain or predict changes in stream quality as a response to watershed development.

Impervious cover is the best indicator to measure the intensity of watershed development and to predict the severity of development impacts on the network of streams within a watershed. The extent of IC in a watershed is closely linked to the specific LULC cover types that reflect intensive land uses traditionally associated with urban growth. Typically, increases in IC result in the fragmentation of natural area remnants, create interruptions in stream corridors, reflect encroachments into and expansion of developments within floodplains, and increase the density of stormwater hotspots. Relatedly, the potential for sediment erosion is known to increase in developing watersheds as natural vegetation is replaced by impervious cover.

The Center for Watershed Protection has developed an impervious cover model (ICM), which relates IC with research findings into a general watershed planning model (Schueler 2003). As shown in **Figure 2.8**, Schueler's (1994) three imperviousness classes of impact provide a useful initial guide to stream quality in the Southeastern United States:

> **Sensitive streams** have 0 to10% imperviousness and typically good water quality, good habitat structure, and diverse biological communities if riparian zones are intact and other stresses are absent.
>
> **Impacted streams** have 10 to 25% imperviousness and show clear signs of degradation and only fair in-stream biological diversity.
>
> **Non-supporting streams** have >25% impervious, a highly unstable channel, and poor biological condition supporting only pollutant-tolerant fish and insects.

The ICM predicts that when watershed IC exceeds 10%, stream quality is likely degraded, with the degradation increasing to severe when watershed IC exceeds 25%. While impervious cover is a more robust and reliable indicator of overall stream quality beyond the 10% IC threshold, several studies cited in Schueler (2003) have documented stream degradation at levels of watershed imperviousness below the 10% threshold.

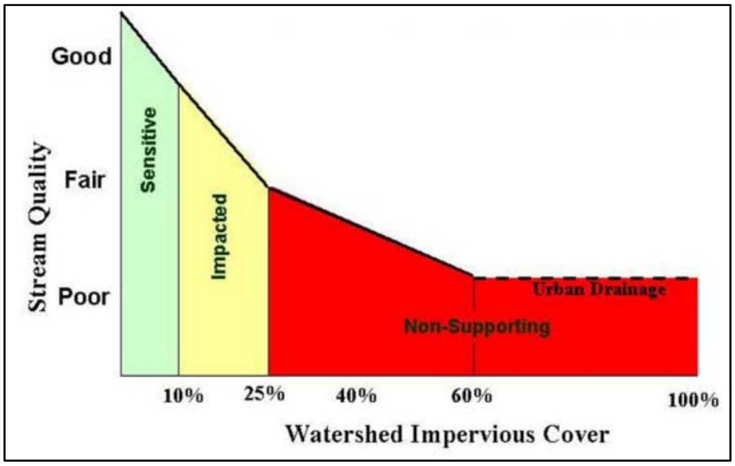


Figure 2.8 The Center for Watershed Protection's Impervious Cover Model (Schueler 2003)

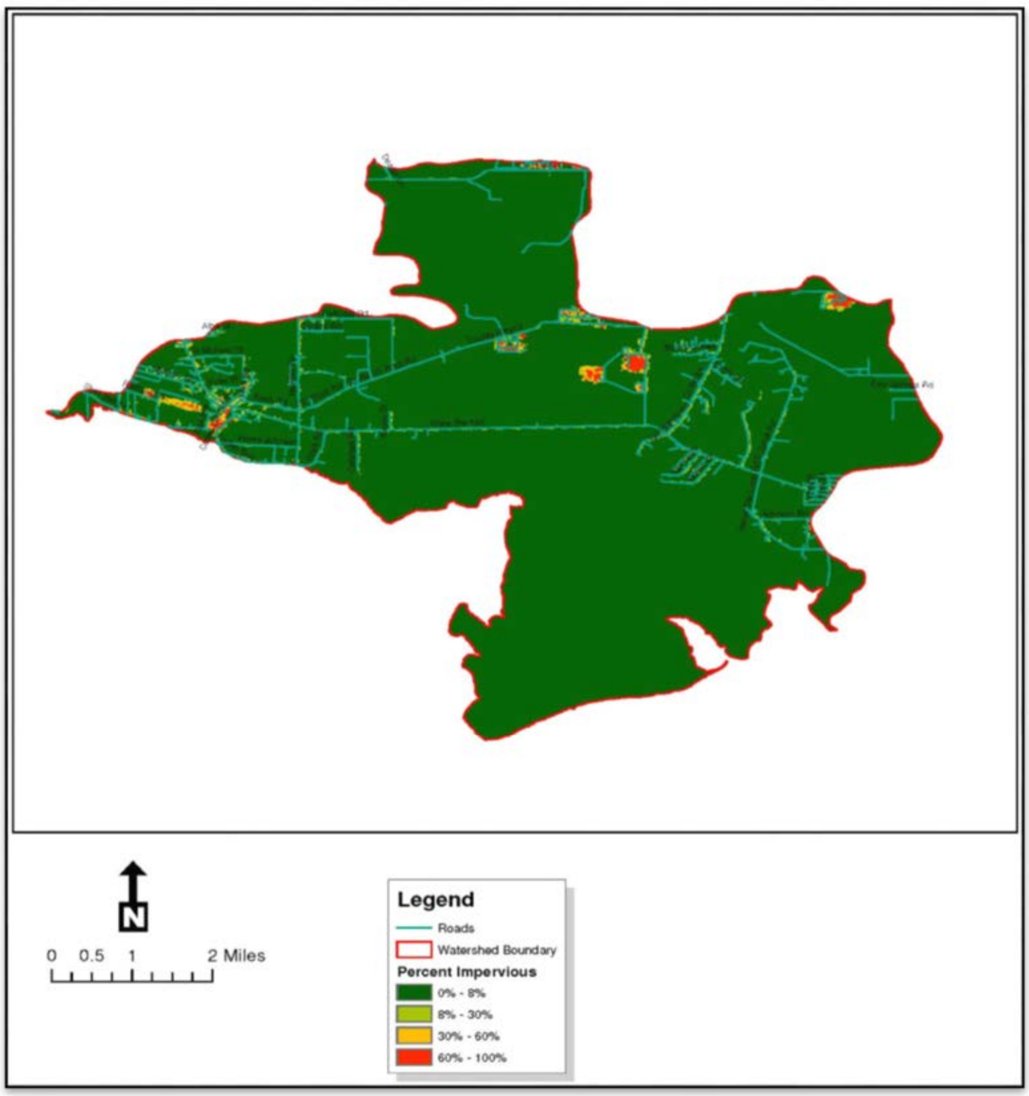


Figure 2.9 West Fowl River Watershed Percent Imperviousness (Xian et al. 2011)

2.2.11 NLCD 2011*(Xian et al. 2011)*

The NLCD 2011 Percent Developed Imperviousness data layer (Xian *et al.* 2011) was used to assess impervious surfaces within the Watershed. The 2011 NLCD Percent Developed Imperviousness dataset presents estimates of land cover imperviousness with values ranging from 0-100% imperviousness for the contiguous United States at 30-meter resolution (Xian *et al.* 2011). A pixel (30x30 meter resolution) with a value of zero has no impervious surface, while a pixel with a value of 100 is completely covered with impervious surfaces. Pixels with values in between are only partially covered with impervious surfaces.

According to Xian *et al.* (2011) most of the West Fowl River Watershed has a low percent imperviousness (**Figure 2.9**) and indicating that stream quality is sensitive (impervious cover is between 0 – 10%) as presented in **Figure 2.9**. The highest percentages of imperviousness are found near development, i.e., the major roadway/ transportation networks and Bayou Coden.

The most accurate way to calculate impervious surfaces is to digitize the surfaces using the most up-to-date aerial imagery available. The 2011 NLCD Percent Imperviousness dataset (Xian *et al.* 2011) relies on satellite imagery that use night-time light signatures to determine LULC. Investigations regarding the validity of this NLCD product has shown that the results tend to underestimate the percentage of IC. In the case of the West Fowl River Watershed, impervious areas are small due to the large-lot, residential type of land use.

2.2.12 Transportation

The transportation system within the West Fowl River Watershed consists of several common means of conveyance including: road and highway systems; railway systems; and waterway network systems. Common to most developing watersheds, locations for development and urbanization are closely linked to the location and type of transportation infrastructure. For the West Fowl River Watershed, development is predominately concentrated along the waterway network and the road and highway system, which are discussed in more detail in the following sections.

2.2.13 Roads

Highways greatly influence the location, type, and pattern of land use. Four roadways in particular have played a major role in influencing land use change within the Watershed: State Route 188 (also known as Alabama's Coastal Connection), State Route 193, Rock Road, and Bellingrath Road (**Figure 2.10**).

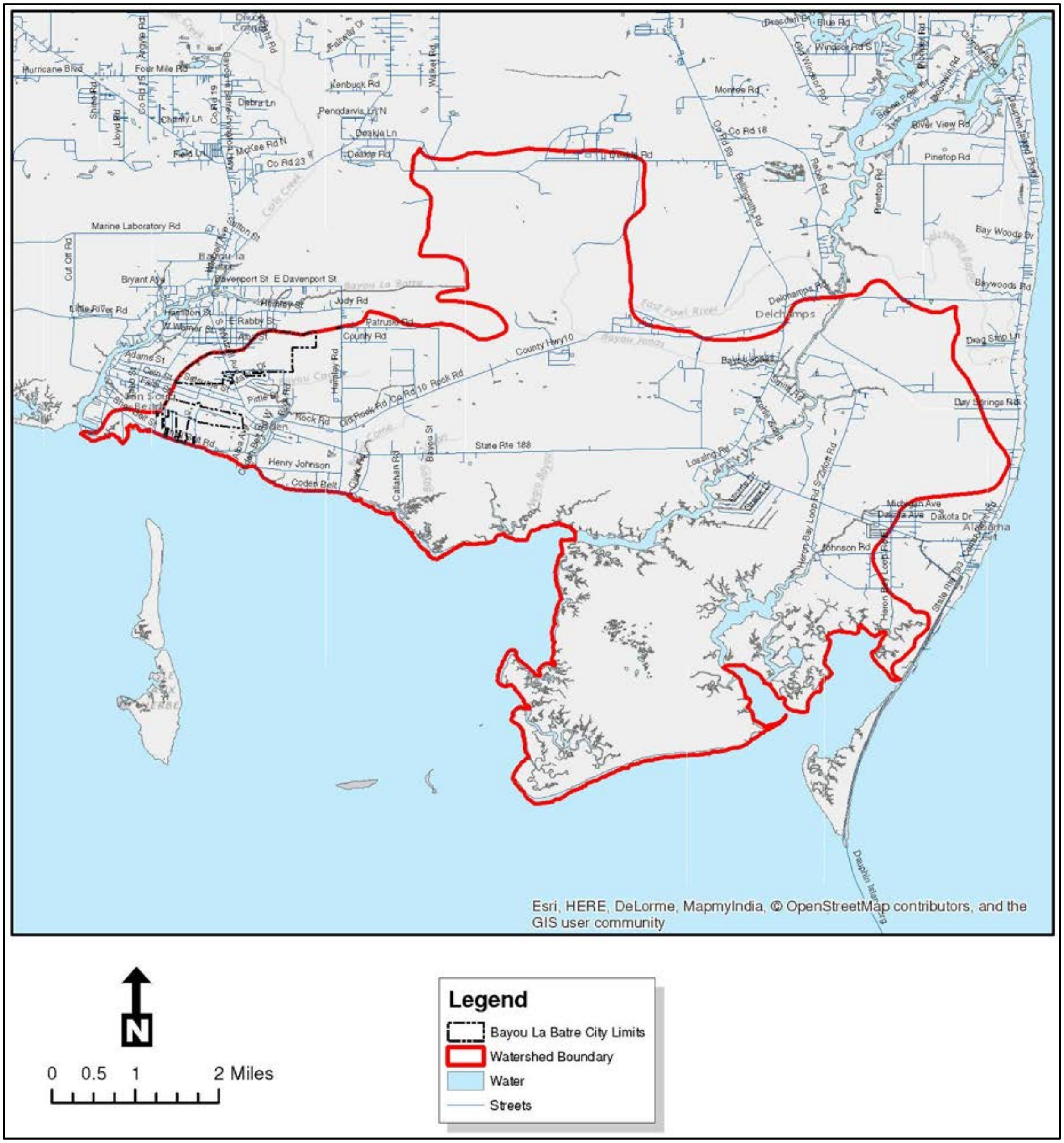


Figure 2.10 Transportation Networks in the West Fowl River Watershed

2.2.14 Navigation Channels, Ports, and Harbors

Bayou Coden is a tidally-influenced coastal waterbody and includes several boat building facilities and seafood operations, including numerous oyster houses and crab processing facilities. The USACE oversees the continued operations and maintenance activities of the federally-authorized channel within Bayou Coden (USACE 2014)

Authorization to maintain sufficient channel depths began in 1969 as authorized by the 1960 River and Harbor Act. Authorization allows for "*a channel 8 feet deep and 60 feet wide* *extending from La Belle Avenue Bridge south about 3,000 feet through the bayou to Portersville Bay, thence 8 feet deep by 100 feet wide extending about 2.3 miles westward across Portersville Bay to connect with the Bayou La Batre Channel, and a turning basin 8 feet deep by 60 feet wide by 100 feet long on the west side of the bayou channel about 500 feet south of La Belle Avenue Bridge*." The channel provides safe navigation by commercial and private vessels into Bayou Coden as well as the federally-authorized Bayou La Batre navigation channel to which the Bayou Coden channel runs perpendicular. Bayou Coden's channel location along the central Gulf Coast and proximity to the major ship channels of the open Gulf create a natural import/export terminal, particularly for delivery to and from the Caribbean and Central and South America (**Figure 2.11**) (USACE 2014).

Additionally, the "Narrows," a shallow meandering stream, was recently improved by the State of Alabama to provide a 6- by 40-foot canal, 6,000 feet long, connecting East and West Fowl Rivers (USACE 1972).

2.2.15 Political Institutions and Boundaries

Relevant authorities within the watershed include: Mobile County; the City of Bayou La Batre; the State of Alabama; and the United States Federal Government. However, the two main political entities exercising governmental authority within the West Fowl River Watershed are unincorporated Mobile County and the City of Bayou La Batre. Approximately 98% (20,078 acres) of the Watershed lies within unincorporated Mobile County. The remaining area within the Watershed, 2% (411 acres), is located within the municipal boundary of the City of Bayou La Batre.

The unincorporated areas of Mobile County within the Watershed are contained within Mobile County's Planning District No. 3 and include portions of several unincorporated communities, including: Alabama Port, Coden, Delchamps, Heron Bay, and Mon Louis.

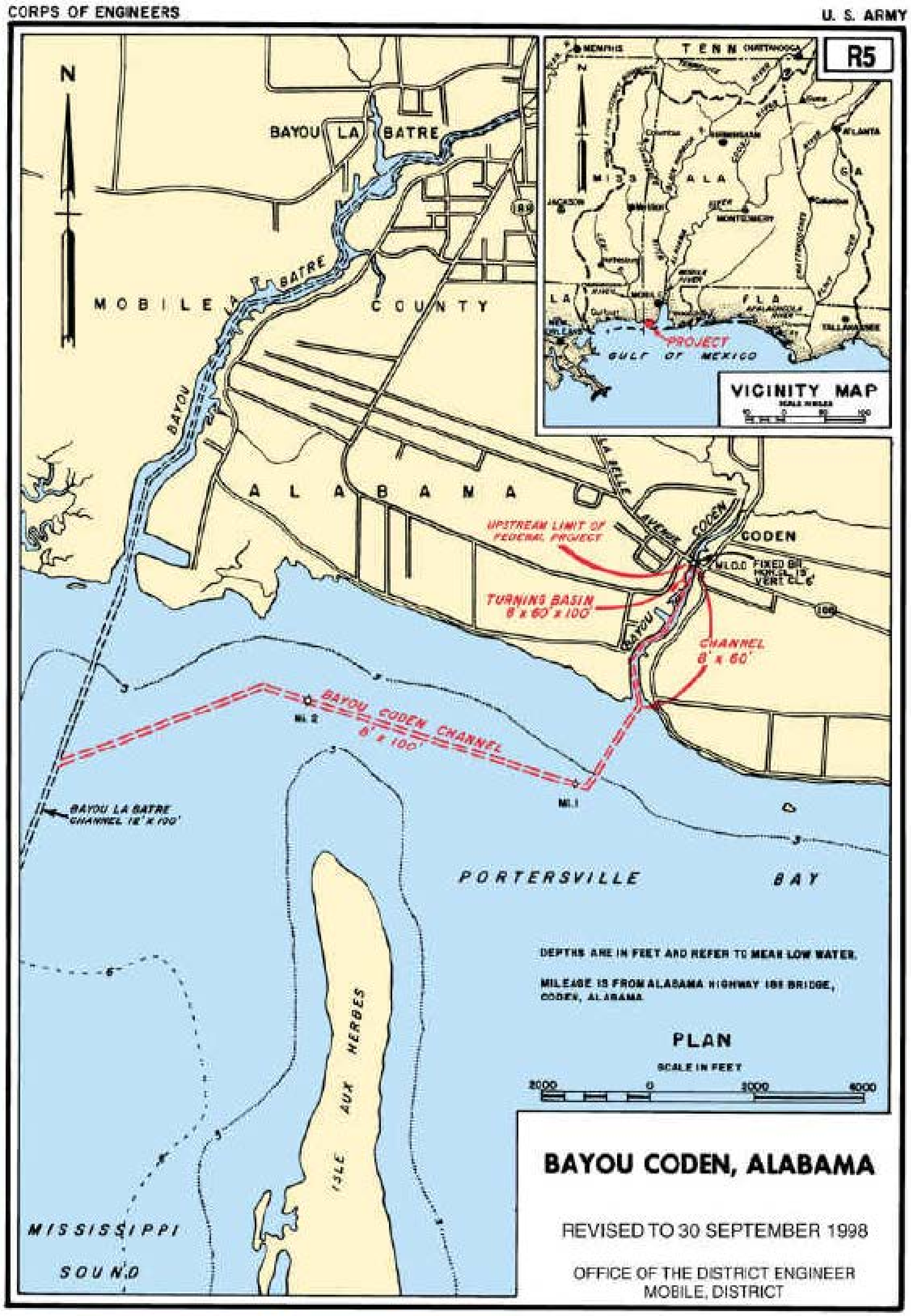


Figure 2.11 Bayou Coden Channel Dredging. Source: USACE 2014

2.2.16 Future Land Use

A future land-use data layer was created as part of a larger study that also included a review of historical land use (see **Section 2.2**) (Estes *et al.* 2012). The study involved the application of the Prescott Spatial Growth Model (PSGM), to the 2001 NLCD to predict future LULC for 2030 throughout Mobile Bay.

> "PSGM is an Arc geographic information system (GIS)-compatible application that allocates future growth into available land based on user-defined parameters. The purpose of the PSGM is to help users develop alternative future patterns of LULC based on socio-economic projections such as population, employment, and other controlling factors. When creating scenarios based on future development, the PSGM requires several inputs:
>
> > ***Developable land*** must be provided as an input grid that represents areas suitable for accepting future growth.
> >
> > ***Growth projections*** quantify the demand for land area to be developed for each time horizon for each LULC type. These projections are derived from socio-economic drivers using a PSGM utility that determines the growth for each urban LULC category (industrial, high-density residential, etc.).
> >
> > ***Suitability rules*** for location of future growth are specified using a PSGM table interface. When the PSGM runs, it allocates the new growth onto the developable land grid, in the order of most- to least-suitable land. The output of the PSGM is a series of growth grids, one for each time step and LULC type, showing the anticipated future growth pattern."

Estes *et al.* (2012) predicted future land needs for residential development by using census population data for the counties in the study area along with population projections available from 2005 to 2025 at five-year intervals. Future commercial land use was determined using employment data for the counties. Estes *et al.* (2012) also assumed current LULC trends would not change and that people would be drawn to development along shorelines without infringing upon wetland areas. The resulting demand for land did not exceed the amount of land suitable for development.

According to Estes *et al.* (2015), the West Fowl River Watershed, in addition to Bayou La Batre, Fish River, Fowl River, Dog River, and upper Chickasaw Watersheds, showed the largest change in LULC from agricultural/pasture rural environment to increasing urbanization by year 2030. This qualification is based on LULC change data from 1948 to 2001 and coupled demographic and urban growth models projecting and predicting urban land use to year 2030 for Mobile and Baldwin County (**Figure 2.12**). **Table 2.10** compares the results of 2030 projected LULC with historical LULC from 1974 and 2008 (see **Section 2.2**). Trends in future LULC indicate the continued decline in upland forests and the expansion of urbanization.

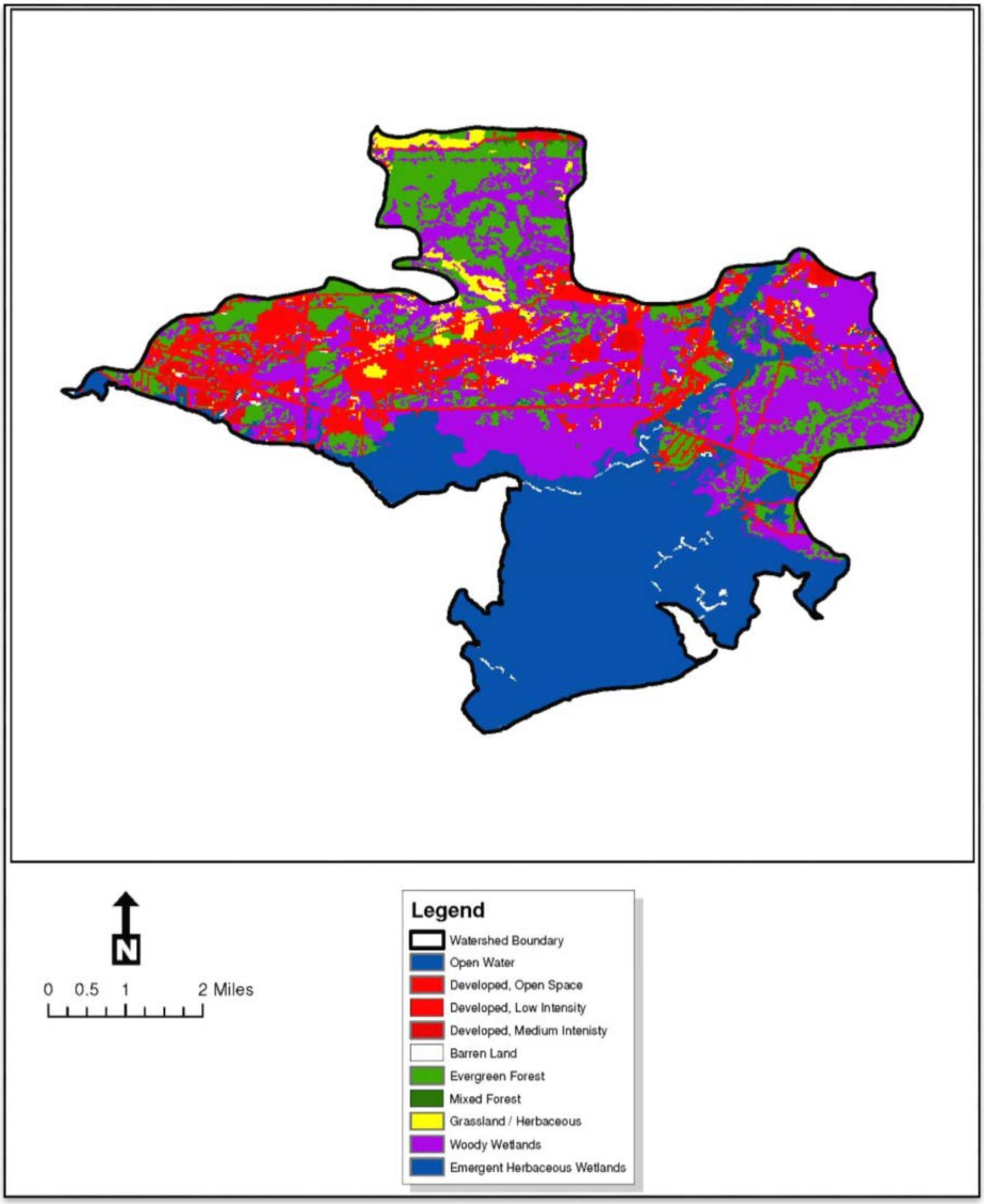


Figure 2.12 West Fowl River Watershed Predicted LULC for 2030 (Estes et al. 2015)

Table 2.10 Comparison of Future and Historical LULC in the West Fowl River Watershed (Spruce et al. 2009 and Estes et al. 2015)

	1974		2008		2030 Projection	
Class Name	**Total Area (Acres)**	**Percent %**	**Total Area (Acres)**	**Percent %**	**Total Area (Acres)**	**Percent %**
Open Water	243	1.19	169	0.87	95.18	0.49
Barren	155	0.76	92	0.48	108.75	0.55
Upland Herbaceous	1,104	5.39	6,637	34.17	6,384.97	32.65
Non-Woody Wetland	7,003	34.19	203	1.05	189.71	0.97
Upland Forest	2,703	13.20	6,347	32.68	5,527.39	28.27
Woody Wetland	7,968	38.90	3,705	19.08	3,952.21	20.21
Urban	1,305	6.37	2,268	11.68	3,296.47	16.86
Total	20,481	100	19,421	100	19,554.68	100

2.3 Demographic Characteristics

Demographic data specific to the West Fowl River Watershed are not available. Therefore, demographic distributions within the Watershed were determined by overlaying the Watershed boundary (see **Section 2.1**) on 219 Census Blocks and five Census Block Groups that cover the same geographical area. Census Blocks are the smallest geographical unit for which the United States Census Bureau (USCB) publishes demographic data; the next biggest spatial entity is Census Block Groups. There were five Census Block Groups that fall within the West Fowl River Watershed boundary. The demographic distributions were derived from an area-weighted average of the combined Census Blocks or Census Block Groups that comprise the Watershed area. The estimates provided in the following sections are for informational purposes only.

2.3.1 Population

The West Fowl River Watershed encompasses unincorporated areas of Mobile County (Alabama Port, Bayou Coden, Delchamps, Heron Bay, and Mon Louis) and a small portion within the jurisdictional boundary of the City of Bayou La Batre. The total area-weighted population estimate from the 2010 Census Block redistricting data for the West Fowl River Watershed was 2,154 people (USCB 2010).

The Watershed has many multi-ethnic populations. According to estimates obtained from the 2010 Census redistricting data (USCB 2010), the ethnic distribution of people located within the Watershed boundary is approximately 86% White; 5% African American; 5% Asian; 0.1% Hawaiian and Pacific Islander; 0.2% American Indian and Alaska Native, and 2% Other (**Figure 2.13**).

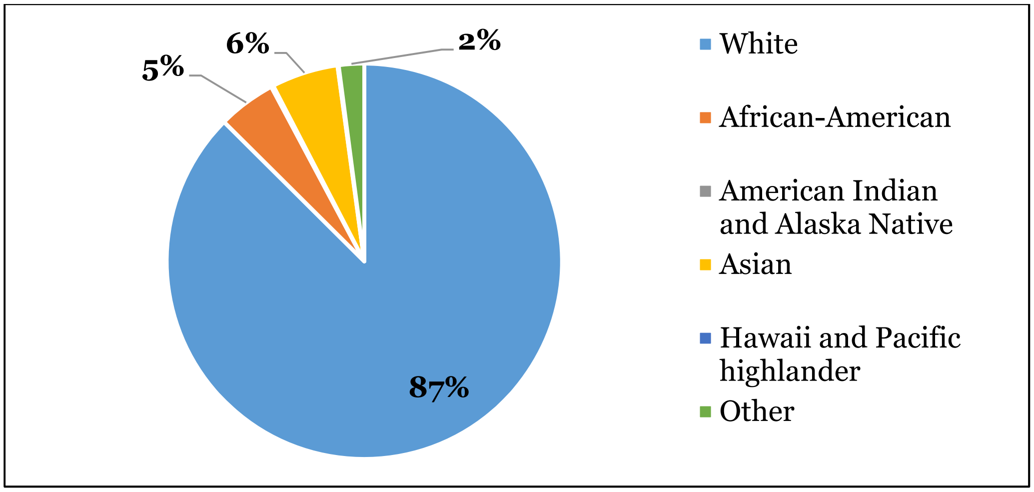


Figure 2.13 Ethic Groups Located within the West Fowl River Watershed

For comparison purposes, the estimated ethnic distributions of Mobile County are 74% White; 12% African American; 12% Asian; and 2% other (see **Figure 2.14**)

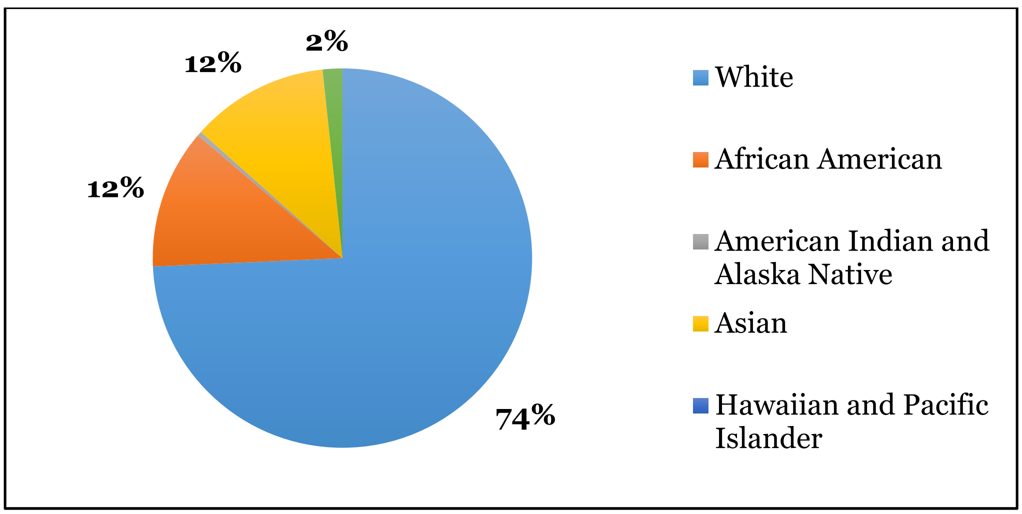


Figure 2.14 Estimated Ethic Distributions of Mobile County

The total area-weighted population does not exactly match the total area-weighted population by race; this is a function of the limitations of the area-weighted technique used to estimate information provided from the 2010 Census redistricting data.

2.3.2 Economics

Household income data for the Watershed were summarized as area-weighted estimates from information provided in the American Community Survey (ACS) five-year, 2013 data (ACS 2013). The data were provided on the Census Block Group level that are large geographies, not recommended for area-weighted estimates. These estimates are for informational purposes only.

The median household income for the West Fowl River Watershed is approximately $40,000 to $44,999 (**Table 2.11 and Table 2.12**).

Table 2.11 Household Income Data from Census Block Groups Intersecting West Fowl River Watershed

Number of Households with Income ($ x 1000)															
Less than $10	$10 to $15	$15 to $20	$20 to $25	$25 to $30	$30 to $35	$35 to $40	$40 to $45	$45 to $50	$50 to $60	$60 to $75	$75 to $100	$100 to $125	$125 to $150	$150 to $200	$200 or more
161	122	110	68	58	69	117	105	15	160	217	163	143	38	40	4

Table 2.12 Household Income Data by Percentages from Census Block Groups Intersection West Fowl River Watershed

Number of Households with Income ($ x 1000)															
Less than $10	$10 to $15	$15 to $20	$20 to $25	$25 to $30	$30 to $35	$35 to $40	$40 to $45	$45 to $50	$50 to $60	$60 to $75	$75 to $100	$100 to $125	$125 to $150	$150 to $200	$200 or more
10%	8%	7%	4%	4%	4%	7%	7%	1%	10%	14%	10%	9%	2%	3%	0%

2.3.3 Languages

The West Fowl River Watershed has many multi-ethnic populations. Within the Watershed, the most common household languages include: English only 56%; Spanish 28%; Asian 8%; Indo-European 7%; and Other 1% (see **Figure 2.15**) (ACS 2013).

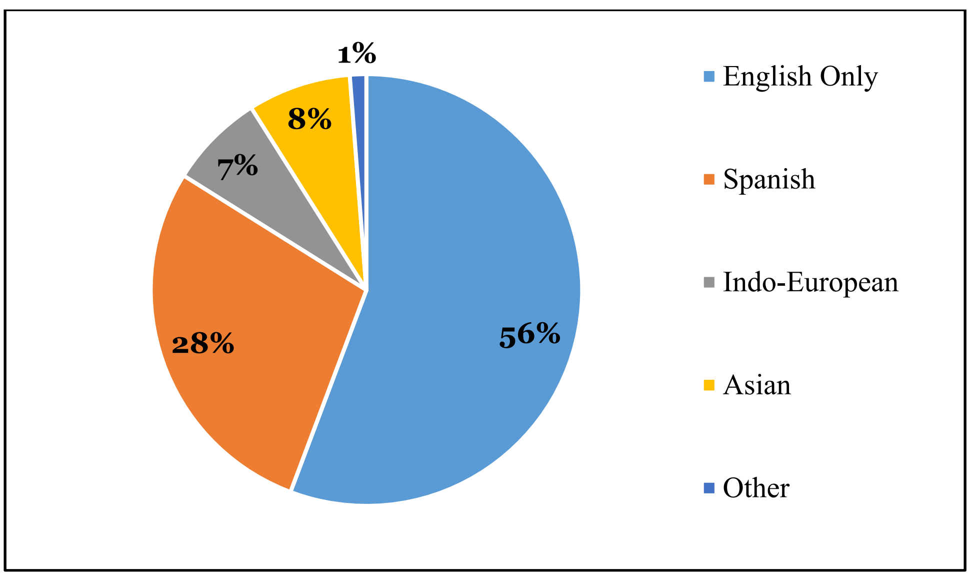


Figure 2.15 Spoken Languages within the West Fowl River Watershed

Spoken languages for the population are given in **Table 2.13** for the West Fowl River Watershed. Data were summarized as area-weighted estimates from information provided in the

American Community Survey five-year, 2013 data (ACS 2013). The data were provided on the Census Block Group level that are large geographies, not recommended for area-weighted estimates. These estimates are for informational purposes only.

Table 2.13 Number of Households Spoken Language Statistics for all Census Block Groups intersecting the West Fowl River Watershed

Languages (Number of Households Speaking)				
English Only	Spanish	Indian-European	Asian	Other
180	91	23	25	4

2.3.4 Education

According to area-weighted estimates of Educational Attainment information provided in the 2013 American Community Survey (ACS) from the Census Block Groups within the West Fowl River Watershed of people aged 25 and above, approximately 15% of people attained only a High School Diploma; 19% a GED or equivalent; 21% an Associate Degree; 34% a Bachelor's Degree; 7% a Master's Degree; 2% a Professional School Degree; and 2% a Doctorate Degree. (**Table 2.14** and **Figure 2.16**), (ACS 2013).

Table 2.14 Education Attainment Statistics for the West Fowl River Watershed

Education Attainment (Number of People)						
High School Diploma	GED or Equivalent	Associate Degree	Bachelor Degree	Master Degree	Professional School Degree	Doctorate Degree
128	157	170	281	56	19	15

Education data are not included for people who did not complete high school or people who dropped out of college. Data were summarized as area-weighted estimates from information provided in the American Community Survey (ACS) five-year, 2013 data. Data were provided on the Census Block Group level that are large geographies, not recommended for area-weighted estimates. These estimates are for informational purposes only.

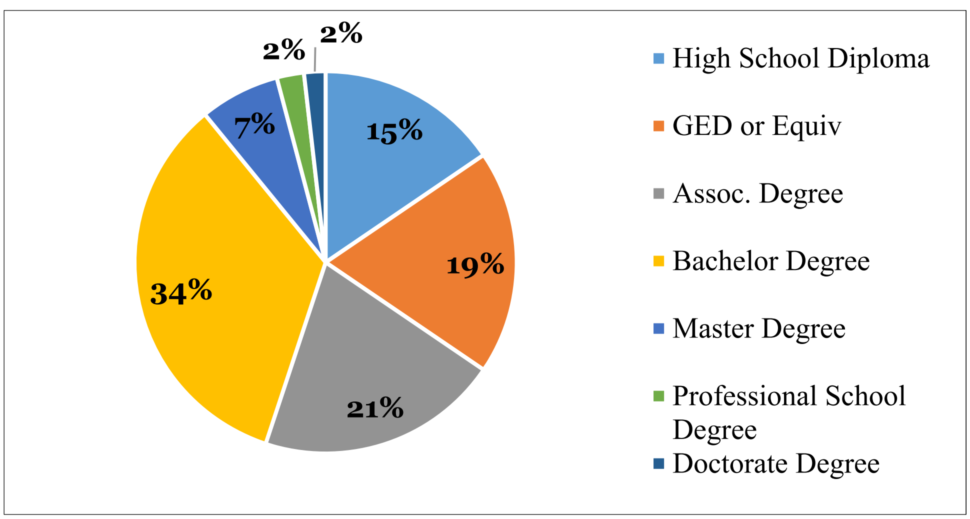


Figure 2.16 Education Attainment by Percentages for the West Fowl River Watershed

3 Watershed Conditions

This section presents a narrative summary of existing watershed conditions in the West Fowl River Watershed from the review of previously collected data and findings as well as field sampling results gathered by the Dewberry team and others. The West Fowl River Watershed is comprised of a dominant tributary, the West Fowl River that discharges to Fowl River Bay, which is a subset of Portersville Bay, and two additional tributaries; Bayou Coden and Bayou Heron.

3.1 Existing Water Quality

Understanding the distinction between freshwater and tidal influences is important to the characterization of existing water quality conditions in the Watershed. This distinction provides the foundation for the physical and chemical characteristics and anticipated responses to inputs. There are two reasons these distinctions are important. First, the chemistry and biology of freshwater streams and rivers are very different from those of tidal estuaries. Accordingly, the ecosystem functions and services provided by rivers and estuaries are also distinctly different. However, there is also an intimate relationship between the freshwater and tidal portions of a water body in that quality, quantity, and timing freshwater deliveries essentially determines the overall health of the estuary. Secondly, regulatory guidance concentrations and standards differ between freshwater and tidal segments for many water quality parameters. Therefore, in relating existing data to various measures of water quality, the applicable criteria are different in most cases. In the West Fowl River Watershed, the tidal influence, inferred by salinity values, is found throughout the full extent of the West Fowl River, from station WFR1 to WFR5 (**Figure 3.1**). Similarly, Bayou Coden and Bayou Heron exhibit a range of salinities that indicate that their water quality reflects tidal influences.

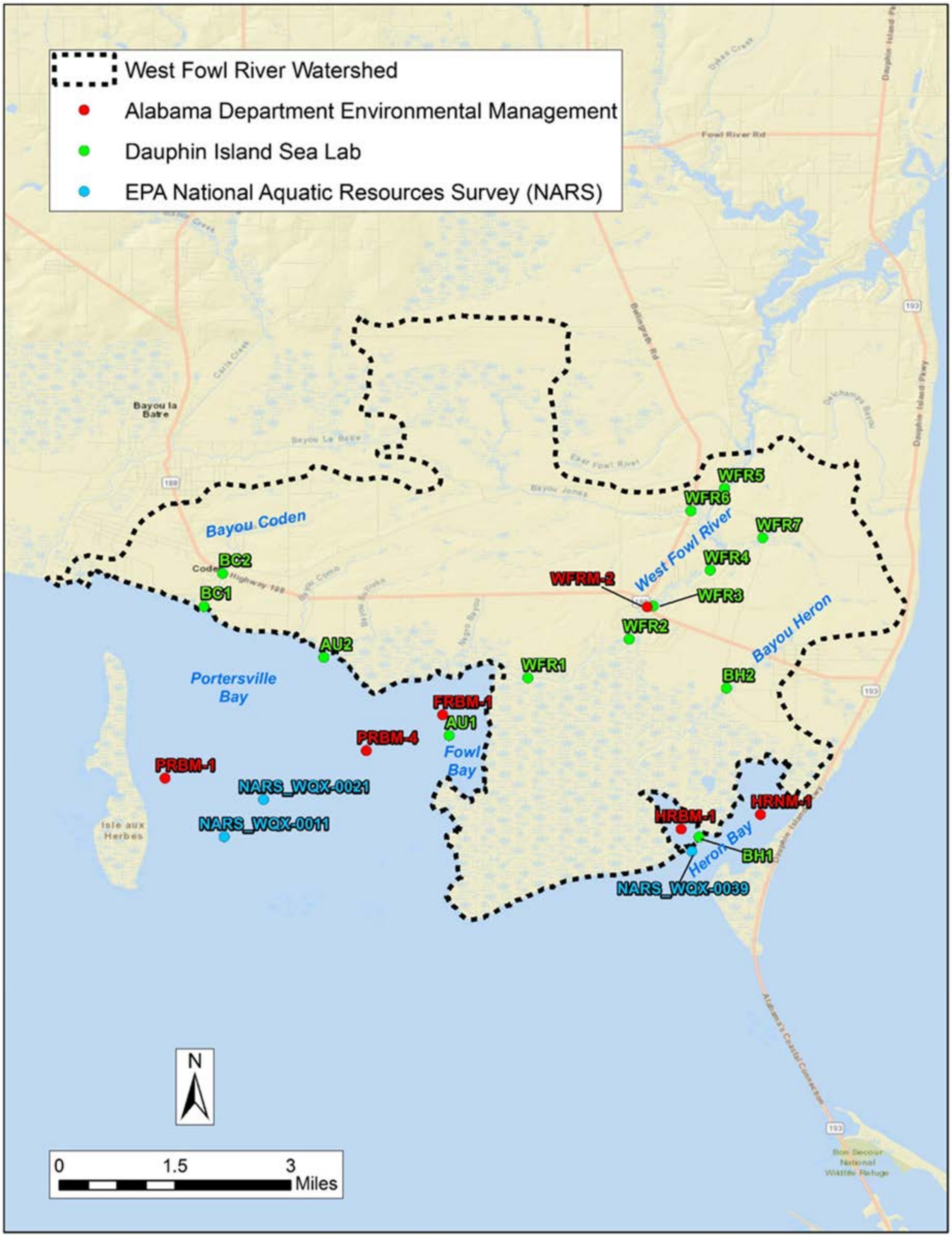


Figure 3.1 Location of water quality sampling stations in the West Fowl River Watershed and Receiving Waters

Characterization of existing water quality can be broken down into the general classes of water quality parameters. These include the following:

- **Physicochemical parameters** - these are measures of the general physical and chemical properties of a water body related to water column mixing and density stratification, in estuaries, including:
    - Temperature
    - Salinity
- **Geochemical parameters** – these are measures of geological inputs into a water body that affect water clarity and sedimentation, including:
    - Total suspended solids
    - Turbidity
    - Specific conductance
    - pH
- **Trophic parameters** – these are measures of primary production and levels of nutrients that can influence primary production, such as: Chlorophyll-a
    - Dissolved oxygen
    - Nitrogen – both total and inorganic
    - Phosphorus - both total and inorganic
- **Pathogens** – these are bacterial constituents that are used as indicators of more noxious human pathogens associated with animal waste products (e.g., viruses, disease causing bacteria), including:
    - Fecal coliform
    - Enterococci
- **Contaminants** – these are chemical constituents that are potentially toxic to aquatic organisms and humans, including:
    - Heavy metals
    - Organics.

The water quality parameters listed above are measures and/or indicators of different characteristics of the waterbody. The cumulative assessment of these parameters can be used to determine the overall water quality of a particular water body with regard to its designated uses. In the sections that follow, water quality in the West Fowl River Watershed is characterized with regard to the various classes of water quality parameters.

3.1.1 Data Sources

Determination of water quality conditions was based on the following data sources:

- **Dauphin Island Sea Lab (DISL)** – data collected specifically to support the development of the West Fowl River Watershed Management Plan
    - Physicochemical and trophic data collection in the West Fowl River, Bayou Coden, Bayou Heron and associated receiving waters during the period 2016-2017

- **Alabama Department of Public Health (ADPH)** – Staff from ADPH provided a detailed pathogen data set for Fowl River Bay for the years of 2009 up to July of 2018
- **Alabama Department of Environmental Management (ADEM)** – programmatic ambient monitoring and assessment data
  - Physicochemical, trophic, pathogen, and contaminant data collection in the West Fowl River Watershed during the period 2000-2017

Table 3.1 provides a summary of the programmatic data collected by ADEM in the West Fowl River Watershed. **Figure 3.2** provides the spatial distribution and sampling entity for the surface water quality monitoring stations evaluated as part of this plan.

Table 3.1 Summary of data collection in the West Fowl River Watershed

Source	System	Station ID	First Sampling Date	Last Sampling Date
DISL	Bayou Coden	BC1	22-Nov-16	23-Jun-17
DISL	Bayou Coden	BC2	22-Nov-16	23-Jun-17
DISL	Bayou Heron	BH1	22-Nov-16	23-Jun-17
DISL	Bayou Heron	BH2	22-Nov-16	23-Jun-17
ADEM	Heron Bay	HRNM-1	12-Apr-11	14-Oct-15
ADEM	Heron Bay	HRBM-1	12-Apr-11	14-Oct-15
NARS	Heron Bay	NARS_WQX-0039	13-Jul-00	9-Jul-04
ADEM	Portersville Bay	PRBM-1	11-Apr-12	6-Nov-12
ADEM	Portersville Bay	PRBM-4	11-Apr-12	6-Nov-12
DISL	Portersville Bay	AU1	22-Nov-16	23-Jun-17
DISL	Portersville Bay	AU2	22-Nov-16	23-Jun-17
NARS	Portersville Bay	NARS_WQX-0021	5-Jul-00	11-Jul-06
ADEM	West Fowl River	FLR-5	15-Mar-06	28-Mar-06
ADEM	West Fowl River	WFRM-2	9-Apr-13	9-Oct-13
DISL	West Fowl River	WFR1	22-Nov-16	23-Jun-17
DISL	West Fowl River	WFR2	22-Nov-16	23-Jun-17
DISL	West Fowl River	WFR3	22-Nov-16	23-Jun-17
DISL	West Fowl River	WFR4	22-Nov-16	23-Jun-17
DISL	West Fowl River	WFR5	22-Nov-16	23-Jun-17
DISL	West Fowl River	WFR6	22-Nov-16	23-Jun-17
DISL	West Fowl River	WFR7	22-Nov-16	23-Jun-17

3.1.2 Water Quality Classification

Code of Alabama Section 335-6-11 establishes the designated use classification system for Alabama surface waters. There are seven basic classifications including:

1. Outstanding Alabama Water
2. Public Water Supply
3. Swimming and Other Whole Body

4. Water-Contact Sports
5. Shellfish Harvesting
6. Fish and Wildlife
7. Limited Warmwater Fishery
8. Agricultural and Industrial Water Supply

In addition to these classifications, there are two additional special designations: Outstanding National Resource Waters and Treasured Alabama Lakes. Designated use classifications essentially define the existing and/or intended use of a particular water body. Code of Alabama Section 335-6-10 defines the water quality criteria that correspond with specific designated uses. These criteria establish water quality standards and other measures developed to protect designated uses of each waterbody.

The West Fowl River Watershed is separated into two segments, West Fowl River (which includes Bayou Heron) and Bayou Coden. All surface waters in the greater West Fowl River Watershed have a default water use designation of Fish and Wildlife (F&W). However, the West Fowl River segment is also designated for Swimming and Other Whole Body Water-Contact Sports.

3.1.3 Clean Water Act (CWA) Section 303(d) and Total Maximum Daily Loads (TMDLs)

Under Section 303(d) of the Federal Clean Water Act 9 (CWA), waterbodies that are determined to not meet water quality criteria for their respective designated uses are required to be listed as “impaired waters”. Section 303(d) of the CWA requires states to submit a list of surface waters that do not meet applicable water quality standards (impaired waters) where implementation of technology-based effluent limitations alone did not ensure attainment of applicable water quality standards. The 303(d) list is submitted to the U.S. Environmental Protection Agency (EPA) for approval after an opportunity for public comment. The list includes the causes and sources of water quality impairment for each waterbody listed and a schedule for development of total maximum daily loads (TMDLs) for each pollutant-causing impairment identified (ADEM, 2017a).

TMDLs determine the amount of each pollutant causing water quality impairments that can be allowed without resulting in exceedances of prescribed water quality standards for the waterbody. A TMDL is the sum of the allowable loads of a single pollutant from every contributing point and nonpoint source, including a margin of safety to account for uncertainty. TMDLs also address reductions needed to meet water quality standards and allocate those reductions among the point and non-point sources in a watershed. Therefore, development of TMDLs is an important step in restoring surface waters to their designated uses.
ADEM is responsible for the implementation of the Section 303(d) program in Alabama (ADEM, 2017b). A review of the 303(d) lists as provided by ADEM over the period of 1998 to 2018, neither segment have been identified as impaired and no TMDLs have been developed for this watershed.

3.2 Water Quality Assessment of the West Fowl River Watershed

A feature common to all estuaries is the mixing of freshwater from the watershed with salt water. Within the physical boundaries of an estuary this mixing is often uneven due to density differences between fresh and salt water. As a result, virtually all estuaries exhibit density stratification to some extent, where denser saltier water flows upstream along the bottom, while freshwater flows downstream along the surface. This stratification is normally not a problem. However, if there is too much bacterial respiration occurring in the bottom layer or in bay sediments due to excessive organic production (e.g., algae blooms), stratification can result in dissolved oxygen deficits which in turn can adversely impact living resources such as fish and shellfish.

Data collected by ADEM as part of their long-term monitoring program indicates that West Fowl River does not exhibit density stratification within the reaches encompassed within the Watershed boundaries, and that there is no evidence of dissolved oxygen deficits due to stratifications and excessive respiration in bottom waters or sediments. However, excessive production of organic material can also be problematic in terms of the ability of algal blooms to reduce water clarity, or for nutrient-stimulated algal overgrowth of desired organisms such as oysters. Estuarine algal production, including the potential for excessive algal production, is in turn often a function of nutrients delivered to an estuary from its watershed.

Nutrients and Phytoplankton

A review of available data was conducted, including data uploaded to STORET from state agencies, as well as water quality data collected by staff from the Dauphin Island Sea Lab. The examined data set included stations located in Bayou Coden, the West Fowl River, Portersville Bay, and Bayou Heron. Although Portersville Bay is the receiving water, and not located within the watershed boundaries, activities such as oyster farming are conducted in the coastal waters and the Watershed Team determined extending their water quality analysis to coastal waters was an important part of this study. To allow for statistical testing of potential relationships between the various parameters examined, only locations where at least 30 samples were collected were considered for further analysis. This did not mean that each parameter examined had at least 30 samples, but that at least one parameter had been sampled at least 30 times. This *a priori* requirement reduced our analyses to those stations located in the West Fowl River, Portersville Bay, and Heron Bay systems.

A summary of water quality data from the West Fowl River system is shown in **Table 3.2**.

Table 3.2 Summary of water quality data from West Fowl River. Period of record for displayed data is from April 2013 to June 2017

	Parameter							
	Salinity (psu)	Fecal Coliform Bacteria (cfu/100 ml)	Enterococci Bacteria (#/100 ml)	Chlorophyll -a (µg/L)	*TN (mg/L)	*TP (mg/L)	Secchi Disk Depth (m)	*DO (mg/ L)
Count	49	-	11	53	54	11	60	49
Minimum	0.01	-	6.00	0.03	0.27	0.04	0.20	3.86
Maximum	31.40	-	70.00	19.91	1.25	0.08	1.10	9.72
Mean	10.62	-	28.36	2.28	0.62	0.05	0.68	6.86
Std Dev	9.09	-	21.89	3.33	0.20	0.01	0.23	1.56
Median	7.00	-	20.00	0.91	0.60	0.04	0.70	7.00

*TN = Total Nigrogen, TP = Total Phosphorous, and DO = Dissolved Oxygen

In the West Fowl River, the salinity ranged between freshwater (i.e., 0.01 psu) to nearly full-strength seawater (31.4 psu). The mean salinity of 10.62 psu was nearly matched by a standard deviation of 9.0 psu, indicating that salinity is highly variable in West Fowl River. The median salinity value indicates that roughly, half the time salinities are higher than 7.00 psu, and half the time they are lower than 7.00 psu. Levels of phytoplankton do not appear to be excessive in the River, as the maximum value recorded (out of 53 samples) was 19.9 µg / liter, a value not considered excessively high for most estuarine locations. Mean and median chlorophyll-a values of 2.28 and 0.91 µg / liter, respectively, suggest that eutrophication is not a current concern for West Fowl River. Levels of dissolved oxygen only rarely fell below the ADEM standard of 5 mg / liter, with mean and median values approximating 6.86 mg / liter.

In addition to comparing values against existing criteria, the data from West Fowl River were compared against each other, to determine if water quality parameters indicated relationships that could indicate management actions would be appropriate. When chlorophyll-a values are compared against salinity, it appears that the highest chlorophyll-a values co-occur with salinity values of 5 to 15 psu (**Figure 3.2**).

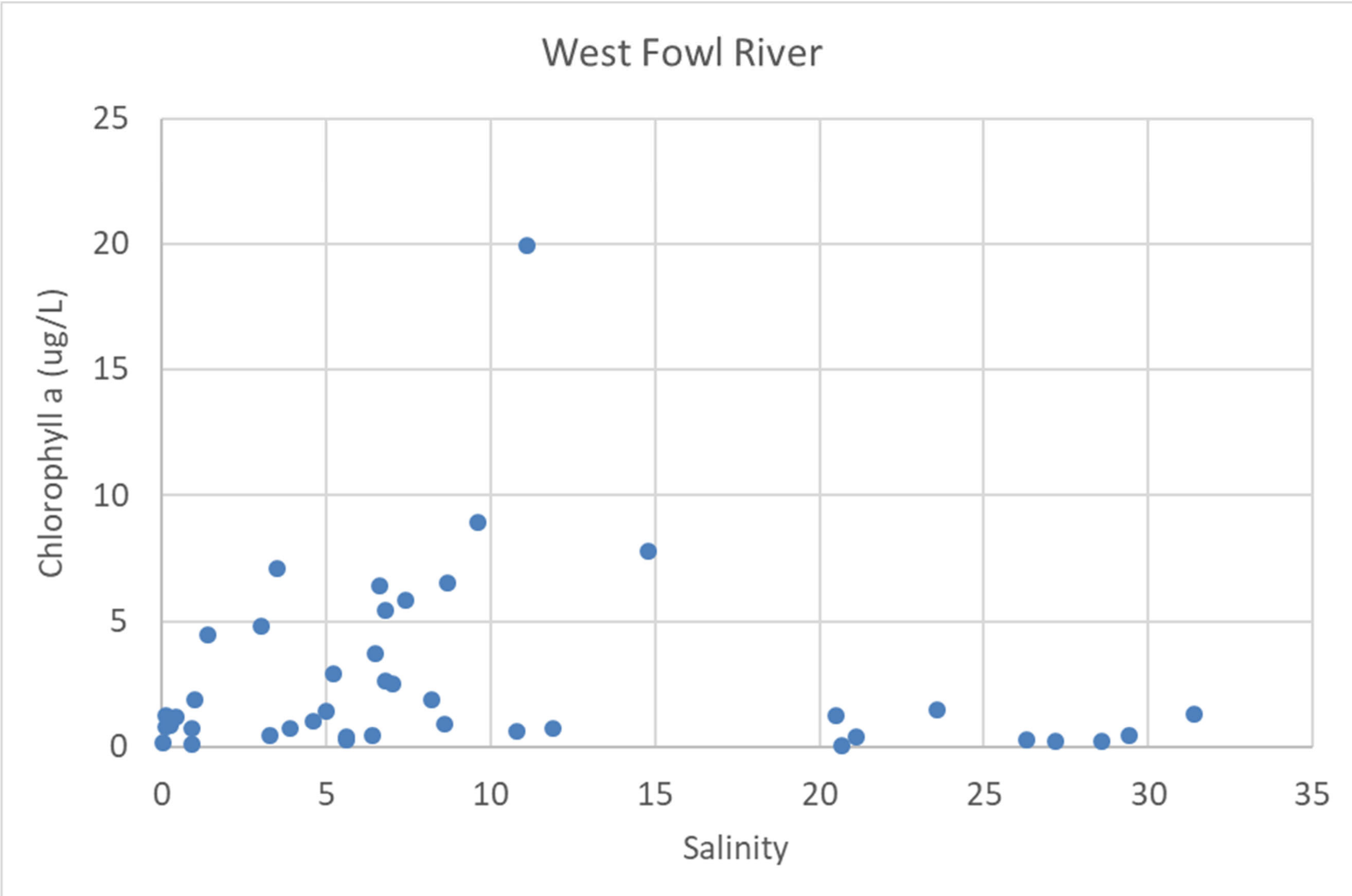


Figure 3.2 Chlorophyll-a (µg / liter) vs. salinity (psu) in the West Fowl River system

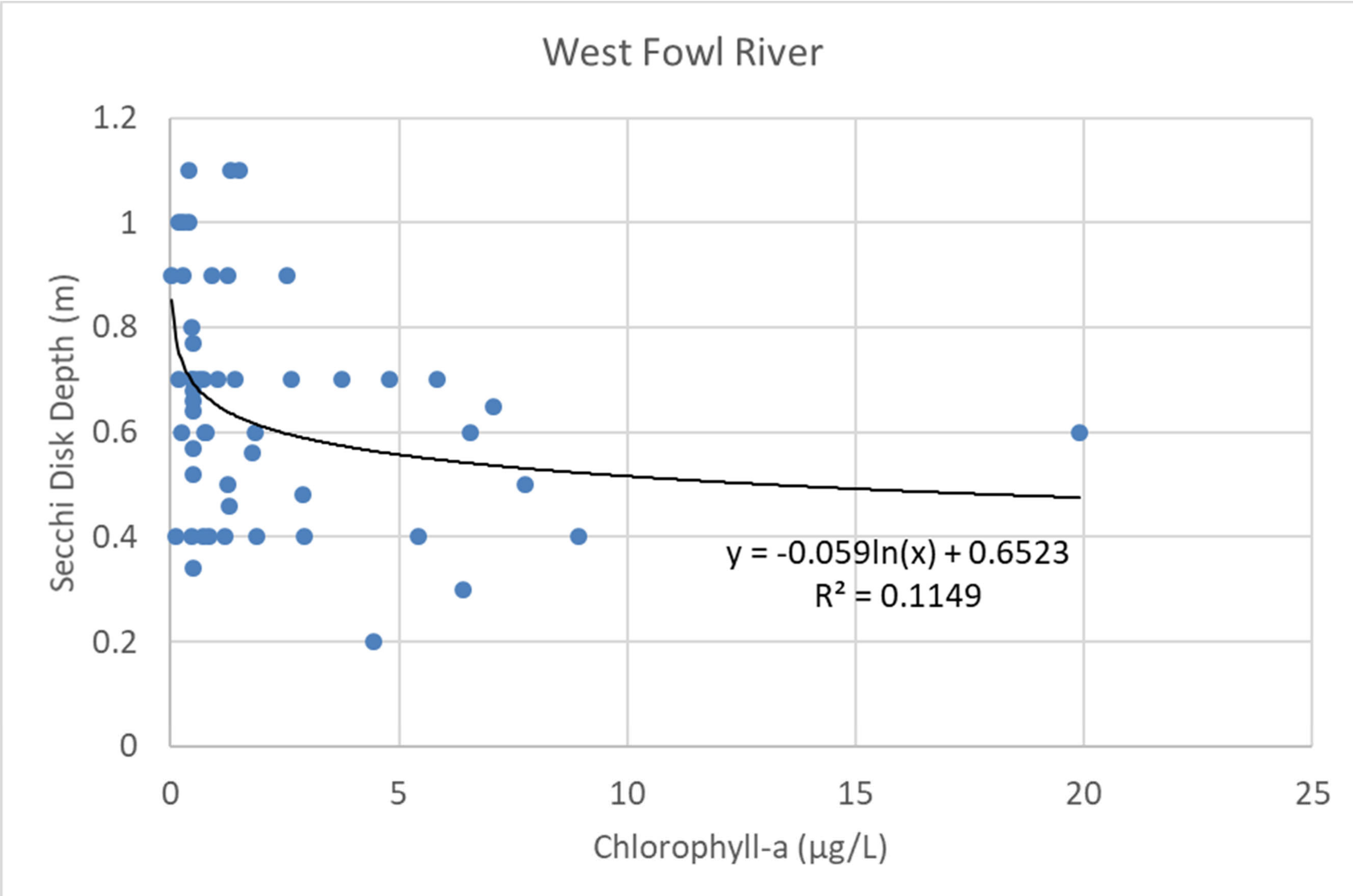


Figure 3.3 Secchi disk depth (m) vs. Chlorophyll-a (µg / liter) in the West Fowl River system

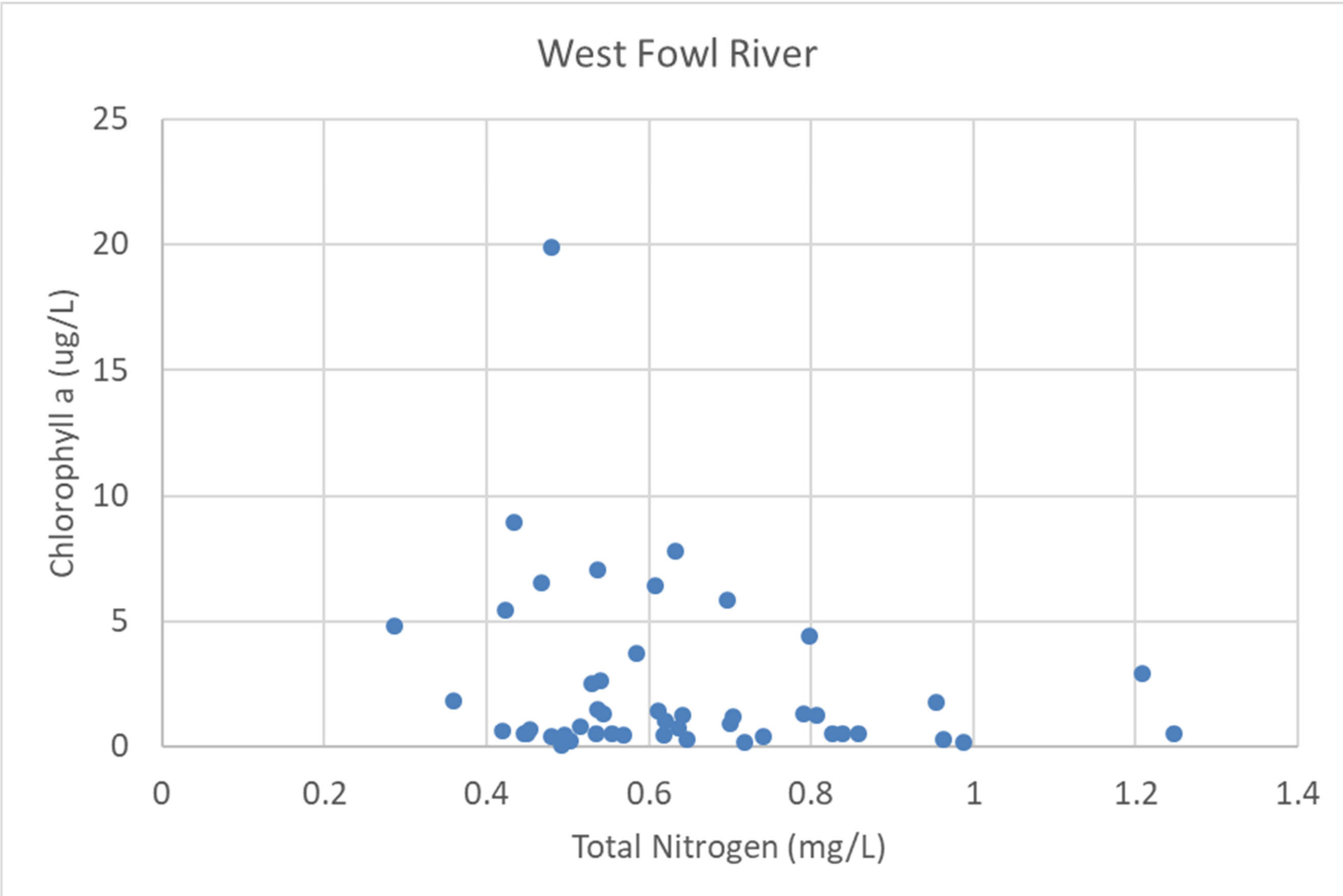


Figure 3.4 Chlorophyll-a (μg / liter) vs. Total Nitrogen (mg / liter) in the West Fowl River system

At salinities higher than 15 psu, chlorophyll-a values remain well below 5 µg / liter, which could reflect lower residence times in higher salinity waters located farther from the shore. Water clarity, measured as Secchi disk depths, was inversely correlated with chlorophyll-a concentrations (**Figure 3.3**). Although the relationship had a weak predictive capacity, as evidenced by the low r-squared value, it was statistically significant ($p < 0.05$).

Nitrogen did not correlate with concentrations of chlorophyll-a (**Figure 3.4**) and there was an insufficient amount of data on total phosphorus (i.e., < 30 samples) to determine if phosphorus might be limiting phytoplankton production in the West Fowl River.

A summary of water quality data from Portersville Bay is shown in **Table 3.3**.

Table 3.3 Summary of water quality data from Portersville Bay. Period of record for displayed data is from July 2000 to June 2017

	Parameter							
	Salinity (psu)	**Fecal Coliform Bacteria (cfu/100 ml)**	**Enterococci Bacteria (#/100 ml)**	**Chlorophyll-a (µg/L)**	**TN (mg/L)**	**TP (mg/L)**	**Secchi Disk Depth (m)**	**DO (mg/L)**
Count	14	33	37	53	49	35	48	2
Minimum	1.20	1.00	2.00	0.11	0.03	0.017	0.20	6.08
Maximum	26.70	10.00	60.00	20.40	1.71	0.090	1.10	6.47
Mean	11.61	2.09	6.59	3.86	0.72	0.062	0.51	6.27
Std Dev	8.23	1.77	9.83	4.24	0.03	0.019	0.20	0.27
Median	8.70	2.00	2.00	2.30	0.65	0.061	0.46	6.27

In Portersville Bay, the salinity ranged between 1.2 and 26.7 psu. As the West Fowl River, the mean salinity of 11.61 psu was nearly matched by a standard deviation of 8.23 psu, indicating that salinity in Portersville Bay is similarly variable as in the West Fowl River. The median salinity value indicates that roughly half the time salinities are higher than 8.70 psu, and half the time they are lower than 8.70 psu.

Levels of phytoplankton do not appear to be excessive in Portersville Bay, as the maximum value recorded (out of 53 samples) was 20.4 µg / liter, a value not much higher than the maximum value found in the West Fowl River, and a concentration no considered excessively high for most estuarine locations. Mean and median chlorophyll-a values of 3.86 and 2.30 µg / liter, respectively, suggest that eutrophication is not a current concern for Portersville Bay.
Levels of dissolved oxygen cannot be accurately characterized in Portersville Bay due to the very small sample size (n = 2).

Water quality data from Portersville Bay were compared against each other, to determine if water quality parameters indicated relationships that might suggest management actions would be appropriate. Insufficient data prevented an assessment of the relationship between chlorophyll-a and salinity.

Water clarity, measured as Secchi disk depths, was inversely correlated with chlorophyll-a concentrations in Portersville Bay (**Figure 3.5**; $p < 0.05$). Although the relationship had a weak predictive capacity, as evidenced by the low r-squared value.

As in the West Fowl River, there was no correlation between Total Nitrogen and chlorophyll-a (**Figure 3.6**) or between Total Phosphorus and chlorophyll-a (**Figure 3.7**).

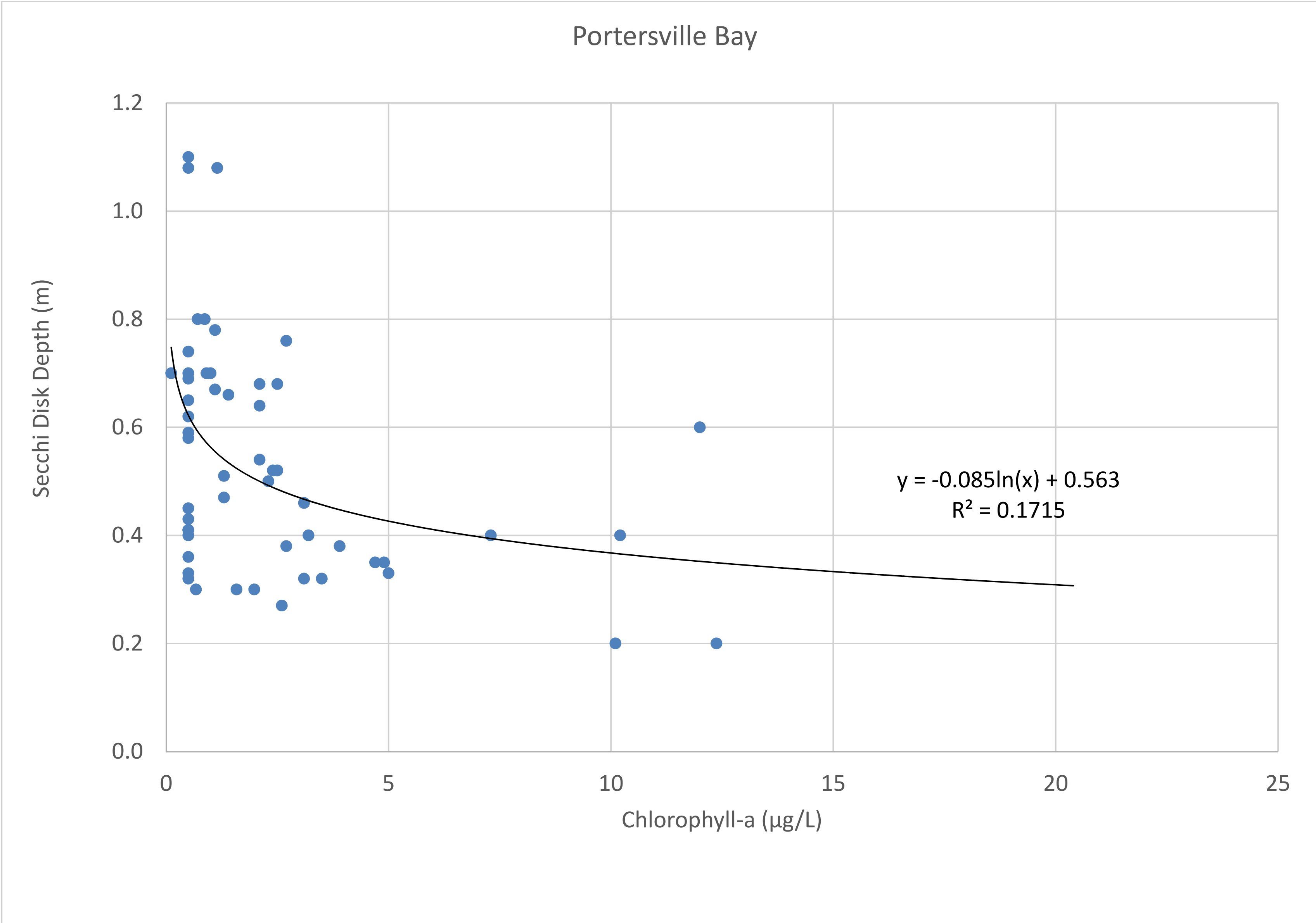


Figure 3.5 Secchi disk depth (m) vs. Chlorophyll-a (µg / liter) in Portersville Bay

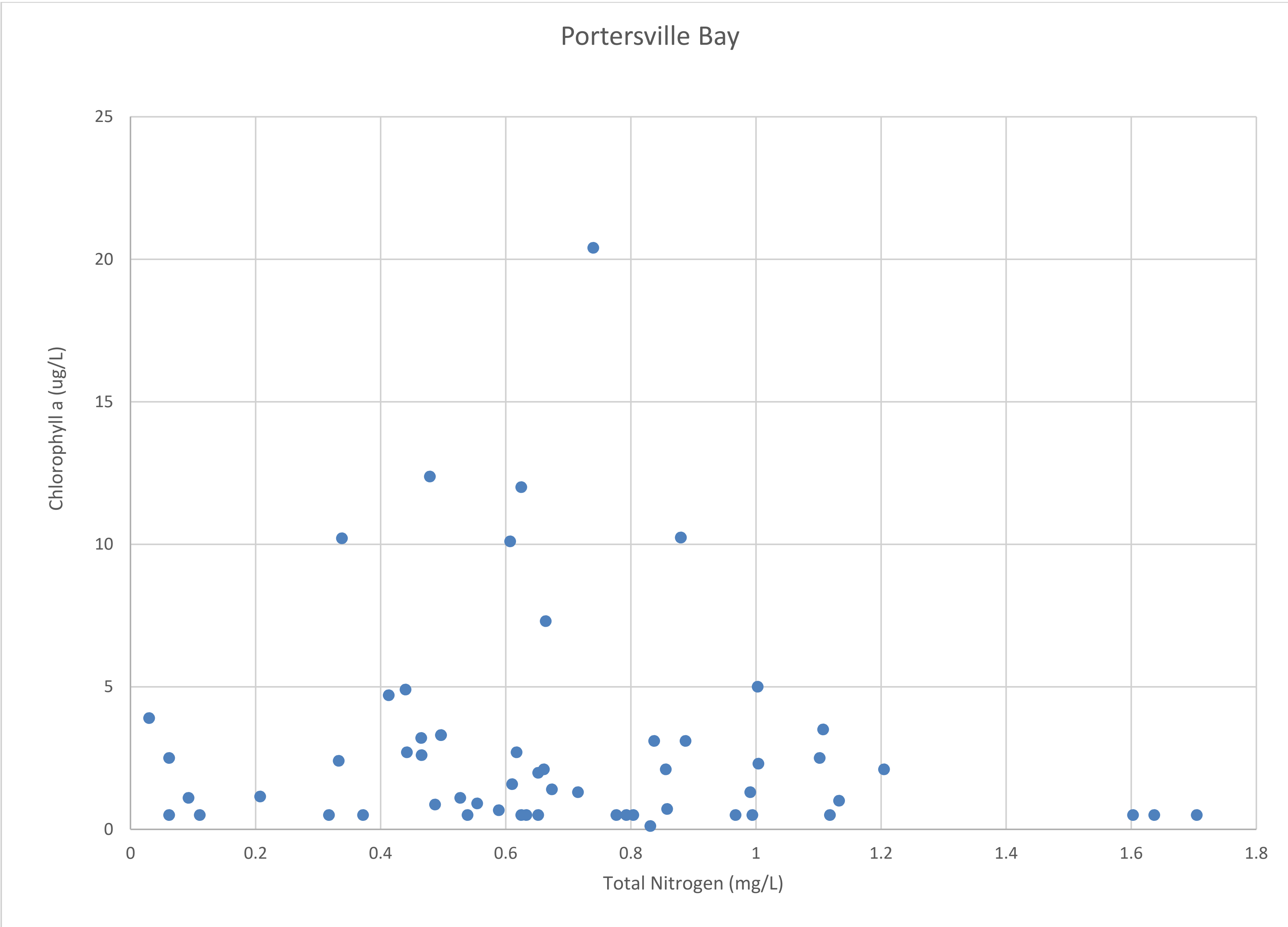


Figure 3.6 Chlorophyll-a (µg / liter) vs. Total Nitrogen (mg / liter) in Portersville Bay

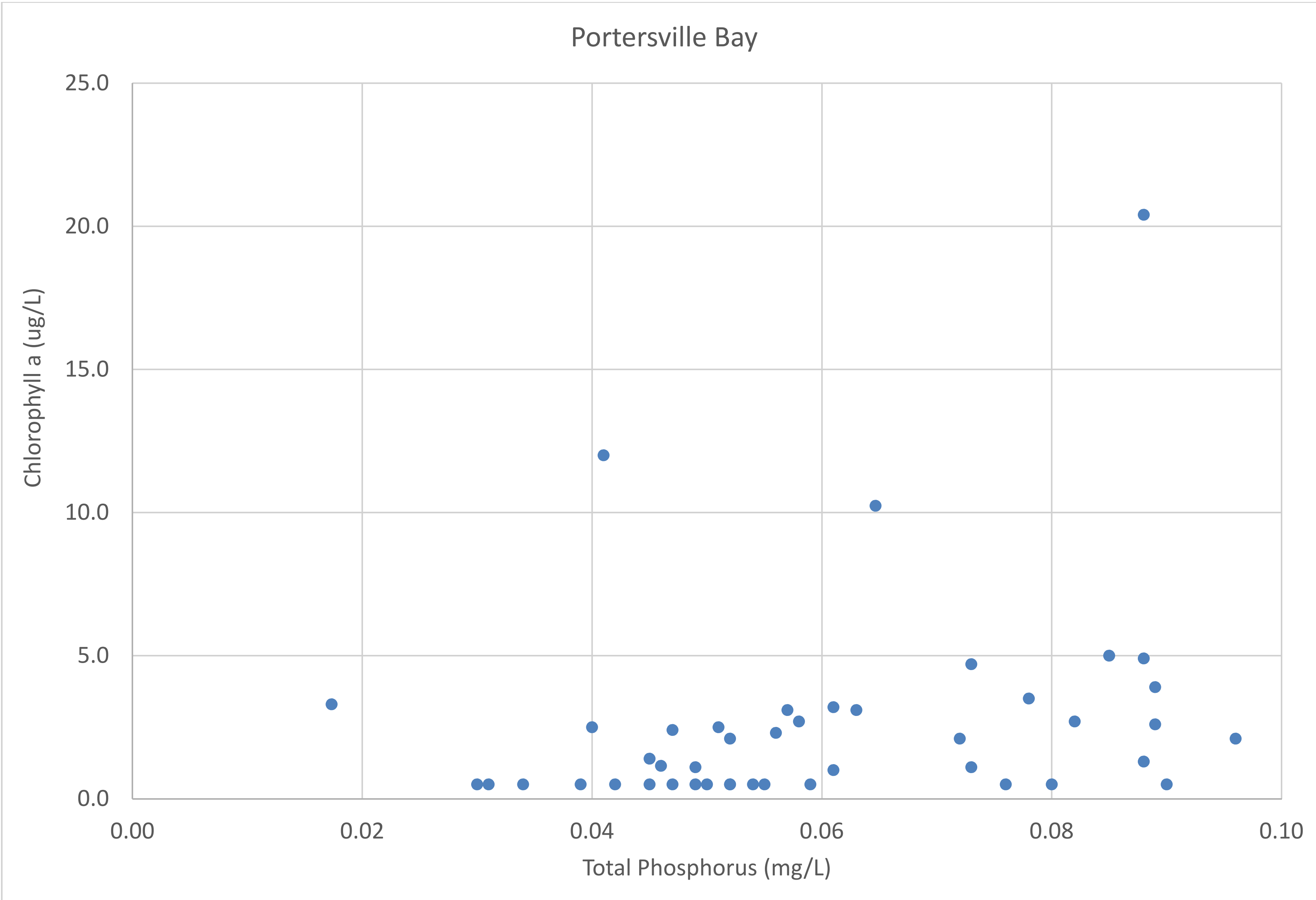


Figure 3.7 Chlorophyll-a (µg / liter) vs. Total Phosphorus / liter) in Portersville Bay

A summary of water quality data from Heron Bay is shown in **Table 3.4**.

Table 3.4 Summary of water quality data from Bayou Heron and Heron Bay. Period of record for displayed data is from July 2000 to June 2017

	Parameter							
	Salinity (psu)	**Fecal Coliform Bacteria (cfu/100 ml)**	**Enterococci Bacteria (#/100 ml)**	**Chlorophyll-a (µg/L)**	**TN (mg/L)**	**TP (mg/L)**	**Secchi Disk Depth (m)**	**DO (mg/L)**
Count	14	41	53	73	68	54	66	14
Minimum	1.20	1.00	2.00	0.13	0.03	0.01	0.18	5.74
Maximum	26.70	26.00	18.00	12.33	2.92	0.25	0.89	10.76
Mean	10.76	3.05	7.21	3.44	0.77	0.07	0.41	7.85
Std Dev	8.34	4.45	4.10	3.35	0.47	0.04	0.16	1.62
Median	7.57	2.00	10.00	2.50	0.72	0.06	0.38	7.72

In Heron Bay, the salinity ranged between 1.2 and 26.7 psu, indicating a smaller range of values than was recorded for the West Fowl River, but similar to that recorded for Portersville Bay. The median salinity value of 7.57 is similar to the median values of 7.00 and 8.70 psu recorded for the West Fowl River and Portersville Bay, respectively.

Levels of phytoplankton do not appear to be excessive in Heron Bay, as the maximum value recorded (out of 73 samples) was less than 13 µg / liter, a value not considered excessively high for most estuarine locations. Mean and median chlorophyll-a values of 3.44 and 2.50 µg / liter, respectively, suggest that eutrophication is not a current concern for Heron Bay. Levels of dissolved oxygen were not recorded at levels below the ADEM standard of 5 mg / liter, although there were many fewer samples available for analysis than was the case in the West Fowl River.

In addition to comparing values against existing criteria, the data from Heron Bay were compared against each other, to determine if water quality parameters indicated relationships that could indicate management actions would be appropriate.

There was insufficient data for simultaneous measurements of chlorophyll-a and salinity, and so those to parameters could not be compared against each other in Heron Bay. As opposed to the West Fowl River and Portersville Bay, there was no statistically significant relationship between water clarity, measured as Secchi disk depths, and chlorophyll-a concentrations in Heron Bay (**Figure 3.8**) nor were chlorophyll-a concentrations correlated with either nitrogen or phosphorus (**Figures 3.9 and 3.10**, respectively). Similar to findings from the West Fowl River, neither nitrogen (**Figure 3.9**) nor phosphorus (**Figure 3.10**) correlated with concentrations of chlorophyll-a in Heron Bay, suggesting factors other than nutrient supply limited phytoplankton production in this system.

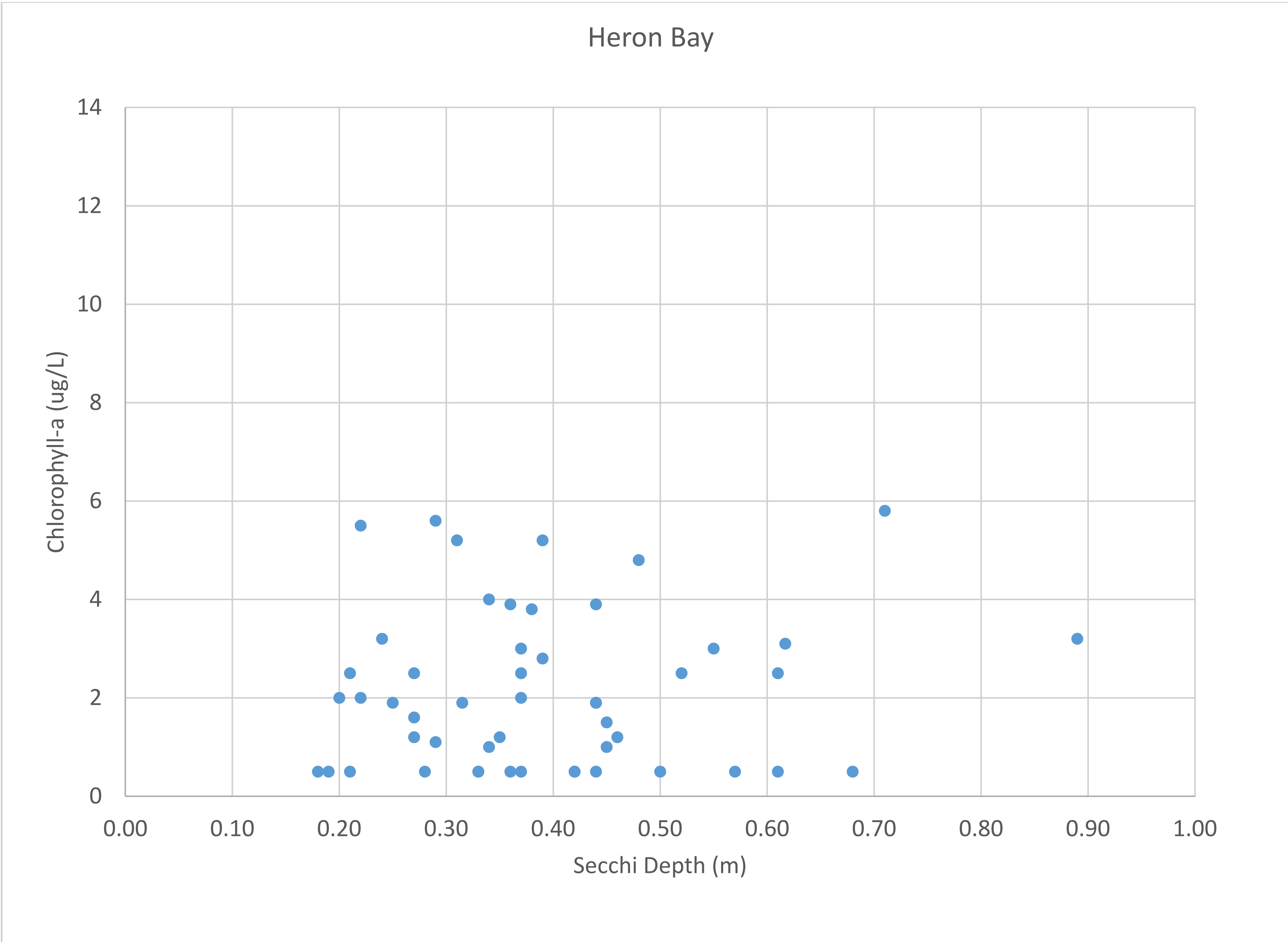


Figure 3.8 Secchi disk depth (m) vs. Chlorophyll-a (µg / liter) in the Heron Bay system

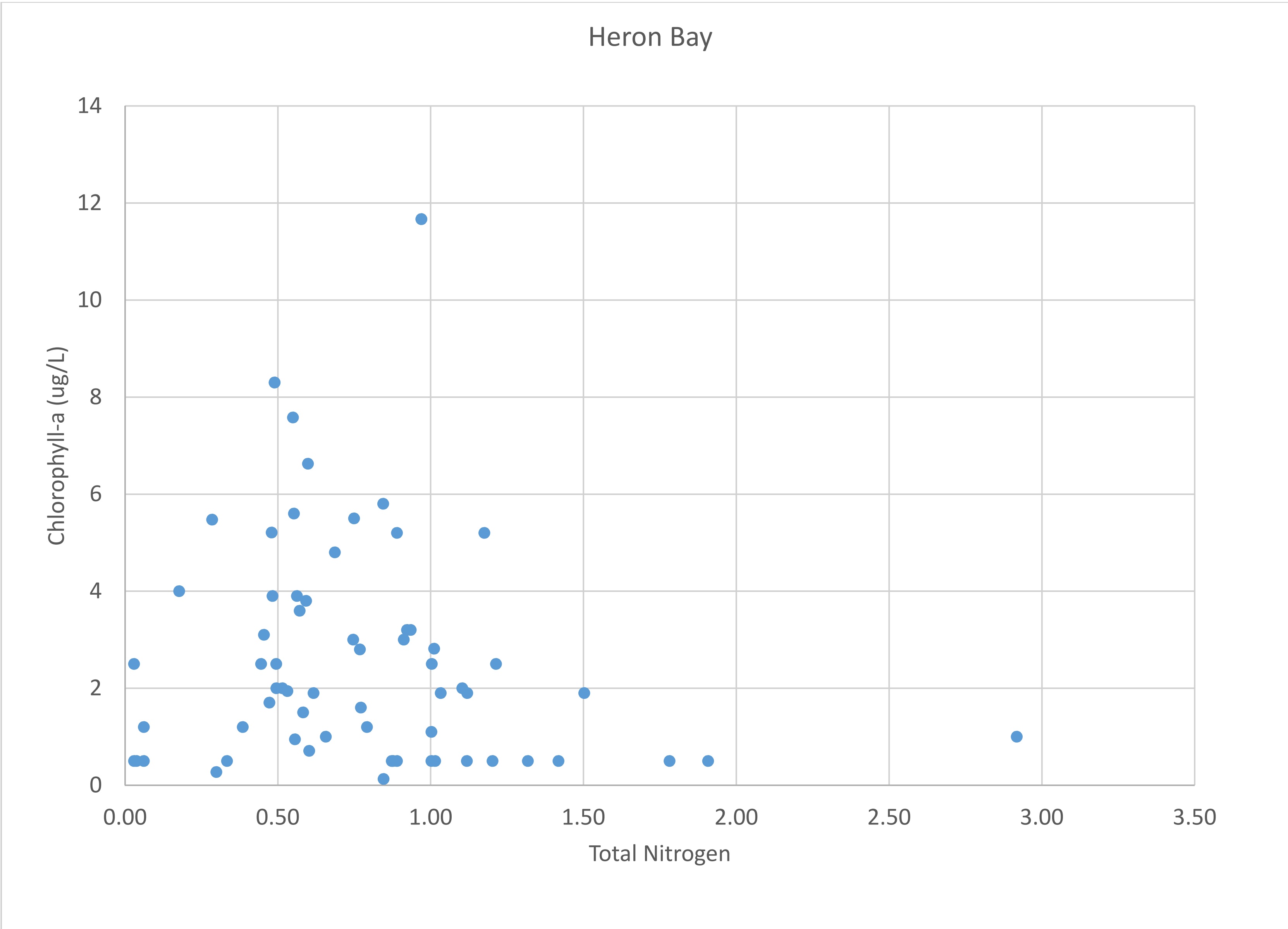


Figure 3.9 Chlorophyll-a (µg / liter) vs. Total Nitrogen (mg / liter) in the Heron Bay system

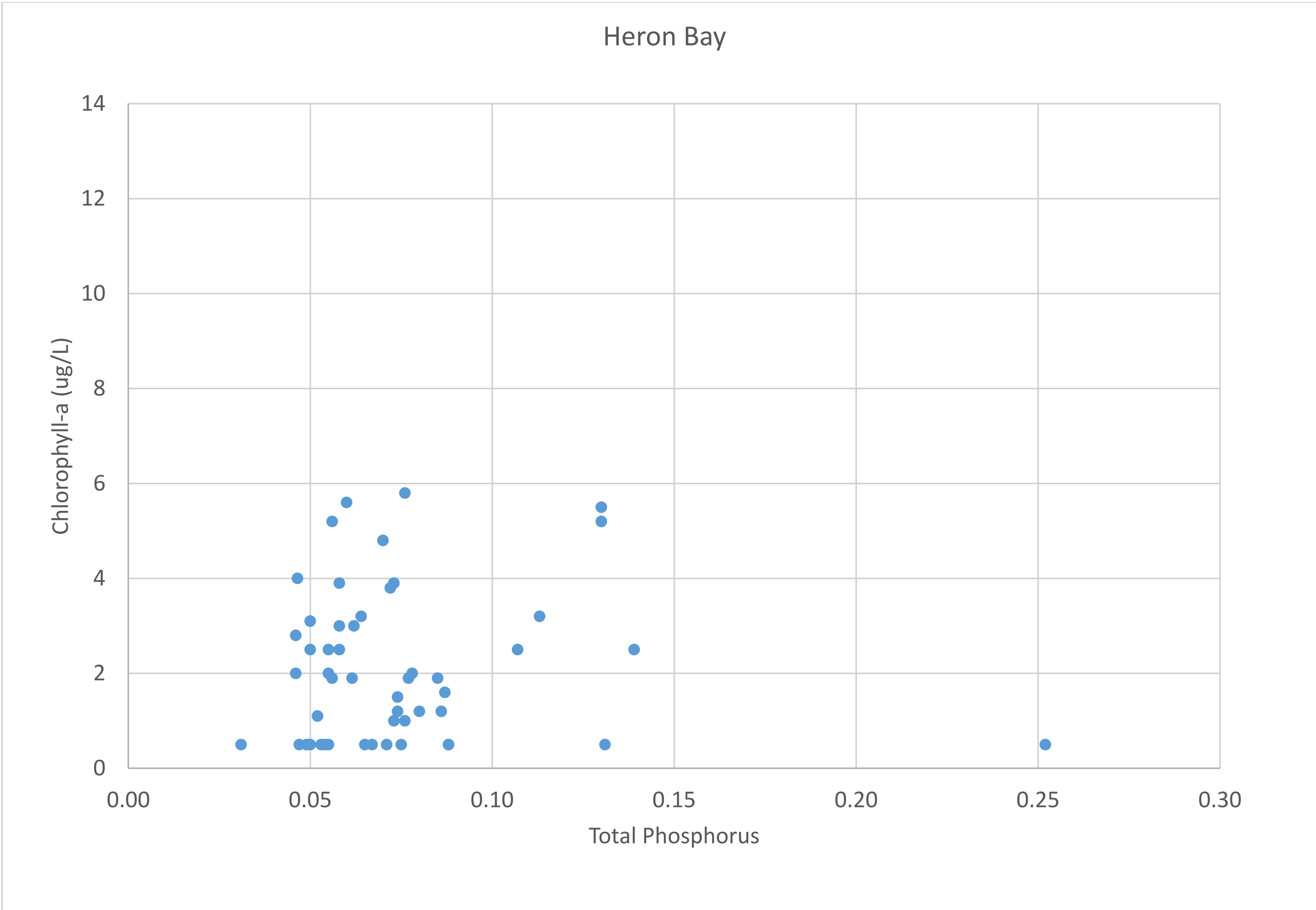


Figure 3.10 Chlorophyll-a (µg / liter) vs. Total Phosphorus (mg / liter) in the Heron Bay system

Summary of Eutrophication and Nutrients

Based on TN to TP ratios, it would be expected that West Fowl River, Portersville Bay and Heron Bay would be either nitrogen limited (TN:TP < 10) to co-limited by both nitrogen and phosphorus (TN:TP between 10 and 30). However, the lack of statistically significant relationships between either nutrient (when both could be tested) and chlorophyll-a in the three systems suggest that phytoplankton growth is not solely limited by availability of nutrients. Based on data from the West Fowl River, it appears that phytoplankton values are typically less than 5 µg / liter at salinities higher than 15 psu. These results suggest that offshore, higher salinity waters might be tidally flushed to such a degree that phytoplankton levels are kept in check by reduced residence times.

While there was a statistically significant relationship between water clarity and chlorophyll-a in the West Fowl River, the relationship was statistically weak, with low predictive capacity. In Portersville Bay, the relationship between chlorophyll-a and water clarity was stronger, which suggests that phytoplankton might be an important contributor to light attenuation in those waters. In contrast, there was no relationship between water clarity and chlorophyll-a in Heron Bay. These results would suggest that factors other than phytoplankton levels are stronger influences on water clarity than phytoplankton in the West Fowl River and Heron Bay, but that water clarity in Portersville Bay may be more strongly influenced by phytoplankton levels. Combined, these results do not suggest that there is clear evidence of a nutrient enrichment problem in the West Fowl River, Portersville Bay or Heron Bay. And while concentrations of fecal coliform bacteria can exceed criteria for direct-to-market shellfish harvesting in Fowl River Bay, neither that system nor Heron Bay have evidence of bacteria levels that would be considered hazardous to human health or the propagation of health fisheries (other than for shellfish).

3.2.1 Pathogens

Bacterial concentrations are used as indicators of the presence of fecal material in drinking and recreational waters, specifically *Escherichia coli* (*E. coli*) and *Enterococci* sp. (common name - enterococcus). Measured concentrations of either bacteria indicate the possible presence of other disease-causing bacteria, viruses, and protozoans. Such pathogens may pose health risks to people fishing and swimming in a waterbody. Sources of bacteria include improperly functioning wastewater treatment plants, leaking septic systems, storm water runoff, decaying animal remains, and runoff from animal manure and manure storage areas.

If pathogens are present in waterbodies they can cause adverse conditions such as cloudy water, unpleasant odors, and decreased levels of dissolved oxygen. Enterococci levels should be measured in marine and fresh waters while *E. coli* should only be measured in fresh waters. Acceptable levels of both *E. coli* and enterococci are measured in cfu (colony forming units) and commonly include both a 30-day mean and a single sample maximum. As defined by the EPA, suitable levels for enterococci in marine waters are 35 cfu/100ml for a 30-day mean and 104 – 501 cfu/100ml for a single sample, while levels in fresh water should be less than 33 cfu/100ml for a 30-day mean and 61 – 151 cfu/100 ml as a single sample reading.

In West Fowl River and Portersville Bay, levels of enterococci bacteria were low enough to meet ADEM's standards for bodily contact and the promotion of fishing, but Fowl River Bay fecal coliform bacteria exceed the shellfish harvesting criteria of 14 most probably number (mpn) / 100 ml often enough that Fowl River Bay is classified as Conditionally Restricted for shellfish harvesting, meaning shellfish must be relayed to other water bodies before they can be brought to market. In contrast, levels of fecal coliform and enterococci bacteria were low enough to meet ADEM's standards for bodily contact and the promotion of fishing in Heron Bayou and Heron Bay. Staff from ADPH provided a detailed data set for Fowl River Bay for the years of 2009 up to July of 2018. The data set was based on monitoring programs meant to ensure compliance with water quality standards required to maintain Fowl River Bay for the purposes of shellfish harvesting, and so sampling events are "event driven" rather than being conducted on regular time intervals. For example, the Fowl River oyster leases are closed for harvesting whenever the Mobile River at the Barry Steam site exceeds an elevation of 8 feet. Similarly, when the Mobile River falls below 8 feet, ADPH staff sample the waters, and if results show that the 14/43 fecal coliform standard is met, the harvest area can be reopened.

In essence, comparisons of exceedances of criteria for different years should be viewed with caution, as the bacteria data from ADPH are "biased" towards events that might close (or open) Fowl River Bay, in terms of bacteria levels. With those caveats in mind, **Table 3.5** summarizes the water quality data collected by ADPH in Fowl River Bay, during the years of 2009 to 2017 (2018 not included).

Table 3.5 Summary of water quality data from Fowl River Bay, as collected by ADPH. Values for salinity, river stage and fecal coliform bacteria represent arithmetic means. River stage represents water level for Mobile River at the Barry Steam Plant

Year	Dates	Salinity (psu)	River Stage (ft)	Fecal coliform bacteria (mpn/100 ml)	Percent exceedance of fecal coliform criteria
2009	Jan to Nov	15.5	5.9	17.0	11.6
2010	Jan to Sept	17.1	3.9	3.9	10.5
2011	Jan to Sept	16.4	4.1	4.1	9.1
2012	April to Oct	24.1	3.1	2.2	0.0
2013	Feb to Sept	19.4	5.3	20.2	13.5
2014	Jan to July	25.9	4.0	2.1	0.0
2015	Jan to Nov	21.2	3.9	3.6	2.8
2016	Feb to Dec	19.2	4.7	54.9	26.6
2017	Feb to Nov	16.1	4.2	13.6	14.6

The years with the best results, in terms of the lowest percentage of samples exceeding criteria, were 2012 and 2014. In those two years, none of the samples exceeded the 14/43 criteria. Those two years, 2012 and 2014, had the lowest and second lowest (out of 8 years) mean river stage values, respectively, shown in **Table 3.5**. In contrast, the two years with the highest exceedance rates (2016 and 2017) had the third and fourth highest average river stage values, according to the ADPH data set.

Figure 3.11 illustrates the relationship between river stage and exceedance rates for the years 2009 to 2017.

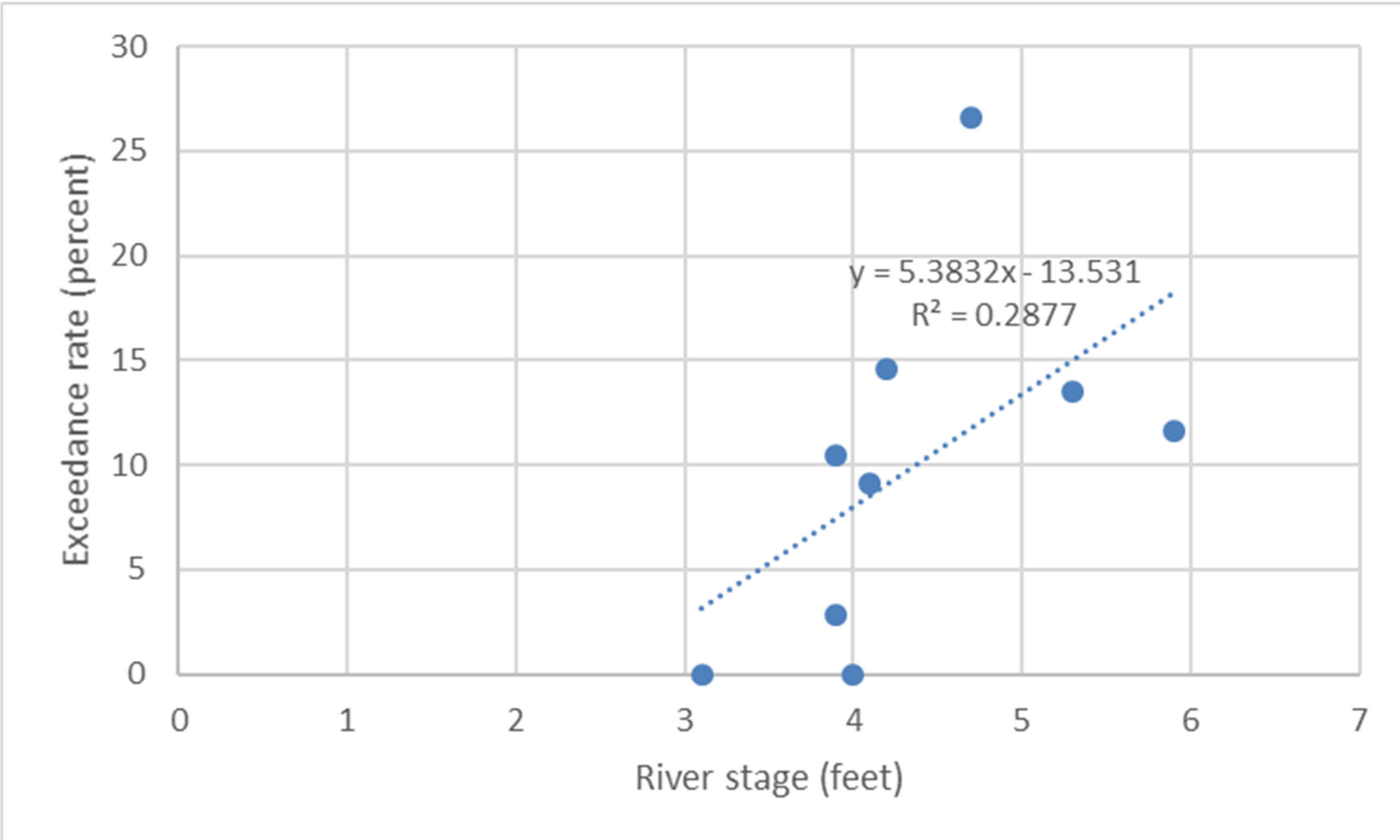


Figure 3.11 Relationship between percent of samples exceeding 14 mpn / 100 ml for fecal coliform bacteria vs average river stage for the Mobile River (feet at Barry Steam Plant). Data from ADPH

The data in **Figure 3.11** were tested for assumptions required for parametric statistical analysis, and results were compared using the non-parametric Spearman's Rank Correlation analysis. The equation in **Figure 3.11** displays the presentation of results if the data were to have meet linear regression requirements. Using Spearman's Rank Correlation, the relationship between average river stage and frequency of impairment was significant at $p < 0.05$, with a Spearman's correlation coefficient of 0.731. Comparing Exceedance rates vs. average salinity in Fowl River Bay (**Figure 3.11**) gave the results shown in **Figure 3.12**.

The data in **Figure 3.12** were tested for assumptions required for parametric statistical analysis, and results were compared using the non-parametric Spearman's Rank Correlation analysis. The equation in **Figure 3.12** displays the presentation of results if the data were to have meet linear regression requirements. Using Spearman's Rank Correlation, the relationship between average river stage and frequency of impairment was significant at $p < 0.10$, with a Spearman's correlation coefficient of -0.581.

To determine if there was a relationship between river stage in the Mobile River and salinity in Fowl River Bay, the annual mean values for data collected by ADPH were compared for the years 2009 to 2016. Results are shown in **Figure 3.13**.

The equation in **Figure 3.13** displays the presentation of results if the data were to have meet linear regression requirements. Using Spearman's Rank Correlation, the relationship between average river stage and salinity in Fowl River Bay was statistically significant at $p < 0.10$, with a Spearman's correlation coefficient of -0.5.77.

Results in **Figure 3.13** suggest that there is an inverse and statistically significant relationship between the stage level of the Mobile River at the Barry Steam Plan and the average salinity in Fowl River Bay. These results likely indicated that patterns of rainfall over the Mobile River's watershed are not, on average, different enough from rainfall patterns over the much smaller West Fowl River watershed, and that the use of the river stage readings from the Mobile River are representative, on average, of the amount of freshwater inflow into Fowl River Bay from its immediate watershed. The use of the river stage measurements at the Barry Steam Plant are thus supported as an external trigger for the likelihood of exceeding bacterial criteria in Fowl River Bay.

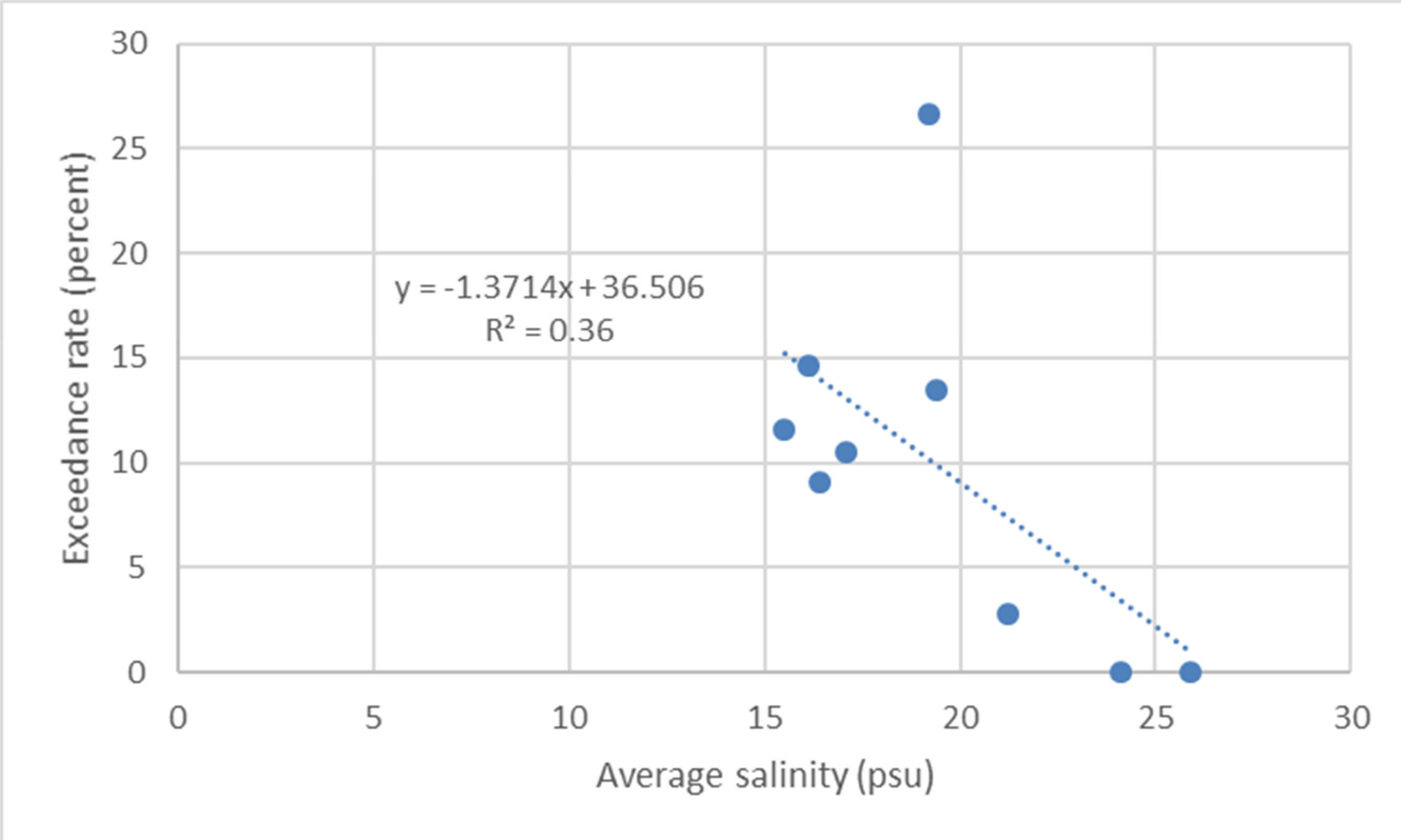


Figure 3.12 Relationship between percent of samples exceeding 14 mpn / 100 ml for fecal coliform bacteria vs annual average salinity (psu) in Fowl River Bay. Data from ADPH

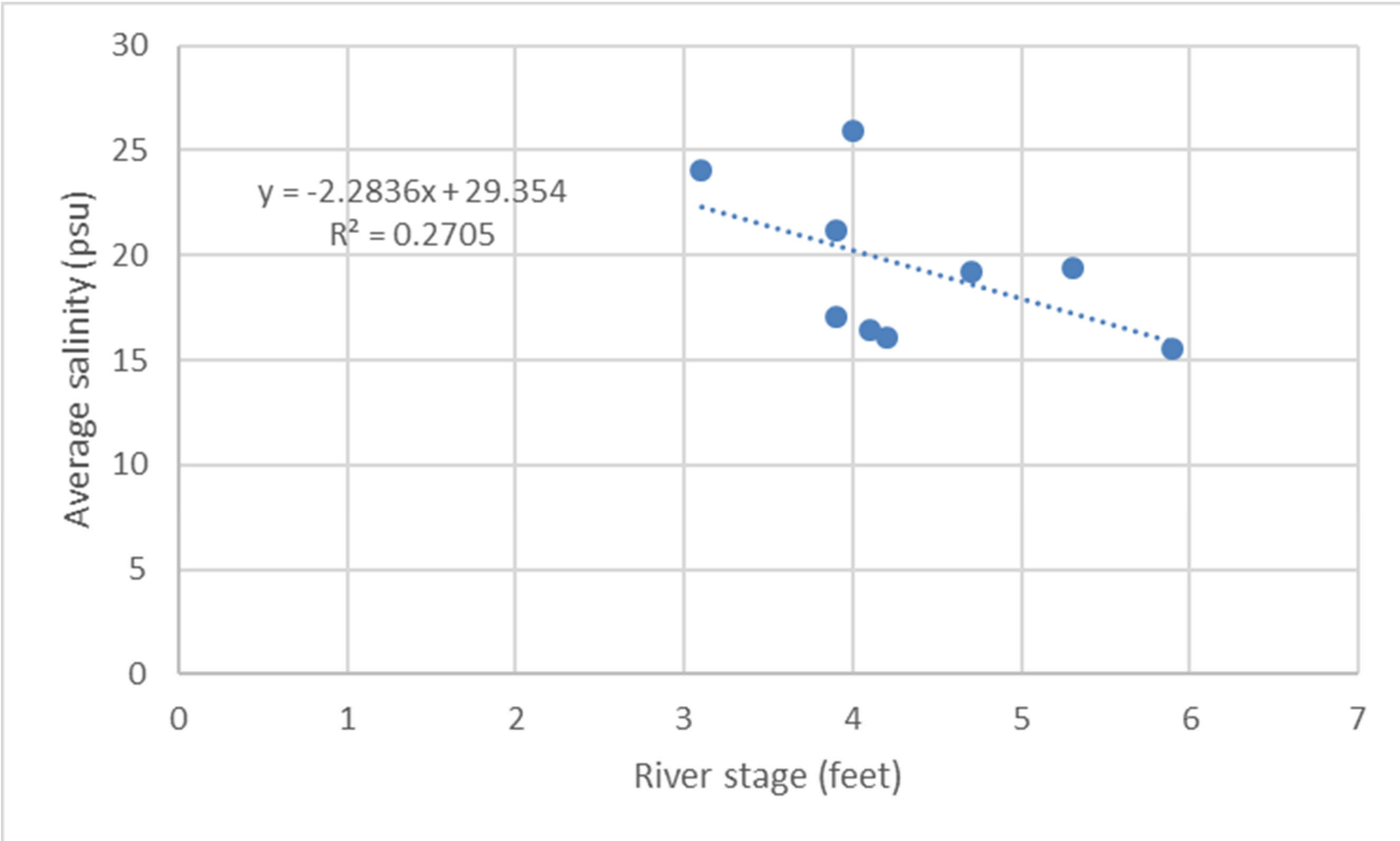


Figure 3.13 Relationship between mean values for stage level for the Mobile River (feet at the Barry Steam Plant) vs. mean salinity for stations within Fowl River Bay (psu). Data from ADPH

As shown in **Figures 3.10** to **3.12**, it appears that freshwater inflows, whether in the Mobile River or from the West Fowl River, correlate with increased impairment frequencies in Fowl River Bay. An additional assessment was conducted to see whether or not there was evidence of changes in rainfall that might explain differences in inflow. Rainfall data from the Mobile Airport were accessed for the period of January 2011 to July of 2018. Results were compiled on an annual basis, and compared to the average value listed for Mobile in the US Climate dataset for the period of 1981 to 2010 (**Figure 3.14**).

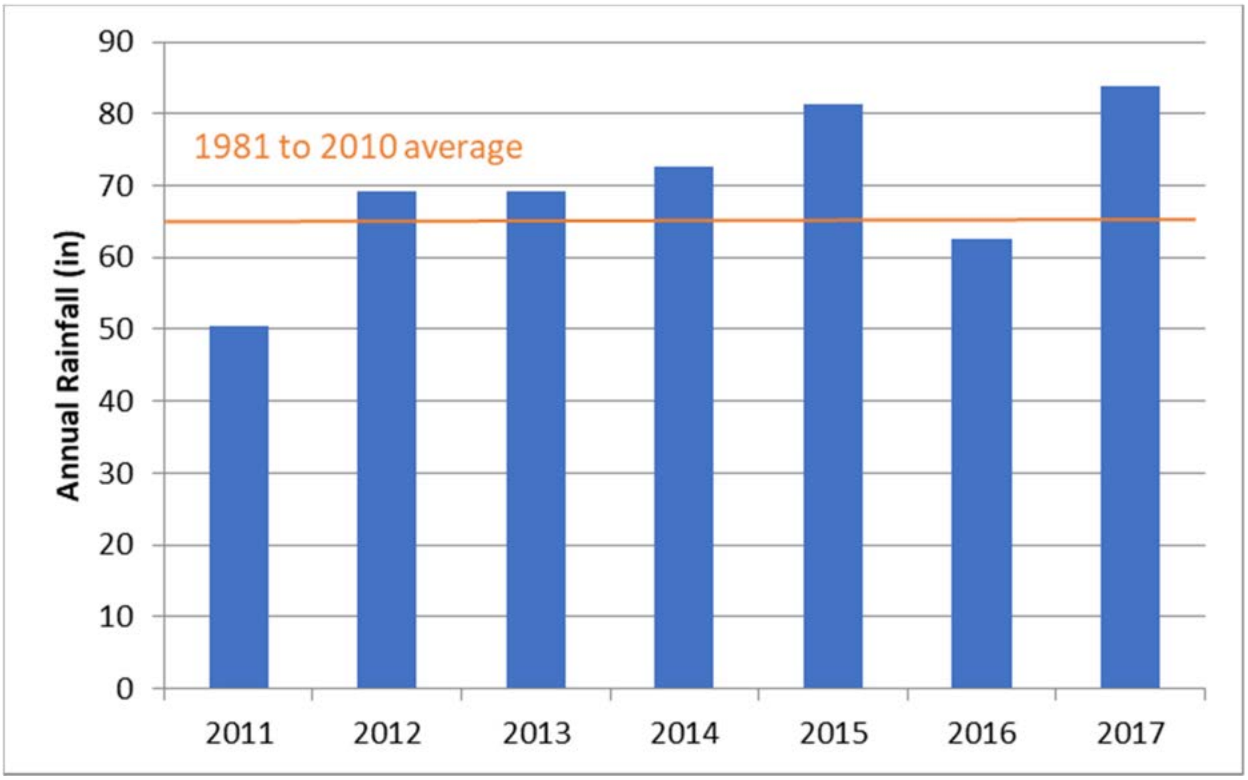


Figure 3.14 Annual rainfall for the years 2011 to 2017 for the Mobile Airport, compared to the average for the period of 1981 to 2010

Five of the past seven years have had more rainfall than the 40-year average value of 66.2 inches, including five of the past six years. In addition, two of the past three years have had more than 80 inches of rainfall, which represent years with more than 20 percent more rainfall than the long-term average. When the rainfall data were tested for trends over time, a statistically significant increase was found, at $p < 0.10$ (**Figure 3.14**).

The results shown in **Figure 3.15** should be interpreted with caution, due to the fairly limited time period included (7 years) and the p value being less than 0.10, rather than 0.05. However, it appears that since 2010, there has been a statistically significant increase in rainfall, on an annual timescale. While 2016 had lower levels of rainfall then the long-term average **(Figure 3-14)** that amounted to less than 6 percent less rainfall than the long-term average, and the month of March had record breaking rainfall, and widespread flooding in the Mobile area (https://www.al.com/news/mobile/index.ssf/2016/03/flash_floods_in_south_alabama.html).

Over the period of 2011 to 2017, the amount of rainfall recorded at the Mobile Airport site equaled 489.2 inches. This amount is 25.7 inches greater than the amount expected if rainfall had accumulated at the long-term average rate of 66.22 inches per year. These results indicate that if current rainfall trends exist into the future, inflows into Fowl River Bay would likely increase as well. Since the frequency of closures is positively correlated with river stage in the Mobile River, and inversely correlated with salinity in Fowl River Bay, these results would suggest that the frequency of impairments might increase in the future, except for years with average or below-average rainfall.

During July 2017 and May 2018, Dauphin Island Sea Lab researchers and staff from the Food and Drug Administration sampled throughout the West Fowl River watershed and Fowl River Bay, looking to link bacteria sources with potential land use types. Sampled parameters included fecal coliform bacteria, as well as isotopes of carbon and nitrogen. Carbon and nitrogen isotopes were used as an indicator of potential bacterial sources, such as sewage.

Highlights of their findings include the following:

- Highest abundances of fecal coliform bacteria were from the river, indicating that activities on the watershed were likely the most important (not only) source of bacteria to the bay
- The lowest levels of fecal coliform bacteria were found at outfall of the City of Bayou La Batre's wastewater treatment plant, indicating that the City's plant is not a significant source of bacteria to the bay
- Carbon and nitrogen isotope values suggested that human activities likely increased fecal coliform loads from the watershed, in particular "unprocessed" sewage that could be coming from failing septic tank systems
- Fecal coliform bacteria were elevated in areas in close proximity to both cattle grazing sites and bird roosting sites, but concentrations rapidly diminished with distance from these sources, which suggests some combination of die-off and mixing might moderate their potential influence.
- Samples taken close to cattle grazing sites had higher levels of fecal coliform bacteria than samples close to bird roosting sites, but the significance of this result is severely limited by the fact that samples were collected on one day only for both potential sources

Taken as a whole, the results of the DISL/FDA efforts support the contention that the watershed is the dominant source of fecal coliform bacteria in Fowl River Bay, as opposed to in-water sources such as bird roosting sites. However, the interpretation of results focused on cattle grazing and bird roosting is compromised by the single days' worth of data. The overall results suggest that human activities on the watershed are likely increasing the load of bacteria into Fowl River Bay, and that increased rainfall on the watershed would likely cause increased bacteria levels in the bay. The finding that rainfall appears to be trending towards higher levels over the past few years **(Figure 3.15**) suggests that the issue of fecal coliform bacteria in Fowl River Bay may not improve over time.

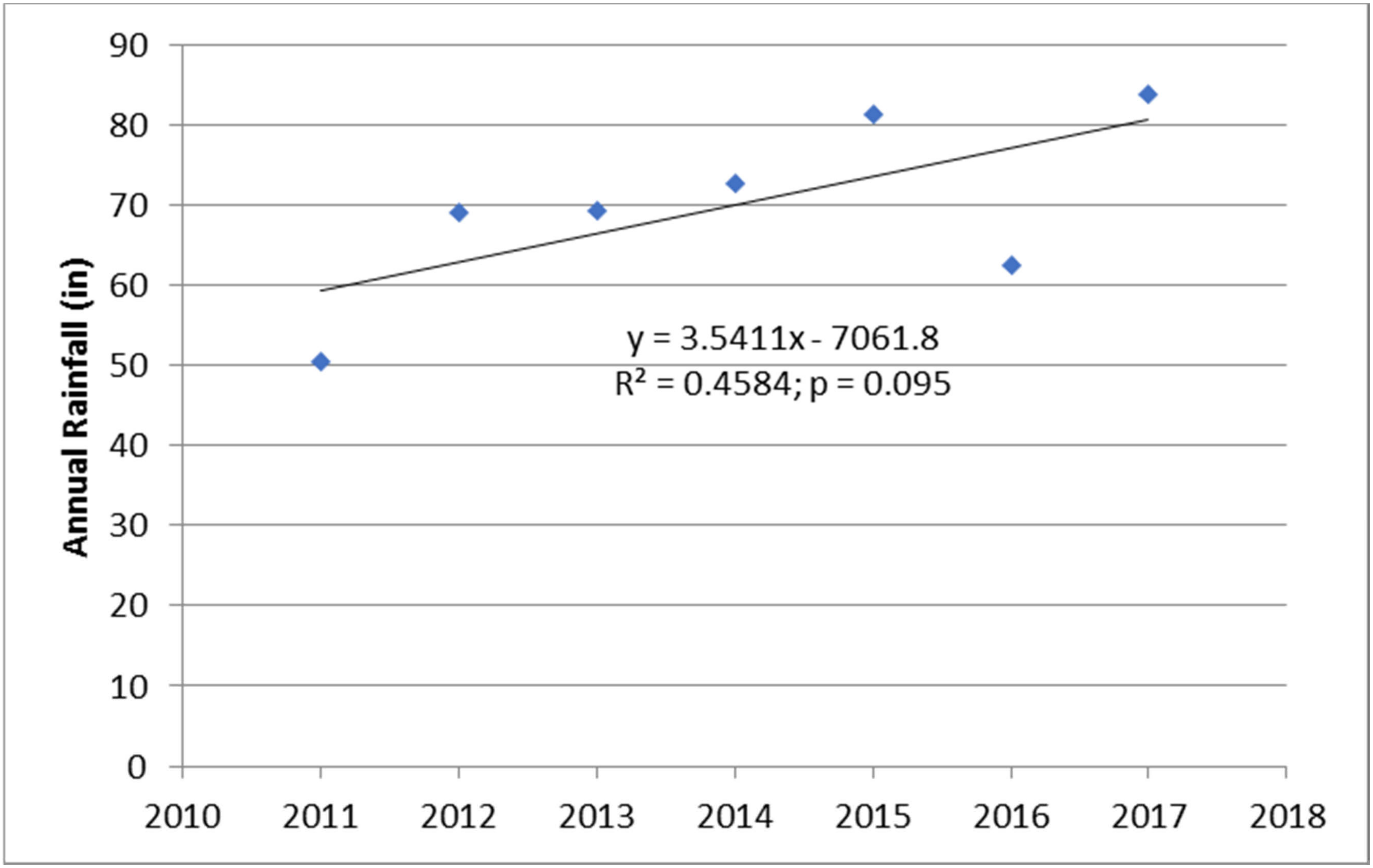


Figure 3.15 Annual rainfall for the years 2011 to 2017 for the Mobile Airport. Line represents linear regression of rainfall vs. year, which was significant at $p < 0.10$)

3.2.2 Contaminants

Limited data are available for metals in the West Fowl River Watershed. For those with data, results were compared to the calculated acute and chronic regulatory limits. Only mercury exceeded the chronic regulatory criteria at site FRBM-1 in 2011 and 2012.

3.2.3 Watershed Water Quality Assessment Conclusion

Water quality conditions can vary substantially on small scales, both spatial and temporal, influenced by localized pollutant loadings, rainfall, and hydrologic alterations. After evaluating the magnitude and frequency of exceedances above or below the referenced regulatory criteria, each of the key water quality parameters were classified as “Fair”, “Good” or “Poor” to assist in prioritizing management actions (**Table 3.6**).

Table 3.6 Relative water quality summary assessment of West Fowl River Watershed

Parameter Class	West Fowl River Watershed
Dissolved Oxygen	Good
Chlorophll-a	Good
Nutrients	Fair
Bacteria	Fair
Metals	Fair

In consideration of the information presented above, the following conclusions have been developed for the West Fowl River Watershed.

- Based on maximum and mean values, it does not appear that the waters of West Fowl River, Portersville Bay or Heron Bay have problematic levels of chlorophyll-a, suggesting that phytoplankton growth is not overly stimulated by nutrients.
- While there was no relationship between chlorophyll-a and water clarity in Heron Bay, higher concentrations of chlorophyll-a correlated with decreased water clarity in the West Fowl River, and more so in Portersville Bay.
- Nitrogen has been identified as the limiting nutrient most directly impacting phytoplankton production in eutrophic estuaries, but there is little evidence suggesting that the availability of nitrogen or phosphorus strongly influences phytoplankton growth in the three estuaries examined here; most likely phytoplankton growth is more strongly influenced by tidal flushing and/or turbidity.
- Bacteria levels in Fowl River Bay are correlated with rainfall and freshwater inflow, such that years with lower salinities and/or higher rates of expected inflow are associated with a greater likelihood of exceedance of criteria for shellfish harvesting
- Recent (i.e., post 2011) trends suggest that rainfall is increasing in the Mobile area. If recent trends persist into the future, it could result in increased frequencies of closure for shellfish harvesting, except for years with average or below average rainfall

- However, ongoing efforts to identify and act upon anthropogenic sources of bacteria should continue, to reduce the likelihood of shellfish closures due to factors other than elevated rainfall.
- The West Fowl River is relatively enriched with regard to mercury, or at least it was so in 2011 and 2012.

3.3 Habitats and Ecosystem Services

Habitats within the Watershed are typical of those found adjacent to Mississippi Sound in the northern Gulf of Mexico. Terrestrial uplands containing varieties of pine and oaks dominate higher-ground areas and are primarily used for agricultural or residential purposes. Maritime forests consisting of primarily slash pine, saw palmetto, and wax myrtle cover the middle portion of the Watershed and transitions from forest to predominantly grasses when entering sandy areas near the coast. These habitats provide storm event/shoreline protection, critical nutrient removal, and habitat for a variety of freshwater and estuarine species.

Numerous anthropogenic activities including increased development, population growth, etc. have impacted natural habitats, native flora and fauna, as well as those migratory species that utilize the Watershed. As human interaction with the areas natural habitats and ecosystems continues to increase, the overall extent and health of these areas have deteriorated due to, amongst other factors, land use land cover change, climate change, and pollution.

Most of the developed coastal and lowland areas in the Watershed are protected by bulkheads or revetment materials, greatly impacting the establishment and growth of marsh vegetation. While human activities have greatly altered the coastal environment, natural processes such as high water events, sea level rise, and wave action have also contributed to the observed changes. A more detailed analysis of shorelines in the Watershed is provided in **Section 3.5**.

Increased development and human-natural community interaction has also resulted in numerous non-native species to be introduced in the Watershed. A non-native species study conducted by Dewberry staff identified 10 non-native species in the Watershed including:

- Torpedo grass - *Panicum repens*
- Cogon grass - *Imperata cylindrica*
- Persian silk tree (Mimosa tree) - *Albizia julibrissin*
- Chinese privet - *Ligustrum sinense*
- Chinese wisteria - *Wisteria sinensis*
- Air potato - *Dioscorea bulbifera*
- Japanese honeysuckle - *Lonicera japonica*
- Phragmites - *Phragmites australis*
- Japanese climbing fern – *Lygodium japonicum*
- Golden bamboo - *Phyllostachys aurea*.

3.4 Sea Level Rise/ Resiliency

A comprehensive study of vulnerability and resiliency in south Alabama was completed by the US Department of Transportation (see ICF 2011 – 2014). While the focus of the study was the Mobile metropolitan area, many of the assessments made and much of the data generated or collected are applicable to West Fowl River. Specifically, South Coast Engineers performed comprehensive hurricane storm surge and wave modeling under a variety of expected future climate conditions (ICF 2013). That modeling included the West Fowl River watershed and surrounding areas and those data could be used to assist in future resiliency planning and/or assessments. Representative results of that modeling are shown in **Figure 3.16** and **Figure 3.17**. The first of these figures shows the simulated water surface elevations (storm surge elevations) resulting from Hurricane Katrina under a future sea-level that is +2.5-ft higher than present. Note that the model clearly captures the inundation of the study area. The second figure shows the increase in storm surge elevations as a result of the sea-level rise scenario, as compared to the actual Hurricane Katrina storm surge event.

3.4.1 SLAMM Model

Over the past two decades, geospatial modeling tools have been developed to forecast changes in coastal wetland habitats in response to sea-level rise (SLR). These tools include the Environmental Protection Agency's Sea Level Affecting Marshes Model (SLAMM), which simulates the dominant processes involved in coastal wetland migration and conversions with long-term SLR. The basis of the model is a decision tree that maps out how quantified linkages between habitat response and SLR will drive habitat locations across a landscape, considering the effects of coastal elevations, SLR, accretion and erosion, and freshwater inflow. The model calculates habitat areas and maps habitat distribution over time based on inputs of existing vegetation, topography, accretion rates, and SLR.

Tools like SLAMM can be used in watershed management to identify restoration and conservation opportunities for changing coastal habitats. This memo summarizes past studies that cover the Gulf Coast region (Section 1), and analyzes how they can be applied to the West Fowl River watershed (Section 2). Section 3 identifies opportunities in the watershed and provides recommendations for possible next steps to refine this analysis.

3.4.1.1 Previous Studies

Many organizations have begun evaluating how habitats may evolve with sea level rise in the Gulf Coast region. The Nature Conservancy (TNC) and Warren Pinnacle Consulting (WPC) used SLAMM to model the Gulf Coast (TNC 2013, WPC 2015), while the USGS has used a simplified GIS model and hydrodynamic modeling to evaluate habitat evolution and erosion along the coast (Enwright et al. 2015, 2016, Passeri et al. 2016). ESA has used SLAMM to model the Fowl River and Bayou La Batre watersheds, which border the West Fowl River watershed and provide estimates of local accretion and erosion rates. Each of these studies is summarized in more detail below.

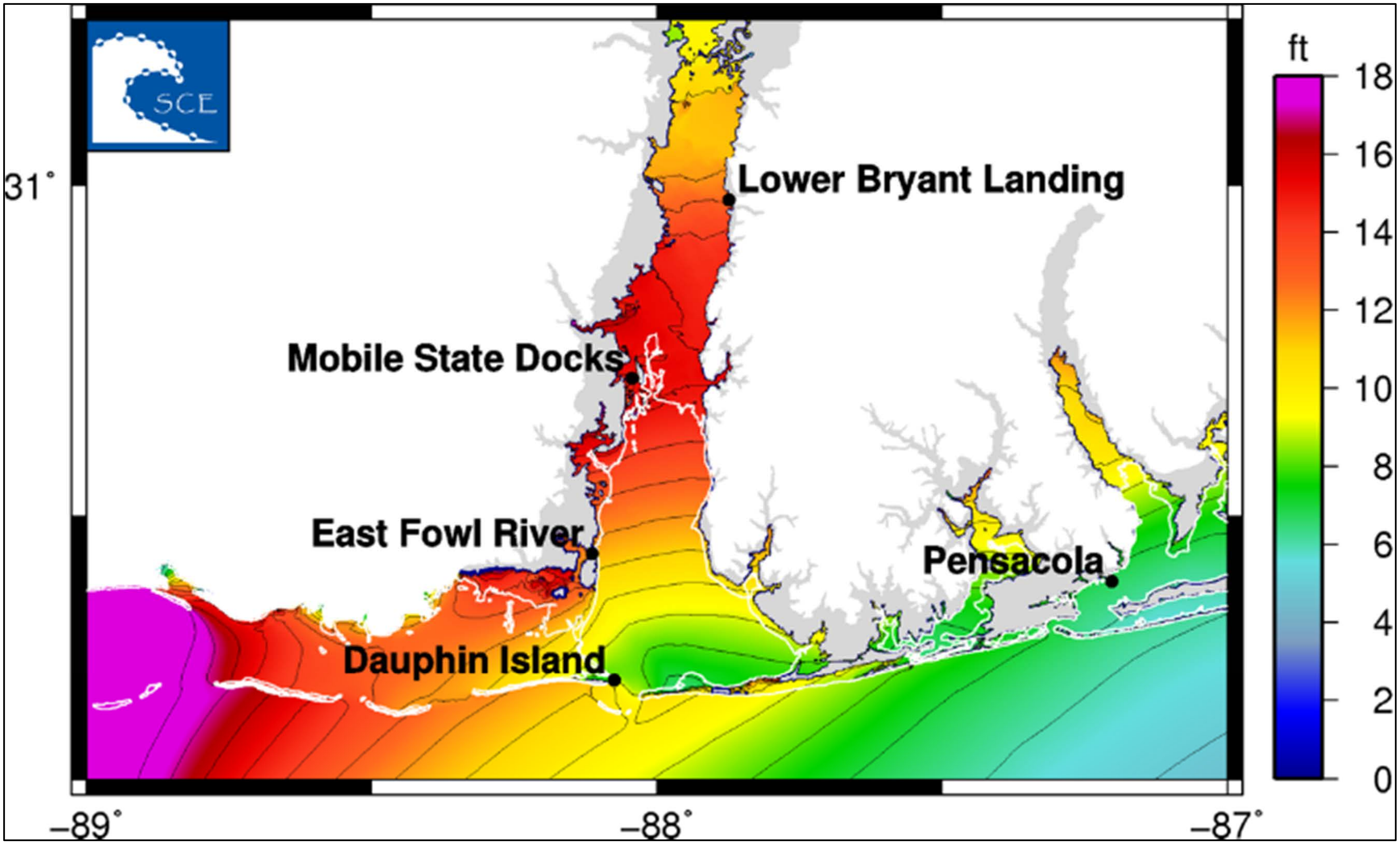


Figure 3.16 Modeled water surface elevations for a hindcast of Hurricane Katrina with a RSLR scenario of +2.5 ft (2100 projection)

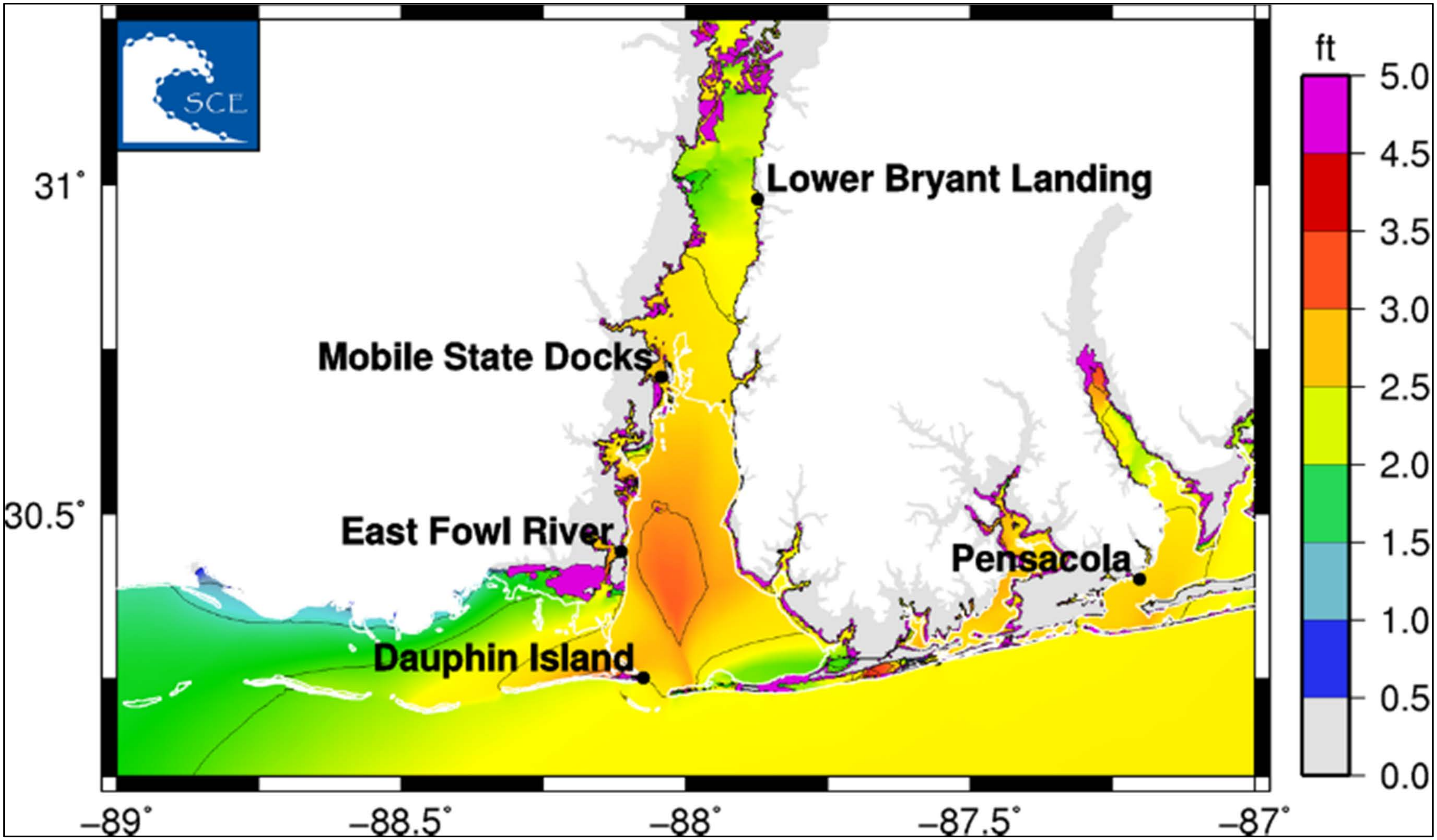


Figure 3.17 Increase in storm water levels during Katrina as a result of the +2.5-ft RSLR scenario shown in Figure 3.16 (Katrina+RSLR – Katrina)

3.4.1.1.1 The Nature Conservancy 2013

TNC used SLAMM 6.2 to model SLR for five sub-areas along the Gulf Coast of Mexico, including Mobile Bay (2013). The primary objectives of the study were to 1) model SLR in five coastal estuaries, 2) use the results to identify nearby areas highly-susceptible to SLR, and 3) present the SLAMM results to stakeholders as a means to encourage dialogue and development of locally relevant adaptation strategies. Additionally, the study assessed the impacts to vulnerable species by evaluating habitat loss under the three SLR scenarios (0.7 m, 1.0 m, 2.0 m) at four time steps (2025, 2050, 2075, 2100). For the Mobile Bay area, vulnerable species assessed included the snowy plover (*Charadrius alexandrines),* the piping plover (*C. melodus),* the Alabama beach mouse (*P. polionotus ammobates),* and the hairy-peduncled beakrush (*Rhynchospora crinipes).*

The Mobile Bay portion of the TNC study covers approximately 80% of the West Fowl River watershed. For each time step and SLR scenario, habitat evolution was modeled under an "allow migration" scenario (allowing habitat evolution onto developed lands) and a "protect development" scenario (limiting transgression to undeveloped land). **Figure 3.16** shows the SLAMM results of Mobile Bay for 2100 with 1.0 m of SLR, compared to initial conditions in 2002, and **Table 3.7** details the habitat acreage of the two management scenarios. Because the coastal areas of the West Fowl River are largely undeveloped, the results from the two runs are similar and show only minor differences.

Table 3.7 Habitat Acreage in west Fowl River Watershed form TNC SLAMM analysis

Habitats[1]	2002: Initial Conditions (Acres)	2100: 1 m SLR + Allow Migration (1 m SLR) (Acres)	2100: 1 m SLR + Protect Development (1 m SLR) (Acres)	Difference between Allow Migration and Initial Conditions (Acres)	Difference between Scenarios (Acres)
Developed Dry Land	655	591	655	-64	+64
Undeveloped Dry Land	6,822	5,917	5,917	-905	0
Freshwater Swamp	2,808	2,375	2,375	-433	0
Freshwater Marsh	376	910	873	+534	-37
Salt Marsh	5,250	2,021	1,996	-3,229	-25
Tidal Flat	0	3,206	3,203	+3,206	-3
Beach	45	7	7	-38	0
Open Water	754	1,686	1,685	+932	-1

1. SLAMM habitats have been combined into simplified categories. See Appendix A for habitat cross-walk.

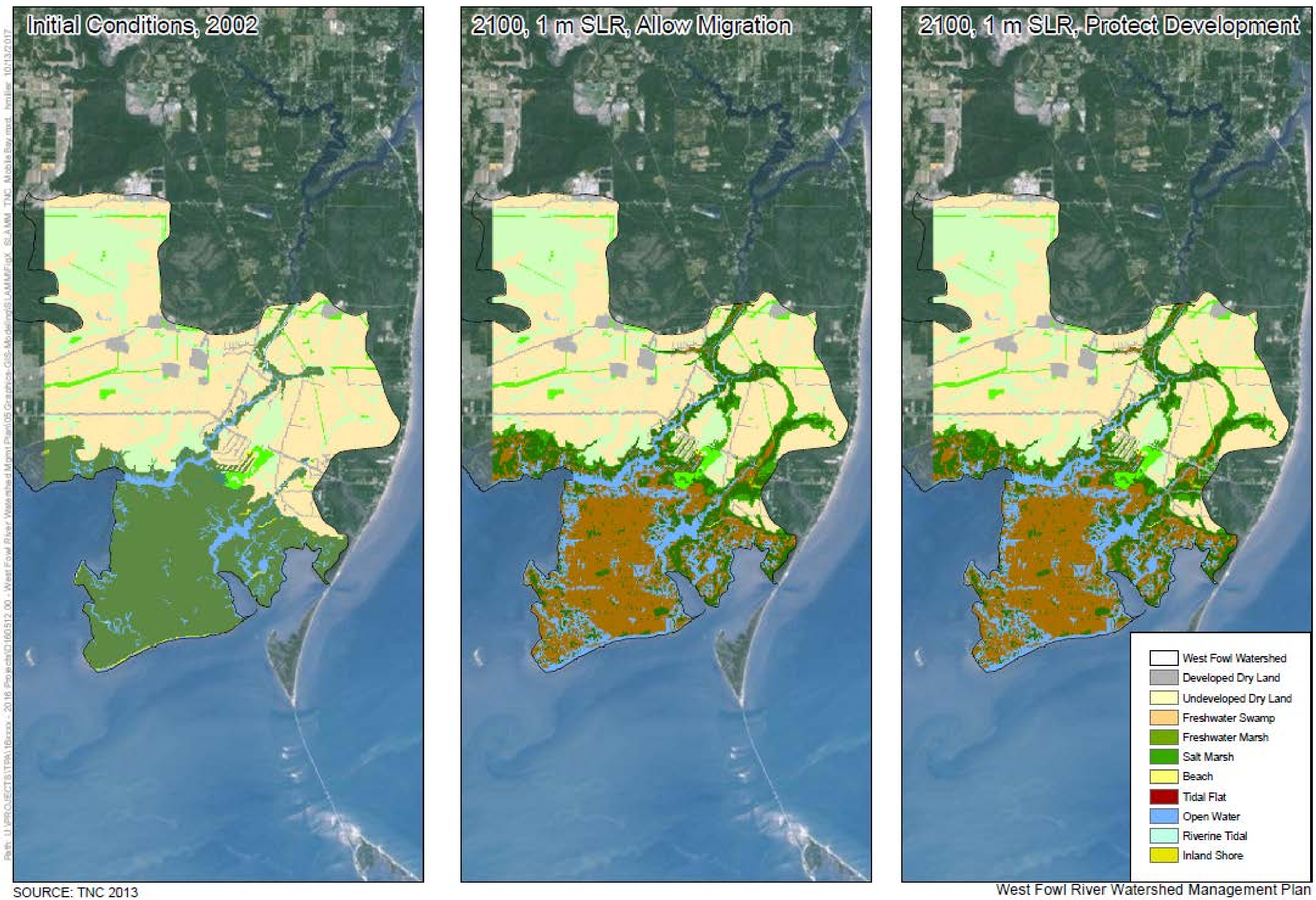


Figure 3.18 TNC SLAMM modeling results of West Fowl Watershed in Mobile Bay Study Area, Habitat Evolution

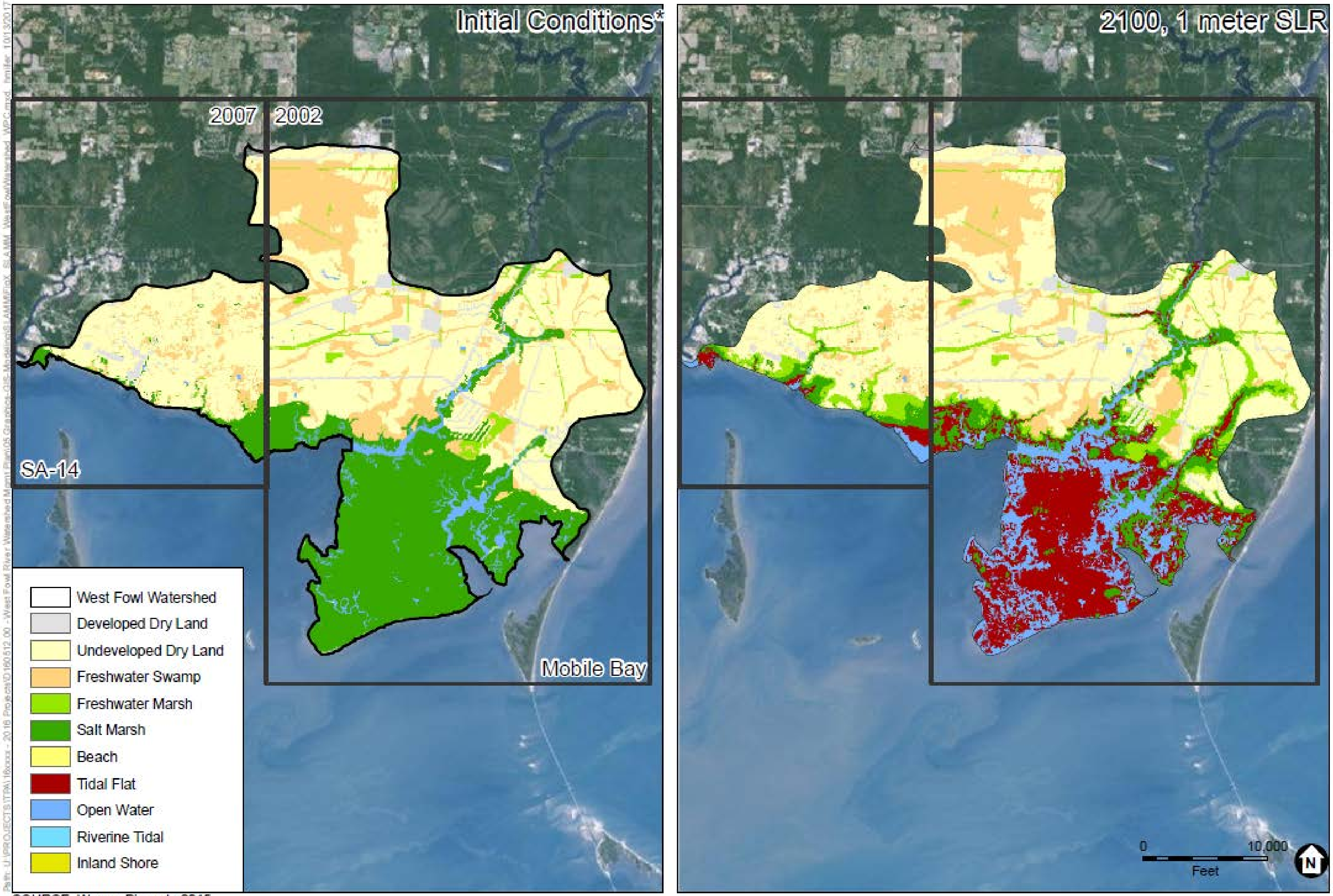
3.4.1.1.2 Warren Pinnacle Consulting 2015

WPC modeled habitat evolution throughout the Gulf Coast using SLAMM 6.5. Prior to the WPC report, individual studies had modeled different pieces of the region with variable domain definitions, model parameters, and SLR scenarios, which rendered the disparate projections incompatible for direct comparison. The primary goals of the WPC project were to generate a "seamless set of land cover projections for the Gulf of Mexico Coast," allowing for direct comparison across the region, and to derive and use a mechanistic accretion feedback rate in the modeling process. The evaluation assessed SLR for the entire Gulf Coast (from the U.S./Mexico Border in Texas to Key West, Florida). Twenty-five areas within the study region had been previously modeled using SLAMM, including Mobile Bay in the 2013 TNC study (see previous section), and twenty new gap areas were identified and modeled for the first time in the 2015 WPC evaluation.

For previously modeled study areas, the 2015 regional evaluation kept the same original inputs, but adjusted the SLR scenarios (0.5, 1.0, 1.2, 1.5, and 2.0 m), and added additional regularly-flooded marsh (RFM) accretion feedback rates, if not included in the initial study, to ensure consistency and allow for comparison across study areas. In some areas, the regional effort also included a "freshwater flow polygon" within the SLAMM parameterization to account for the influence of surface flows in habitat evolution. Finally, the regional model employed only an "allow migration" approach, allowing habitat transgression onto developed lands. The regional model used four time steps: 2025, 2050, 2075, and 2100.

The West Fowl River watershed overlaps two primary regions in the WPC study: Mobile Bay and SA-14. For the Mobile Bay region, SLAMM was run using the same inputs as the 2013 TNC study with the exception of: 1) changing the SLR scenarios and 2) including three additional accretion rates (inland-fresh marsh, tidal swamp, and swamp; these rates and additional model inputs are detailed in Table 4 below). Additionally, the WPC study used a newer version of SLAMM.

Figure 3.17 shows the combined SLAMM results of the Mobile Bay and SA-14 study regions at initial conditions (2002 and 2007) and in 2100 with 1.0 m SLR within the West Fowl River watershed. Because the models for the two regions are based on land uses from different dates (2002 and 2007), the boundary between the regions does not fully align. Table 2 details the habitat acreage shown in **Figure 3.17**. Note that twelve acres of open-water on the easternmost portion of the West Fowl River Watershed were modeled in a third region of the study (Grand Bay, Mississippi). Though these twelve acres of open-water are included in acreage totals in **Table 3.8**, **Figure 3.17** does not include a separate box indicating the bounds of the Grand Bay study due to its small spatial extent.



SOURCE: Warren Pinnacle 2015

*Note that the initial conditions for SA-14 and Mobile Bay were determined from different baseline years

West Fowl River Watershed Management Plan

Figure 3.19 WCP SLAMM modeling results of West Fowl River Watershed, Habitat Evolution

With the slightly varied SLAMM inputs, WPC found "similar susceptibility but different future wetland categories predicted" compared to the TNC study (**Figure 3.18**). The WPC 2100 habitat projection showed slightly different habitat acreages for dry land, freshwater swamp, freshwater marsh, and beach, but showed a larger conversion of salt marsh to open water (a decrease of 426 acres of salt marsh) compared to the TNC study (**Table 3.9**).

The larger conversion of salt marsh to open water is likely due to the difference in model versions used between the two studies. SLAMM 6.5, used in the WPC study, allows direct conversion of freshwater marsh to regularly flooded marsh, irregularly flooded marsh, open water, OR tidal flat, depending on elevation. The previous versions of SLAMM, including SLAMM 6.2 used for the TNC modeling, employed a linear conversion pathway for freshwater marsh, where freshwater marsh had to convert to irregularly flooded marsh, then regularly flooded marsh, then tidal flat, and then open water, as opposed to converting straight to the appropriate habitat for that elevation. This means that the TNC results overestimate salt marsh due to habitat conversion steps as represented in the model.

Table 3.8 Habitat acreage in the West Fowl River Watershed from the WPC SLAMM analysis

Habitats[1]	Initial Conditions (2002/2007) (Acres)	2100, 1 m SLR (Acres)	Difference from initial conditions (Acres)
Developed Dryland	777	672	-105
Undeveloped Dry Land	9,522	8,139	-1383
Freshwater Swamp	3,304	2,787	-517
Freshwater Marsh	403	1,311	+908
Salt Marsh	5,591	1,797	-3794
Tidal Flat	0	3,378	+3378
Beach	55	8	-47
Open Water	785	2,131	+1346
No data[2]	44	247	

1. SLAMM habitats have been combined into simplified categories. See Appendix A for habitat cross-walk.
2. The results include a gap between the Mobile Bay and SA-14 study region

The smaller differences in the remaining habitat types is likely due to the habitat conversion steps or two other differences between the two modeling efforts. First, WPC changed the minimum elevation thresholds for swamp, tidal-fresh marsh, and tidal swamp habitats to ensure consistency with the other regional models, although this change was small. Second, WPC added an additional dynamic regularly-flooded accretion rate. Both of these changes would likely result in minor differences in the habitat acreages.

Table 3.9 Habitat Acreage in the "Mobile Bay" Portion[1] of the West Fowl River Watershed from TNC and WPC SLAMM Analyses

Habitats[2]	Initial Conditions (2002) (Acres)	TNC (2100, 1 m SLR) (Acres)	WPC (2100, 1 m SLR) (Acres)	Difference between TNC and WPC Model Runs (Acres)
Developed Dry Land	655	591	590	-1
Undeveloped Dry Land	6,822	5,917	5,917	0
Freshwater Swamp	2,808	2,375	2,392	+17
Freshwater Marsh	376	910	908	-2
Salt Marsh	5,250	2,021	1,595	-426
Tidal Flat	0	3,206	3,255	+49
Beach	45	7	7	0
Open Water	754	1,686	2,043	+357

1. The Mobile Bay portion of the studies covers approximately 80% of the West Fowl River watershed.
2. SLAMM habitats have been combined into simplified categories. See Appendix A for habitat cross-walk.

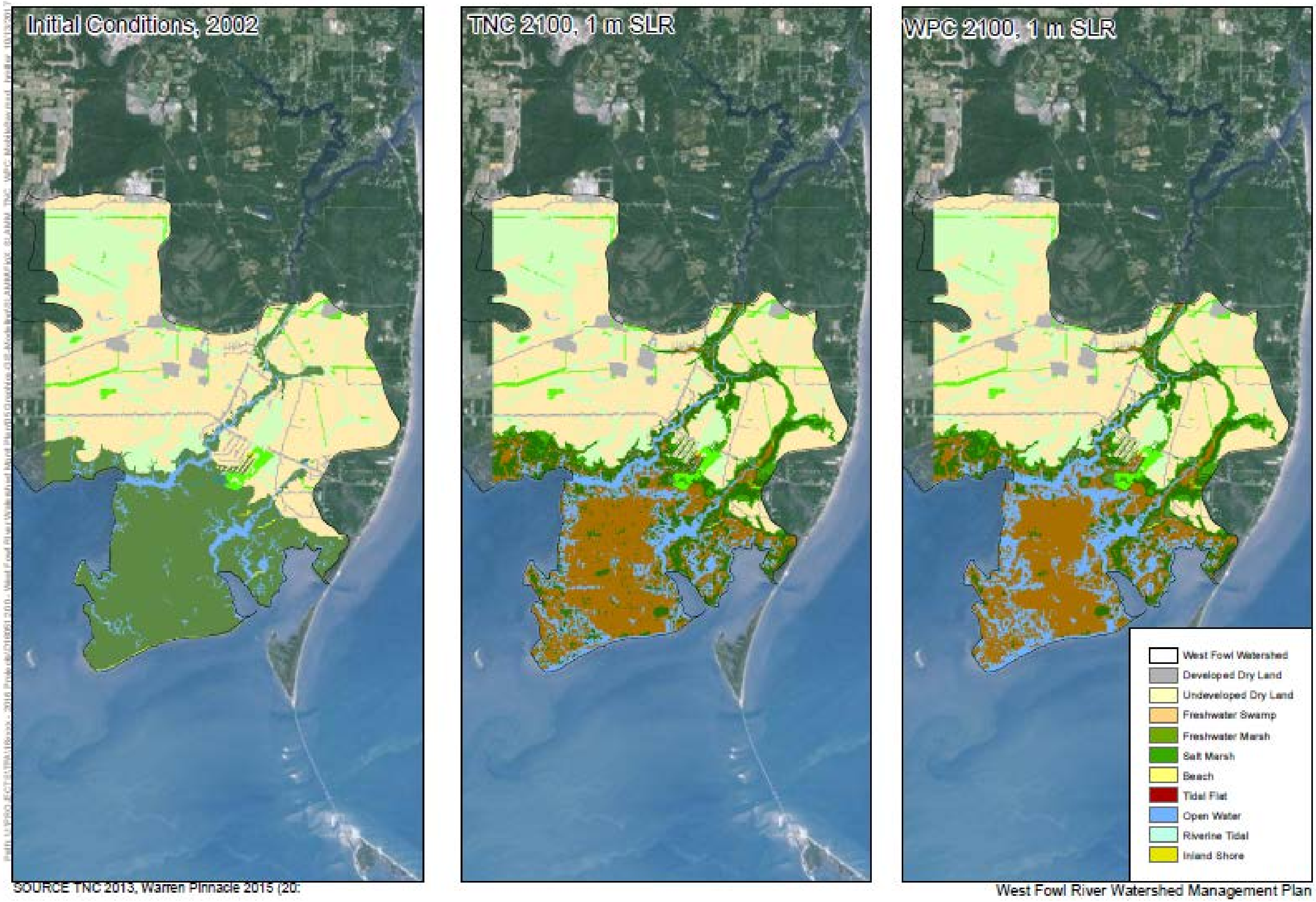


Figure 3.20 SLAM modeling of the West Fowl River Watershed in Mobile Bay Study Area, Comparison of the TNC and WPC Results

3.4.1.1.3 ESA 2015 and Goodwyn Mills Cawood 2016

Goodwyn Mills and Cawood (GMC 2016) led the Fowl River Watershed Management Plan, which included a SLAMM 6.5 analysis of the Fowl River estuary in Mobile Bay performed by ESA (ESA 2015). The goal of the modeling effort was to examine watershed opportunities for habitat restoration and conservation. Due to the proximity of the Fowl River watershed, the model inputs used in the ESA model are likely representative of the conditions in the West Fowl River watershed. The ESA model assessed habitat evolution at two SLR scenarios (0.53 m (21 in) and 0.74 m (29 in)) and four time steps (2030, 2050, 2070, and 2100).

3.4.1.1.4 ESA 2016

ESA (2016) used SLAMM 6.5 to model habitat evolution in Bayou La Batre, Alabama as part of the Bayou La Batre Watershed Management Plan. The ESA model assessed habitat acreage in 2030, 2050, 2070, and 2100 under two different SLR scenarios (0.53 m (21 in) and 0.74 m (29 in)). The modeling effort also included habitat evolution evaluation at two different accretion rates (high and low) and two different management scenarios ("allow migration" and "protect development"). Bayou La Batre is to the west of West Fowl River watershed, so the model inputs used in the ESA model are also good estimates of the conditions in the West Fowl River watershed.

Table 3.10 (below) presents a comparison of the different SLAMM inputs for TNC 2013, Warren Pinnacle 2015, and ESA 2015 and 2016.

3.4.1.1.5 Enwright et al. 2015

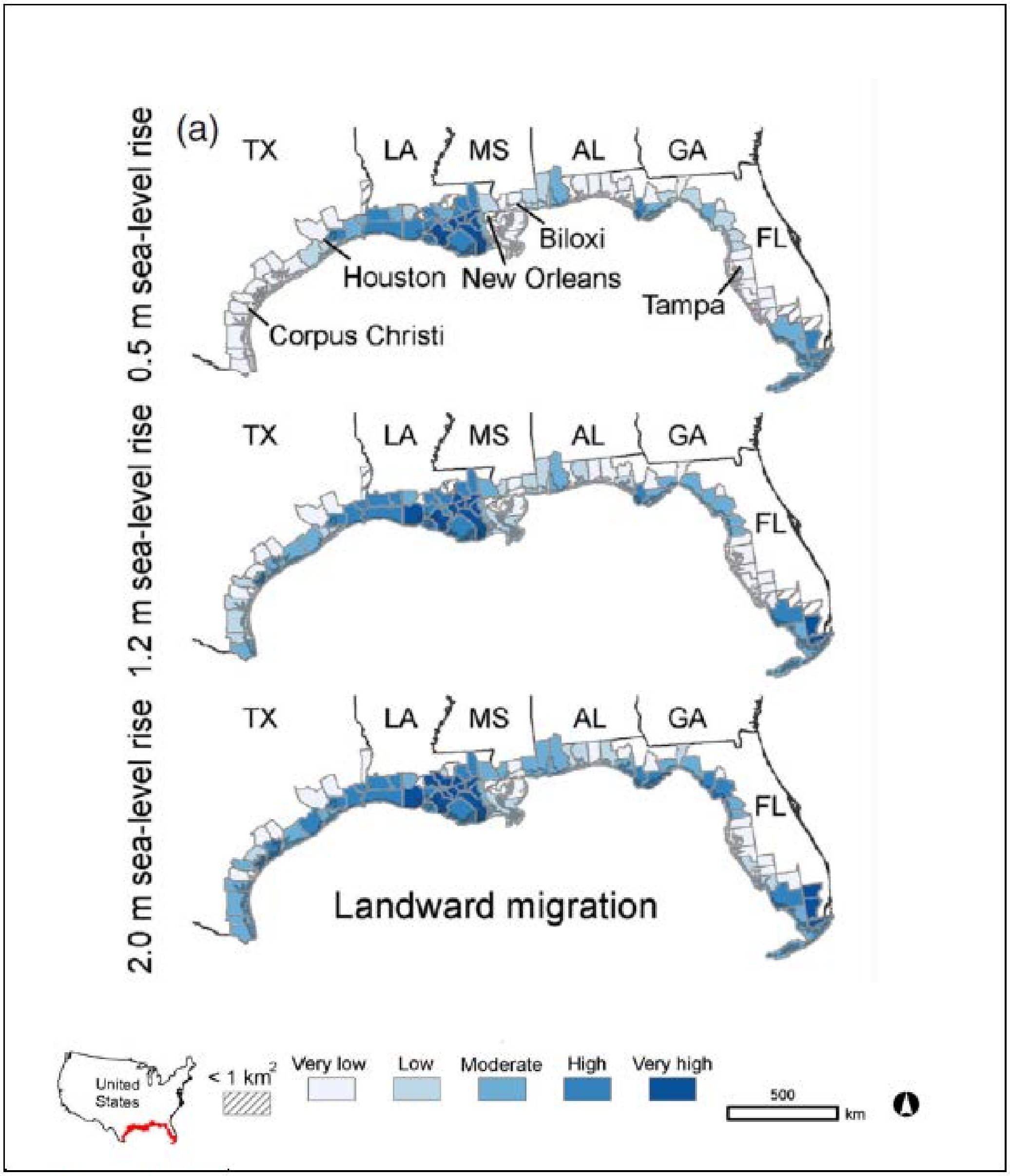
The USGS and the U.S. Fish and Wildlife Service (USFWS) quantified the landward migration of mangrove forests, salt marshes, and salt flats (collectively tidal saline wetlands (TSW)) in the Gulf of Mexico. The simplistic GIS model incorporated five different SLR scenarios (0.5, 1.0, 1.2, 1.5, and 2.0 m) and used existing and expected development barriers to model TSW migration by county at five discrete times: 2030, 2040, 2050, 2060, and 2100. The USGS and USFWS aimed to provide a public dataset detailing areas of expected TWS landward migration and areas where migration is prevented due to an existing or future barrier. The results of the five time steps and five SLR scenarios are available through the USGS. The results of this modeling effort were used in the paper by Enwright et al. (2016) as detailed below.

Table 3.10 Previous studies model inputs

Study	Model Used	Area/Region Modeled	Sea-Level Rise Values Modeled (m)	Accretion (mm/yr)	Erosion (m/yr)	Other notes
TNC 2013	SLAMM 6.2	Mobile Bay, AL	0.7, 1.0, 2.0	Saltmarsh: 11 Brackish Marsh: 4.4 Tidal Freshwater Marsh: 9 Beach Sediment Rate: 4.45	Marsh: 1.5 Tidal Flat: 0.8 Coastal Forest: 1	Freshwater influence polygon used
Warren Pinnacle 2015	SLAMM 6.5	Northern Gulf of Mexico	0.5, 1.0, 1.2, 1.5, 2.0	Saltmarsh: 11 Brackish Marsh: 4.4 Tidal Freshwater Marsh: 9 Beach Sediment Rate: 4.45 Mangrove: 7 Swamp: 0.3 Tidal Swamp: 1.1 Inland fresh marsh: 9	Marsh: 1.5 Tidal Flats: 0.8 Coastal Forest: 1	Freshwater influence polygon used
ESA 2015	SLAMM 6.5	Fowl River estuary	0.53, 0.74	Saltmarsh: 3.1 and 13.2 Brackish Marsh: 3.1 and 13.2 Tidal Freshwater Marsh: 3.1 and 13.2 Beach Sediment Rate: 3.1 and 13.2 Mangrove: 3.1 and 13.2 Swamp: 3.1 and 13.2 Tidal Swamp: 3.1 and 13.2 Inland Fresh Marsh: 3.1 and 13.2	Marsh: 0.82 Tidal Flat: 0.82 Swamp: 0.82	Freshwater influence polygon used
ESA 2016	SLAMM 6.5	Bayou La Batre	0.52, 0.74	Saltmarsh: 5.6 and 6.1 Tidal Freshwater Marsh: 5.6 and 6.1 Beach Sediment Rate: 5.6 and 6.1 Mangrove: 5.6 and 6.1 Swamp: 5.6 and 6.1 Tidal Swamp: 5.6 and 6.1 Inland Fresh Marsh: 5.6 and 6.1	Marsh: 0.571 Tidal Flat: 0.571 Swamp: 0.571	Freshwater influence polygon used
Enwright et. al. 2015	GIS model	Northern Gulf of Mexico	0.5, 1.0, 1.2, 1.5, 2.0	Not included in model	Not included in model	
Enwright et. al. 2016	GIS model	Northern Gulf of Mexico	0.5, 1.2, 2.0	Not included in model	Not included in model	
Passeri et. al. 2016	ADCIRC-2DDI	Northern Gulf of Mexico	0.11, 0.19, 0.20, 0.39, 0.50, 0.62, 1.2, 2.0		Up to 2 m total shoreline change	

3.4.1.1.6 Enwright et al. 2016

The results of the Enwright et al. (2015) modeling report were published in *Frontiers in Ecology and the Environment*. The goals of the publication were to generate discussion on specific SLR adaptation strategies and identify TSW migration corridors of high priority. The paper used only three of the five SLR scenarios outlined in the 2015 report (0.5, 1.2, and 2.0 m) to evaluate and qualitatively rank locations of TSW migration and impediment due to development and levees (**Figure 3.19**). Under the 2.0 m SLR scenario, the report found 25,792 km2 available for TSWs migration in the Gulf of Mexico; the West Fowl River region has moderate opportunities for landward migration. The study did not consider adaptation via local elevation changes (i.e. accretion and erosion) or make any predictions on habitat evolution.



SOURCE: Enwright et al. (2016)

Figure 3.21 TSW land migration opportunities

3.4.1.1.7 Passeri et al. 2016

The U.S. Geological Survey (USGS) examined the hydrodynamic impacts of SLR and projected morphologic changes in the Northern Gulf of Mexico, specifically focusing on three embayments (Apalachicola, Florida, Grand Bay, Mississippi, and Weeks Bay, Alabama). Weeks Bay is an embayment on the east side of Mobile Bay about 20 miles away from the West Fowl River watershed, while Grand Bay is west of the watershed, about 15 miles away. The objective of the study was to develop a large-domain hydrodynamic model to assess changes in water levels, tidal amplitudes and inundation, flood-ebb ratios, and current velocities under varying SLR scenarios (0.11, 0.19, 0.39, 0.62 m in 2050 and 0.2, 0.5, 1.2, and 2.0 m in 2100) and the corresponding alterations to shoreline morphology and boundary conditions. Though the authors noted that prior studies had recognized the dynamic nature of coastal morphology, few had evaluated what impact this may have on coastal hydrodynamics. The model used an existing Bayesian Network developed by Gutierrez (2014) to make probabilistic predictions of coastal morphology (shoreline and dune erosion and accretion) under each of the SLR scenarios.

The model found tidal amplitudes in Weeks Bay to increase by 15% (6.5 cm) in 2100 under the 2.0 SLR scenario, but found negligible changes in tidal amplitude in Grand Bay due to the open exposure of the Gulf of Mexico. Since West Fowl River also has open exposure, it would likely see similarly negligible changes in tidal amplitude. Under the same SLR scenario and time step, Mobile Bay experienced a 33% increase in inlet cross-sectional area, which could imply increased erosion in the West Fowl River watershed. Tidal velocities increased by 6.1 cm/s (102%) in Grand Bay, and 10.8 cm/s (63%) in Weeks Bay, which would also result in increased erosion.

3.4.1.2 SLAMM Results

The SLAMM studies by TNC (2013) and WPC (2015) provide the most useful information to understanding habitat evolution and restoration opportunities in the West Fowl River watershed. The model results show that most of the existing brackish/salt marsh will be inundated with 1.0 m of SLR and will convert to tidal flat and open water. Some areas of freshwater swamp will convert to salt marsh and freshwater marsh as these habitats move inland and upstream. Areas along the coast that are undeveloped will provide key opportunities for wetland migration.

The modeling effort conducted by Enwright et al. (2015 and 2016) provides a high-level understanding of potential habitat evolution in the county (and the whole Gulf Coast), but does not offer details at the watershed level.

The modeling efforts by ESA (2015 and 2016) and Passeri et al. (2016) can be used to evaluate the inputs used in the TNC and WPC models. For example, ESA modeled varying levels of accretion in the Fowl River and Bayou La Batre watersheds and concluded that the model was most sensitive to this factor. However, the TNC and WPC models only evaluated one accretion scenario. ESA found that the different levels of accretion rates resulted in different arrangements of habitats, and not necessarily in the expected patterns (e.g. high accretion rates resulting in more wetland habitat for longer), because when certain habitats kept up with sea level rise, it was at the expense of the expansion of other habitats. Therefore, using accurate accretion rates or modeling a range of accretion rates to bookend the possible results is key to understanding habitat evolution in the West Fowl River watershed.

3.4.1.3 SLAMM Conclusions

The TNC (2013) and WPC (2015) modeling identified areas in the West Fowl River watershed that could provide restoration opportunities in the future. From west to east:

- The area between Bayou La Batre and Bayou Coden along the coast is expected to evolve to freshwater marsh with 1 m of SLR if development is not protected. However, the area is heavily armored to protect Shell Belt Road, which runs along the coastline in this area. Coastal managers may eventually want to consider managed retreat and moving this road inland as inundation becomes more frequent. The area would then provide an ideal restoration opportunity.
- The land surrounding Bayou Coden is projected to evolve to salt and freshwater marsh with 1 m of SLR if development is not protected. This area could provide one of the more contiguous habitats in the watershed, but current land uses may limit the land available for habitat migration. Currently, dredging the bayou is being considered to accommodate larger vessels, so retreat in this area may not be feasible. However, as these areas become inundated more frequently during storm events, coastal managers may consider managed retreat of this area.
- Freshwater marsh is expected to migrate up into Bayou Como along its full extent under 1 m of SLR. The area is currently constrained by Clark Road, which crosses the bayou at the mouth, and may limit the amount of tidal flow that can enter the area. Additionally, there are a few houses in the area, although large swaths remain undeveloped and may offer good areas for habitat migration.
- Another large swath of undeveloped dry land to the north of Bayou Sullivan is expected to convert to freshwater marsh under 1 m of SLR. This area appears to be largely undeveloped, so it could provide an ideal restoration opportunity.
- The area north of Negro Bay to the west of Negro Bayou is currently a large area of undeveloped dry land with some swamp. With 1 m of SLR, this area is expected to convert to salt and freshwater marsh.
- Along West Fowl River near the north and east branch, salt marsh is expected to expand into areas of freshwater swamp and undeveloped land with 1 m of SLR. Some of the areas along the river have light development, but there are other swaths that are undeveloped that could provide good opportunities for habitat migration.
- Heron Bayou also provides a large area where salt and freshwater marsh is expected to expand with 1 m of SLR. Some of this area is already swamp and other areas are undeveloped or lightly developed.

These opportunities focus on areas that would be inundated under 1 m of SLR, but it is important to keep in mind that SLR will continue well beyond 1 m, which may provide additional opportunities moving into the future.

The TNC and WPC models provide insight into how habitats may evolve in the future in the West Fowl River watershed, but exact acreages should be considered approximate. As discussed in Section 2, accretion rates can have dramatic impacts on the model results and both the TNC and WPC models only considered one accretion scenario. Future efforts should focus on gathering data on local accretion rates for each habitat type and modeling multiple accretion scenarios to bookend the range of habitat evolution.

Since the West Fowl River watershed is relatively sparsely developed, the modeling results show that tidal marsh habitats have adequate space to migrate into low lying undeveloped upland areas as sea levels rise. It is recommended that the West Fowl River Watershed Management Plan identify large undeveloped tracts in the watershed for potential public acquisition conservation easements or to ensure that there is adequate land area to allow for the upland migration of tidal marsh habitats with future sea-level rise.

3.4.2 SLOSH Model

The Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model is a two-dimensional numerical model developed by the National Weather Service to estimate storm surge heights from historical, hypothetical, or predicted hurricanes. The model is subdivided into 34 basins covering the entire Atlantic and Gulf of Mexico shorelines, as well as Hawaii, Puerto Rico, the Virgin Islands, and the Bahamas.

For each basin, the National Hurricane Center (NHC) runs thousands of hypothetical hurricanes under different storm conditions. These runs are used to generate Maximum Envelopes of Water (MEOWs) and Maximum of MEOWs (MOMs).

MEOWs provide a worst case scenario for each category of storm, forward speed, radius of maximum wind, landfall location, and tidal levels. MOMs are considered to be the worst case scenario for each category of storm.

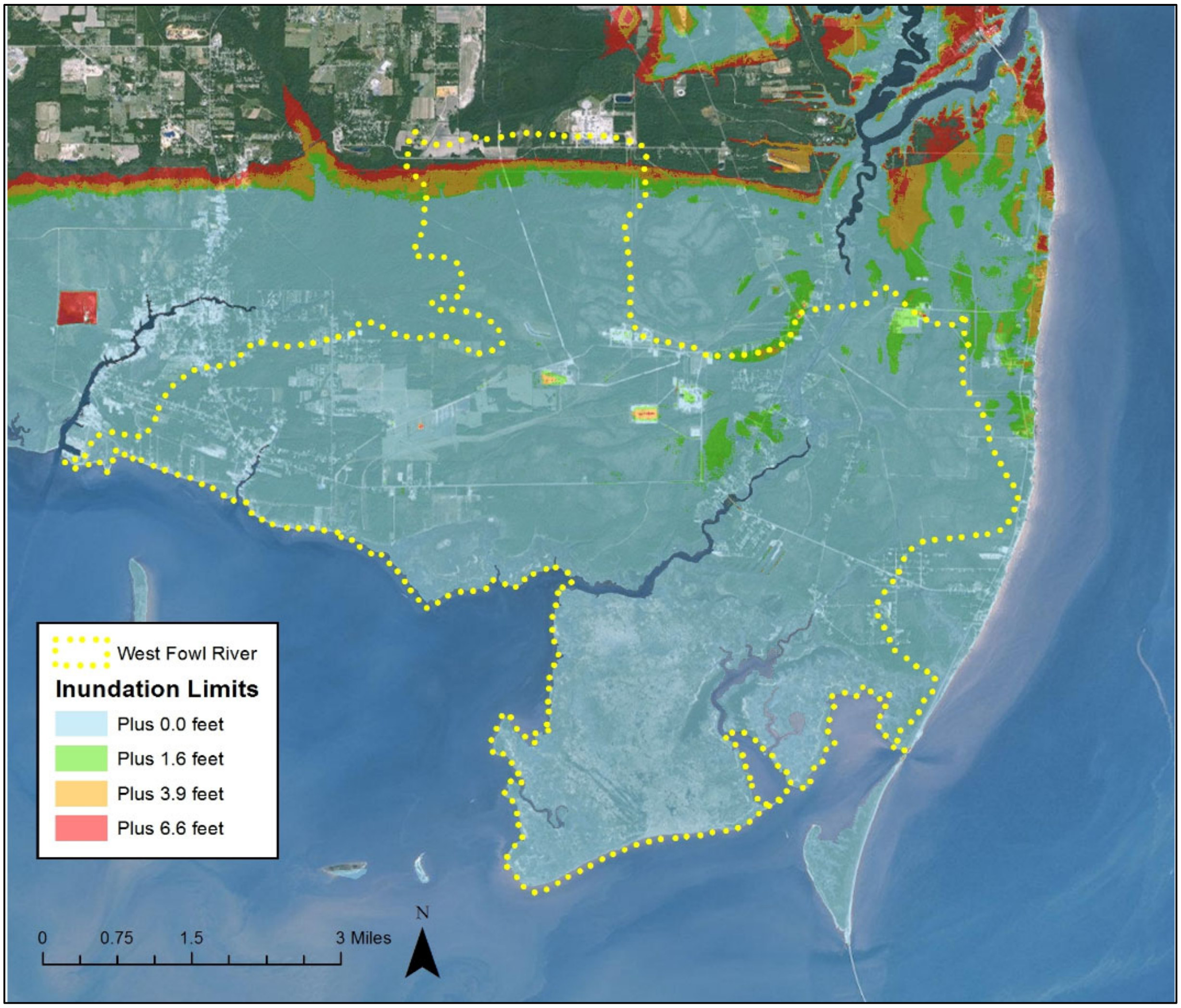


Figure 3.22 SLOSH Model of Inundation Limits

3.4.2.1 SLOSH Model Inputs

For the West Fowl River, the SLOSH model used is the Mobile Bay Version 3 (EMO2), developed by the NHC in 2008. The Category 3 MOM with an initial tidal level of 1.4 feet was used for this scenario. Storm surge elevations are in the North American Vertical Datum of 1988 (NAVD88).

3.4.2.2 Sea Level Rise Scenarios

The West Fowl River Sea Level Rise (SLR) scenarios are based on the ongoing NOAA-funded and aforementioned research *Ecological Effects of SLR in the Gulf of Mexico*. For this study, Global SLR Scenarios for the United States National Climate Assessment (2012) were used and three scenarios were modeled including intermediate-low, intermediate-high, and highest.

3.4.2.3 Digital Elevation Model

Storm surge data from the EMO_2 basin were exported from the SLOSH display program and imported into ArcGIS. Centroids of the SLOSH grids were exported to an ESRI point shapefile.

Points lying outside of the West Fowl River HUC 12 basin were removed from the data set. A water surface was created from the centroids using the Inverse Distance Weighting (IDW) tool within ArcGIS. The methodology of using IDW for water surface creation from SLOSH is common practice and documented by FEMA.

In order to model the anticipated sea level rise scenarios, the increased sea levels from the highest (6.6 feet), intermediate-high (3.9 feet) and intermediate-low (1.6 feet) scenarios were added to the storm surge heights and water surfaces were created from these. To determine the inland extent of flooding, the water depth was determined by subtracting the ground elevation from the water surfaces.

3.4.2.4 SLOSH Model Results

Figure 3.22 depicts the extent of combined SLOSH and SLR inundation under each scenario (intermediate-low, intermediate-high and highest). A category 3 hurricane storm surge affects nearly every structure within the study area including residential, commercial, and retail properties. In addition to buildings, a category 3 hurricane storm surge affects nearly all the roads within the Watershed including major road corridors such as Highway 188 and Bellingrath Road. The only road within the watershed not affected by SLOSH model results is Deakle Road in the extreme northern parameter of the Watershed. While the determination of exact flooding depths is not available for roadways, the potential to have these roads impassable during storm events is a major concern. Highway 188 and Bellingrath Road serve as evacuation routes and are connections to local emergency facilities.

The habitat and water quality changes that may occur due to the increased inundation depths from a category 3 hurricane include:

- Increased depth of flooding from extreme events will put more land areas at risk further threatening the stability of soils and foundational materials. This would increase the sediment loads and associated pollutant loadings (i.e. heavy metals), increased nutrients, and Biochemical Oxygen Demand (BOD) from increased organic debris to the bayou and its tributaries.
- Increased depth of flooding from extreme events will put new land areas at risk increasing the frequency of SSO leading to higher pathogen loads entering the River and its tributaries.

3.5 Shorelines

With exception of shoreline armoring, almost all of the natural shoreline within the watershed is vegetated, with *Juncus roemerianus* dominating most of the marshes. Some *Spartina alterniflora* fringe is evident later in the growing season (i.e., July – October). Outside of the river proper, the shoreline composition is similar with expansive marshes continuing south through Fowl River Bay and east towards Heron Bayou and Heron Bay. West of Fowl River Bay, shorelines are vegetated or characterized by low sandy bank backed by high marsh vegetation near Negro Bayou, Grand Point, Bayou Sullivan, and Bayou Como. West of Bayou Como, there is a rock revetment protecting Coden Belt Road; it ends at Bayou Coden. There is another rock revetment west of Bayou Coden, which protects Shell Belt Road before ending near Lightning Point. A general location overview is provided in **Figure 3.23**.

There are some previous studies and existing data regarding characterization of shorelines, historic shoreline positions, and coastal processes within, or very near to, the watershed. A comprehensive characterization of watershed shoreline type and condition was performed by the Geological Survey of Alabama (Jones & Tidwell 2012). That report documents the lengths and percentages (of total shoreline) of shore protection and shoreline type along West Fowl River (called South Fowl River in report), Fowl River Bay and Portersville Bay, Heron Bay, and Bayou Coden. These data are presented photographically in a GIS-type format and also tabulated. Also shown in the figures are the locations of private and public boat launches. While no published reports on shoreline position and/or shoreline change were found during this study, a number of existing data sets are available and can be used to describe changes in shoreline position over time. Such data sets include digitized shorelines available from the National Geodetic Survey and aerial photography from which shorelines can be digitized. There is comparatively little existing information regarding the coastal processes within the watershed itself, but that is to be expected given its size and limited fetch. The primary wave action within the river is certainly related to boat traffic, while wind-generated waves dominate in Fowl River Bay and Heron Bay. There is, however, some information about the coastal processes of Mississippi Sound and more specifically the area of Portersville Bay adjacent to the mouth of West Fowl River. In their feasibility report on navigation improvements, the US Army Corps of Engineers (USACE 1988) generally describes the coastal processes and major shoreline changes within Portersville Bay during the 1900s.

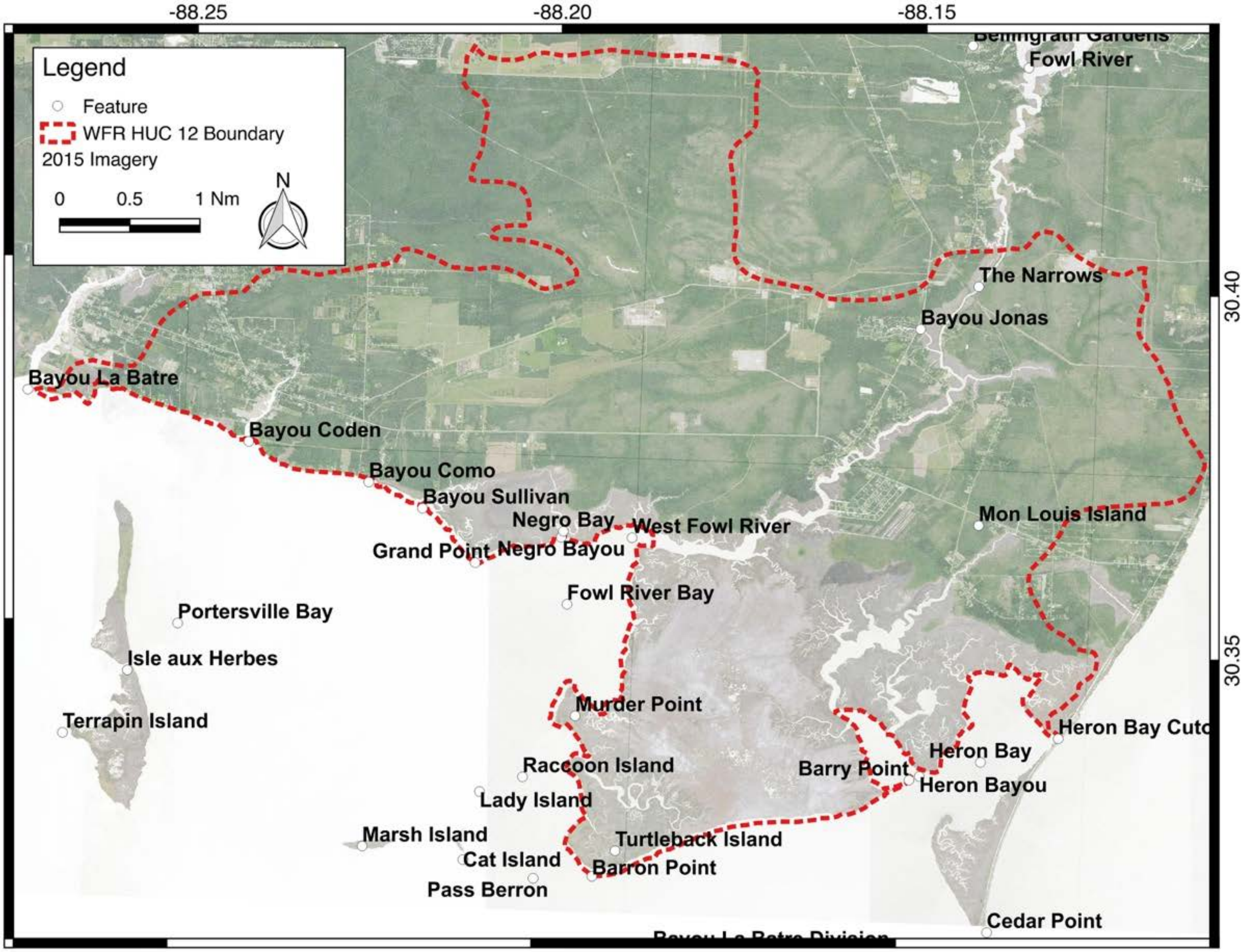


Figure 3.23.Location overview map of the West Fowl River (WFR) watershed with location labels, the HUC-12 boundary, and 2015 aerial imagery

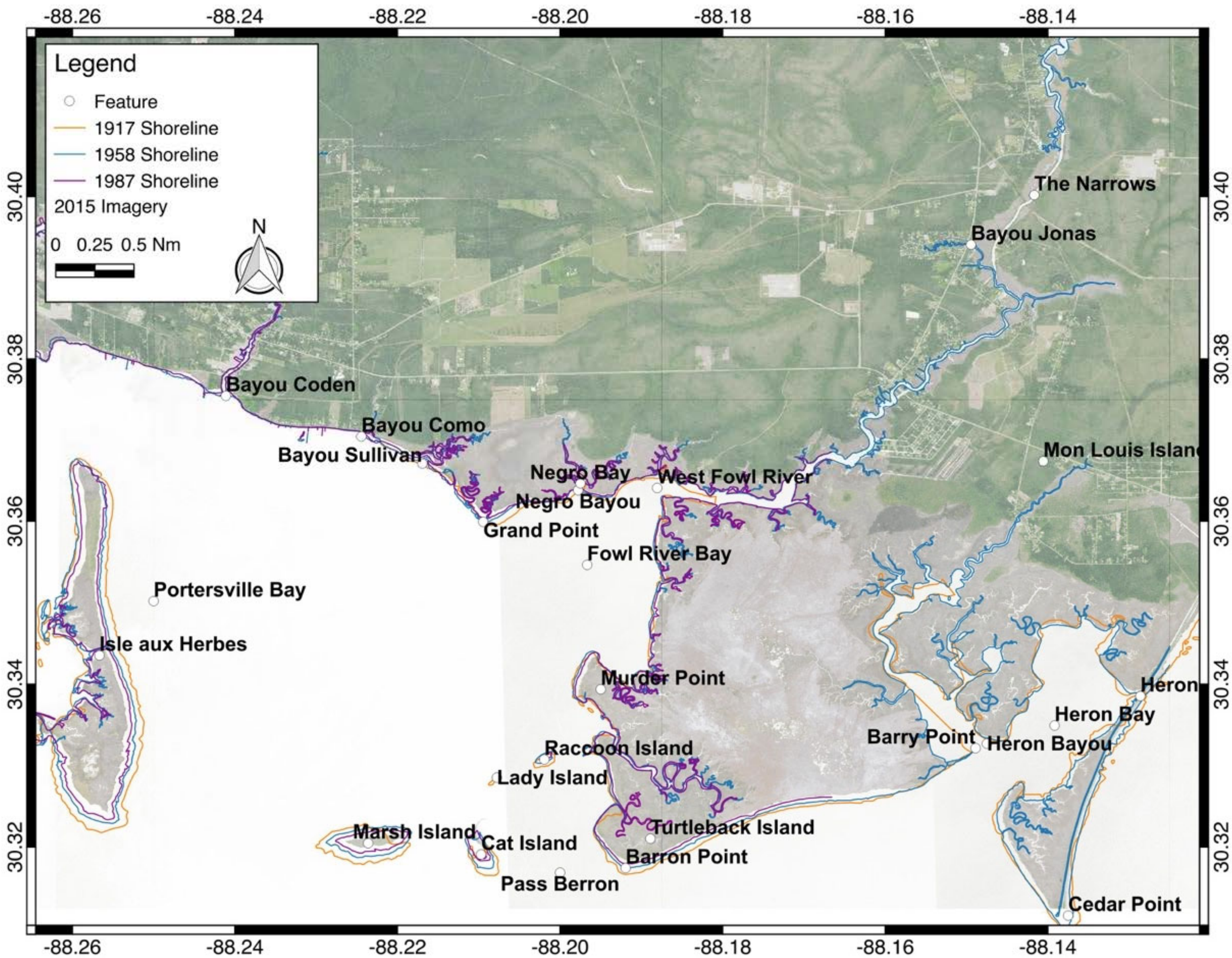


Figure 3.24. Shoreline data overview for the period 1917 - 2015. The background imagery shows the approximate position of the present day shoreline (2015)

3.5.1 Existing Data

Shoreline position data are typically derived from old surveys, nautical charts, and aerial photography of acceptable resolution, or a combination thereof. The National Geodetic Survey's National Shoreline Data Explorer is an online repository of shoreline position data, some of which is provided in vector format for viewing in GIS software. An example of such data is provided in Figure 3.24, which shows the shoreline positions of 1917, 1958, and 1987 using vector shoreline data, and in 2015 by aerial imagery. More detailed imagery and shoreline data are shown in subsequent sections. Additional shoreline positions were not developed for this study, but they could be digitized using any aerial imagery of acceptable resolution. A listing of available vector shorelines and suitable aerial imagery for this study area is provided in **Table 3.11**.

Table 3.11 List of existing shoreline position and aerial imagery data

Year	Type	Source
1916	Vector Shoreline	https://www.ngs.noaa.gov/NSDE/
1940	Aerial Photography	http://alabamamaps.ua.edu/aerials/
1945	Vector Shoreline	https://www.ngs.noaa.gov/NSDE/
1950	Aerial Photography	http://alabamamaps.ua.edu/aerials/
1958	Vector Shoreline	https://www.ngs.noaa.gov/NSDE/
1987	Vector Shoreline	https://www.ngs.noaa.gov/NSDE/
1992	Aerial Photography	Google Earth
1997	Aerial Photography	Google Earth
2005	Aerial Photography	Google Earth
2006	Aerial Photography	Google Earth
2007	Aerial Photography	Google Earth
2008	Aerial Photography	Google Earth
2010	Aerial Photography	Google Earth
2011	Aerial Photography	Google Earth
2012	Aerial Photography	Google Earth
2013	Aerial Photography	Google Earth
2015	Vector Shoreline	https://www.ngs.noaa.gov/NSDE/
2015	Aerial Photography	Google Earth
2016	Aerial Photography	Google Earth
2017	Aerial Photography	Google Earth

3.5.2 Shoreline Conditions

The current shoreline conditions are best summarized in a GSA report by Jones & Tidwell (2012). In that report, lengths and percentages of the overall shoreline are tabulated in terms of shore protection type and shoreline composition.

Over 438,000 feet of shoreline within the West Fowl River watershed were assessed as part of the Jones & Tidwell (2012) study. That report segregates portions of the watershed into West Fowl River (called South Fowl River in the study), Heron Bay, Fowl River Bay and Portersville Bay, and Bayou Coden. The report also includes an assessment of Coffee Island (Isle aux Herbes), but this island is not considered in our analysis and description below. With the exception of Bayou Coden, a large majority of shorelines in this watershed are characterized as natural or unretained and there is very little shoreline armoring. Bayou Coden has the highest percentage of total armoring at about 45% whereas the other regions vary from 2% to 13%. Not including artificial shorelines, the three most common shoreline types in this watershed are marsh and marsh fringe (30 – 80%), vegetated bank (1 – 33%), and sandy bank (3 – 54%). Shoreline classifications by type and armoring are summarized in **Table 3.12** – **Table 3.19**.

Table 3.12 Lengths and percentages of shore protection by type in West Fowl River (Jones & Tidwell 2012)

South Fowl River		
Shore protection classification	**Length (ft)**	**Percent**
Abutment	60	0.0
Boat Ramp	748	0.5
Bulkhead (concrete, rock)	666	0.4
Bulkhead (steel, wood)	15,246	9.9
Bulkhead (w/riprap)	283	0.2
Groin	12	0.0
Natural, unretained	132,209	86.0
Oyster Shells	2,006	1.3
Rubble/riprap	2,404	1.6
Segmented Breakwater (Wave Attenuation Device)	51	0.0
Tires	91	0.1
Total	153,776	100.0

Table 3.13 Lengths and percentages of shoreline by composition in West Fowl River (Jones & Tidwell 2012)

South Fowl River		
Shoreline type classification	**Length (ft)**	**Percent**
Artificial	1,709	1.1
Inlet	2,790	1.8
Organic (marsh)	73,367	46.8
Organic (open, vegetated fringe)	21,967	14.0
Organic (swamp forest)	839	0.5
Pocket Beach	263	0.2
Sediment bank (high, 5 - 20 ft)	2,928	1.9
Sediment bank (low, 0 - 5 ft)	1,329	0.8
Vegetated bank (high, 5 - 20 ft)	14,226	9.1
Vegetated bank (low, 0 - 5 ft)	37,515	23.9
Total	156,933	100.0

Table 3.14 Lengths and percentages of shore protection by type in Heron Bay (Jones & Tidwell 2012)

Heron Bay		
Shore protection classification	**Length (ft)**	**Percent**
Abutment	211	0.1
Boat Ramp	145	0.1
Bulkhead (concrete, rock w/riprap)	855	0.6
Bulkhead (concrete, rock)	292	0.2
Bulkhead (steel, wood)	551	0.4
Natural, unretained	140,803	96.5
Oyster Shells	1,317	0.9
Revetment	90	0.1
Rubble/riprap	1,687	1.2
Sill (wood)	20	0.0
Total	145,971	100.0

Table 3.15 Lengths and percentages of shoreline by composition in Heron Bay (Jones & Tidwell 2012)

Heron Bay		
Shoreline type classification	**Length (ft)**	**Percent**
Artificial	3,506	2.1
Inlet	3,632	2.2
Organic (marsh)	112,866	68.3
Organic (open, vegetated fringe)	19,664	11.9
Pocket Beach	131	0.1
Sediment bank (high, 5 - 20 ft)	1,592	1.0
Sediment bank (low, 0 - 5 ft)	9,716	5.9
Vegetated bank (low, 0 - 5 ft)	14,046	8.5
Total	165,153	100.0

Table 3.16 Lengths and percentages of shore protection by type in Fowl River Bay and Portersville Bay (Jones & Tidwell 2012)

Fowl River Bay and Portersville Bay		
Shore protection classification	**Length (ft)**	**Percent**
Abutment	243	0.3
Bulkhead (steel, wood)	5,554	5.9
Bulkhead (w/riprap)	3,036	3.3
Concrete Rubble (Nearshore)	303	0.3
Natural, unretained	70,319	75.3
Oyster Shells	1,798	1.9
Rubble/riprap	1,771	1.9
Segment Breakwater (rip-rap)	1,332	1.4
Segmented Breakwater (oyster shell)	947	1.0
Segmented Breakwater (Wave Attenuation Device)	2,996	3.2
Wetland Restoration	5,101	5.5
Total	93,399	100.0

Table 3.17 Lengths and percentages of shoreline by composition in Fowl River Bay and Portersville Bay (Jones & Tidwell 2012)

Fowl River Bay and Portersville Bay		
Shoreline type classification	**Length (ft)**	**Percent**
Artificial	11,791	11.5
Inlet	5,010	4.9
Organic (marsh)	80,498	78.6
Organic (open, vegetated fringe)	46	0.0
Sediment bank (low, 0 - 5 ft)	4,664	4.6
Vegetated bank (low, 0 - 5 ft)	388	0.4
Total	102,398	100.0

Table 3.18 Lengths and percentages of shore protection by type in Bayou Coden (Jones & Tidwell 2012)

Coden Bayou		
Shore protection classification	**Length (ft)**	**Percent**
Boat Ramp	95	0.7
Bulkhead (concrete, rock)	352	2.6
Bulkhead (steel, wood)	2,257	16.7
Cement	28	0.2
Natural, unretained	4,004	29.7
Oyster Shells	3,192	23.6
Rubble/riprap	3,570	26.5
Total	13,497	100.0

Table 3.19Lengths and percentages of shoreline by composition in Bayou Coden (Jones & Tidwell 2012)

Coden Bayou		
Shoreline type classification	**Length (ft)**	**Percent**
Artificial	1,326	9.8
Inlet	98	0.7
Organic (marsh)	224	1.7
Organic (open, vegetated fringe)	3,842	28.3
Sediment bank (low, 0 - 5 ft)	7,347	54.2
Vegetated bank (low, 0 - 5 ft)	728	5.4
Total	13,565	100.0

Generally, the condition of the natural, vegetated marsh shorelines is good. There are few visible signs of undercutting or scarping along the marsh edge, some of which occurred during the passage of Hurricane Nate in October 2017. However, there have been dramatic changes in shoreline position along portions of Portersville Bay, Fowl River Bay, and Heron Bay. Some shoreline retreat distances are on the order of 500 – 1000 ft. Also, the shrinking and ultimate disappearance of some islands in Portersville Bay is notable. The next series of figures shows some of the shoreline retreat over the last century (1917 – 2015). The exact cause of retreat is unknown but likely attributable to tropical storms, hurricanes, long-term sea level rise, and a lack of available sediments.

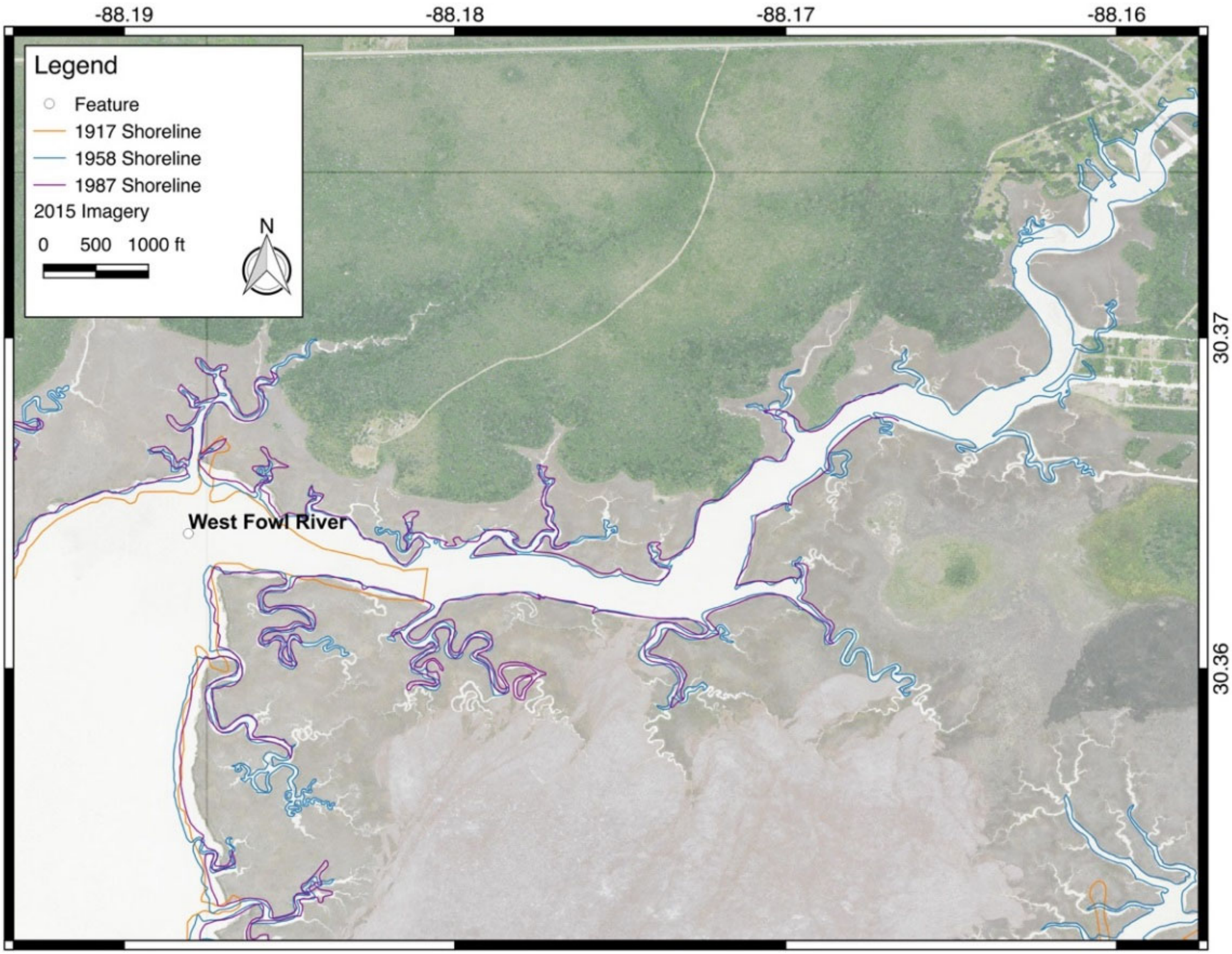


Figure 3.25 Previous shoreline locations along the lower portion of West Fowl River

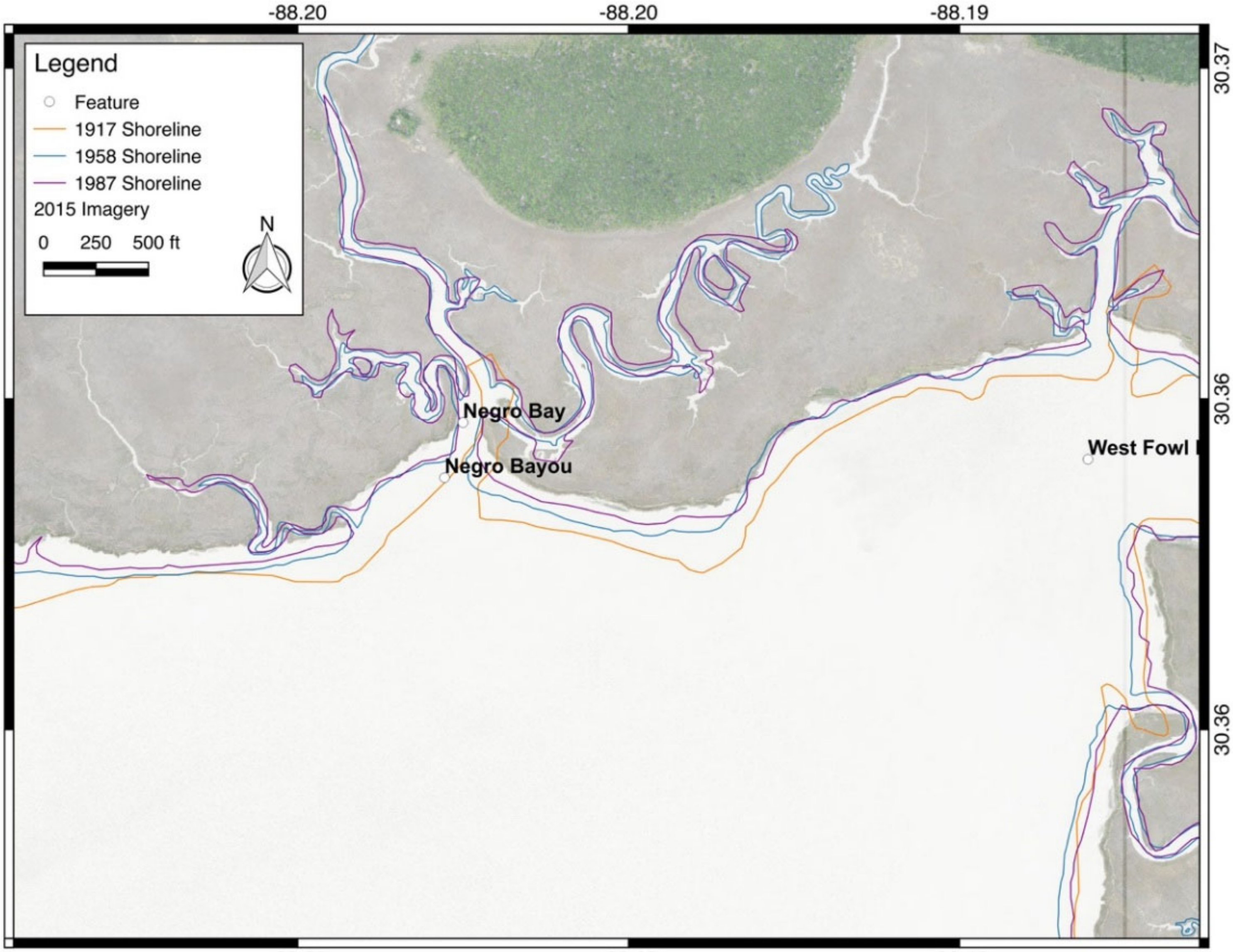


Figure 3.26 Prior shoreline locations along Fowl River Bay and Negro Bayou

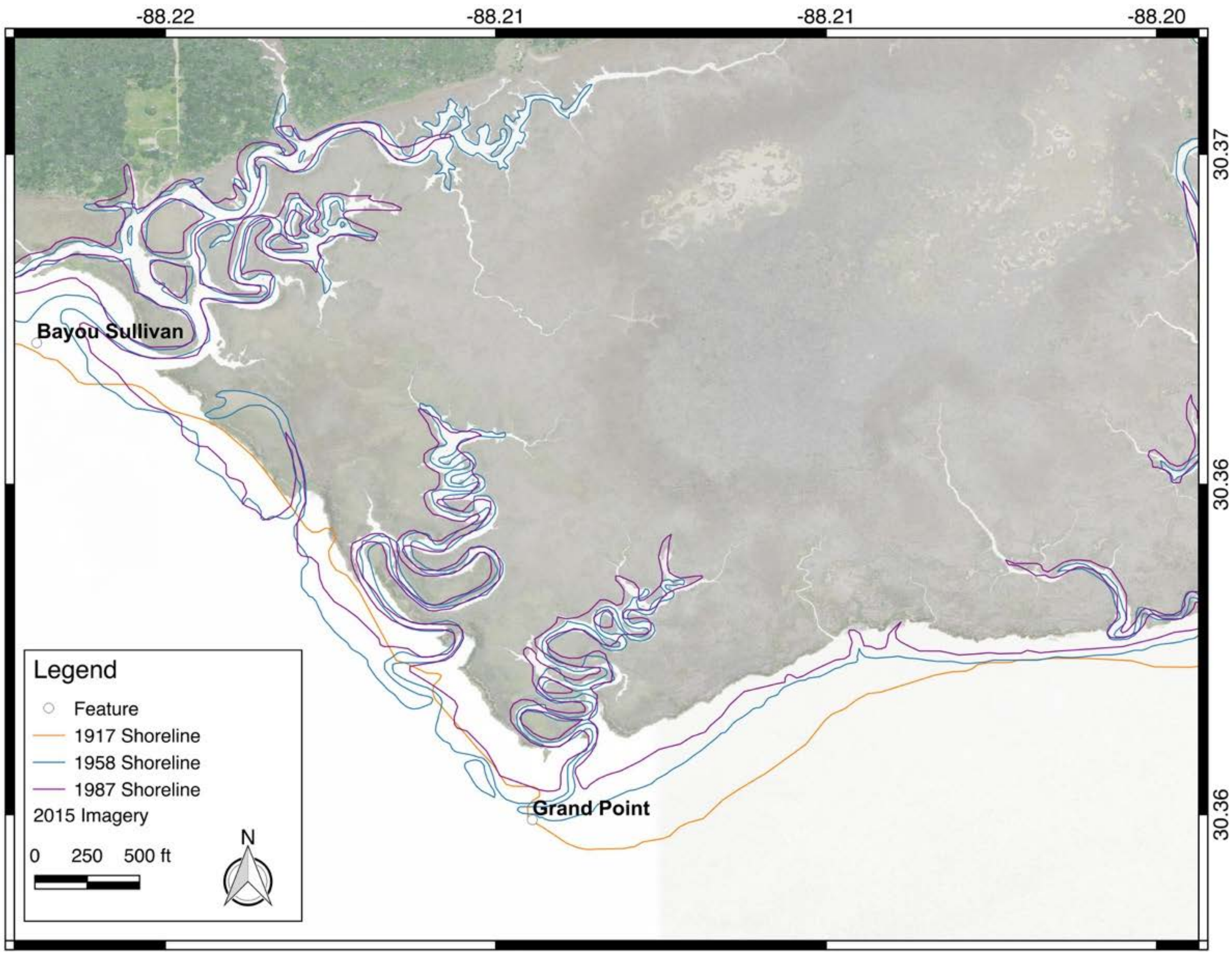


Figure 3.27 Historical shoreline positions near Grand Point and Bayou Sullivan

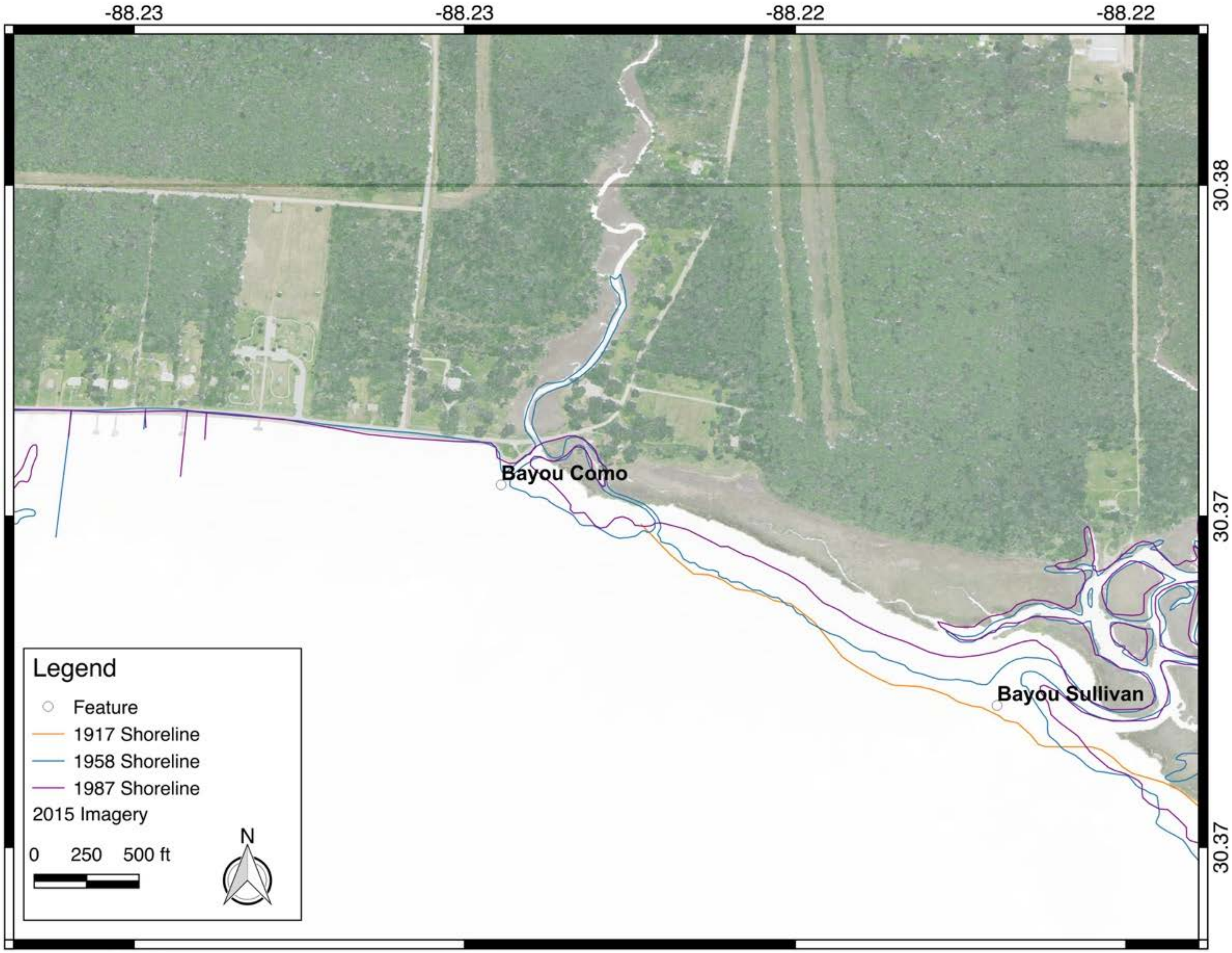


Figure 3.28 Historical shoreline positions near Bayou Como

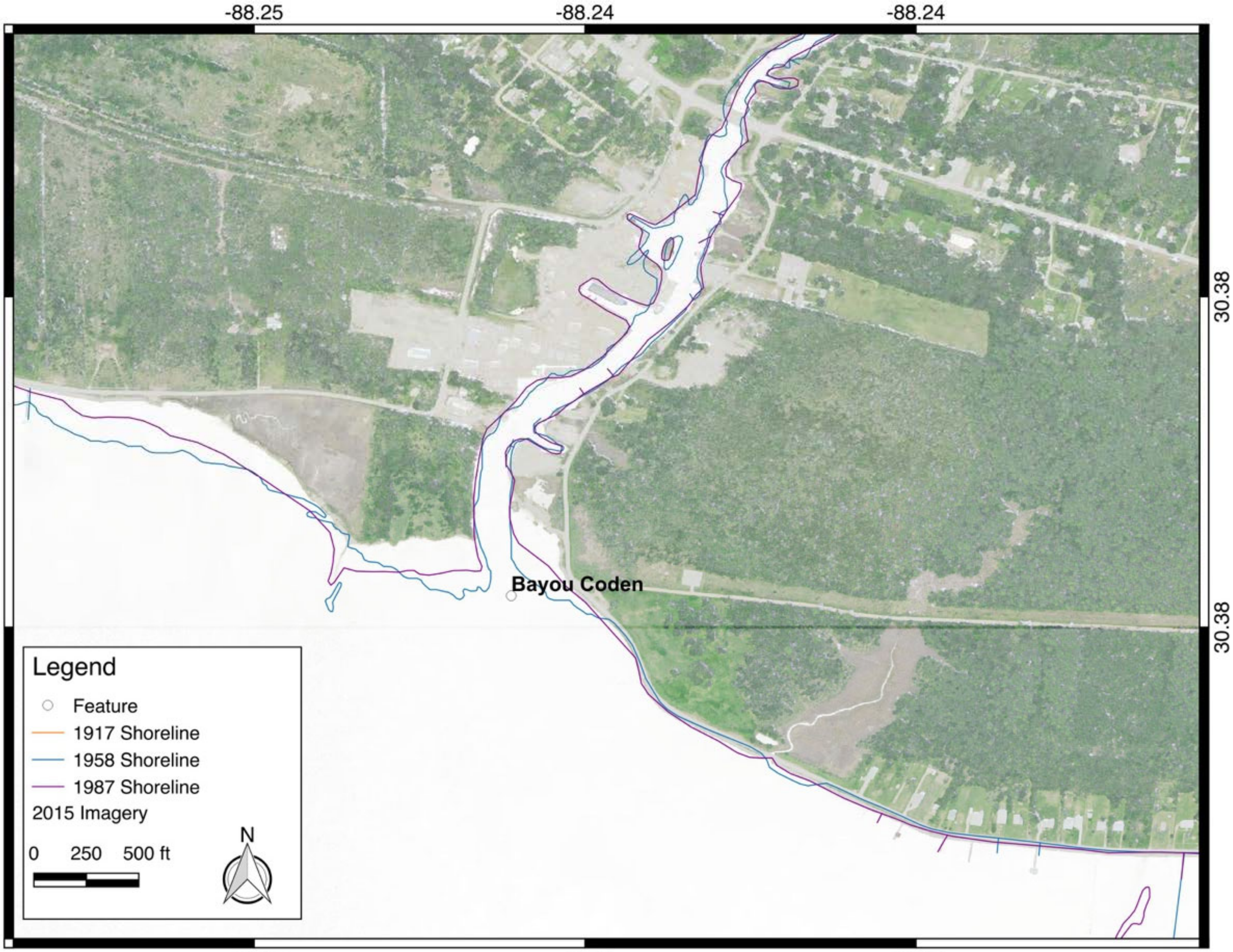


Figure 3.29 Historical shoreline positions near Bayou Coden

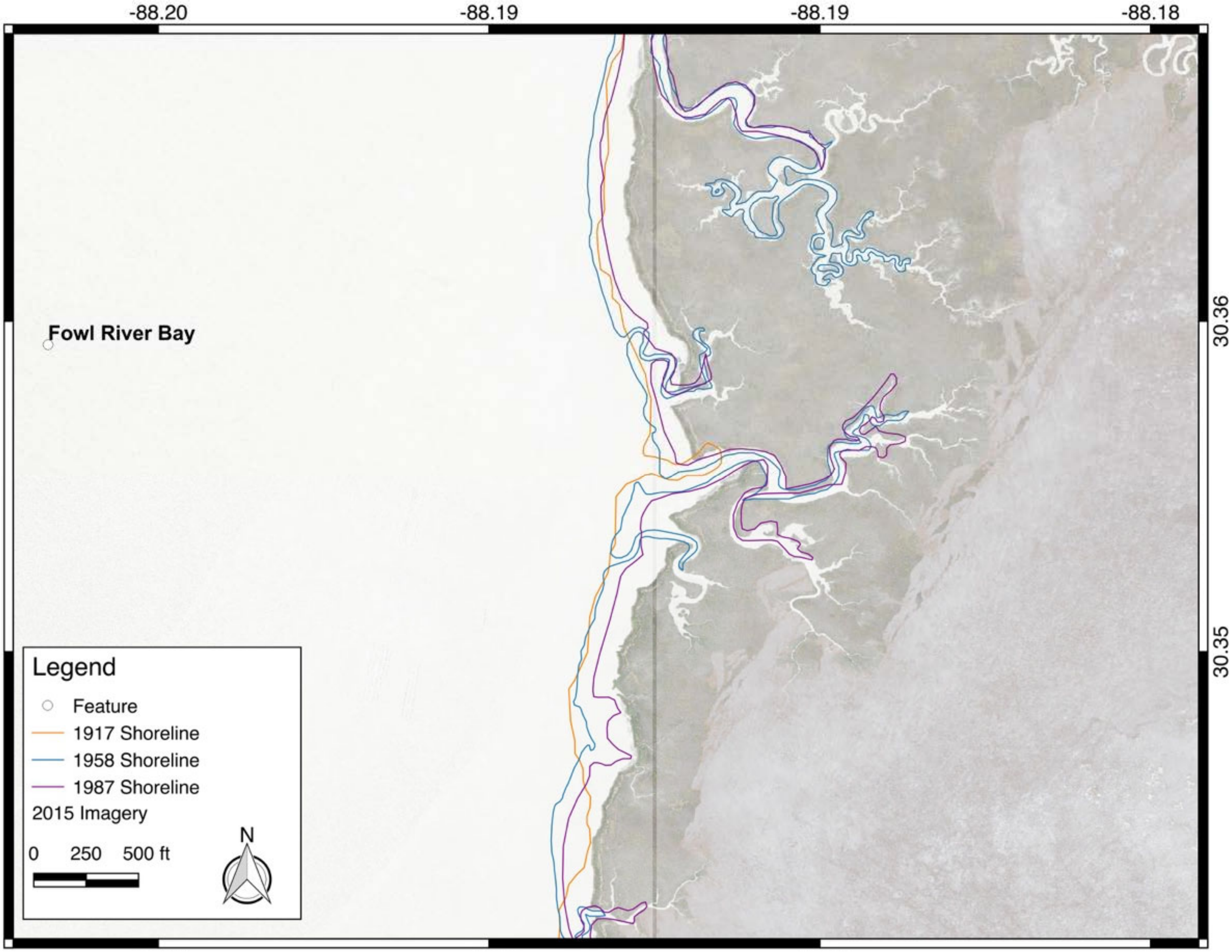


Figure 3.30 Historical shoreline positions along Fowl River Bay

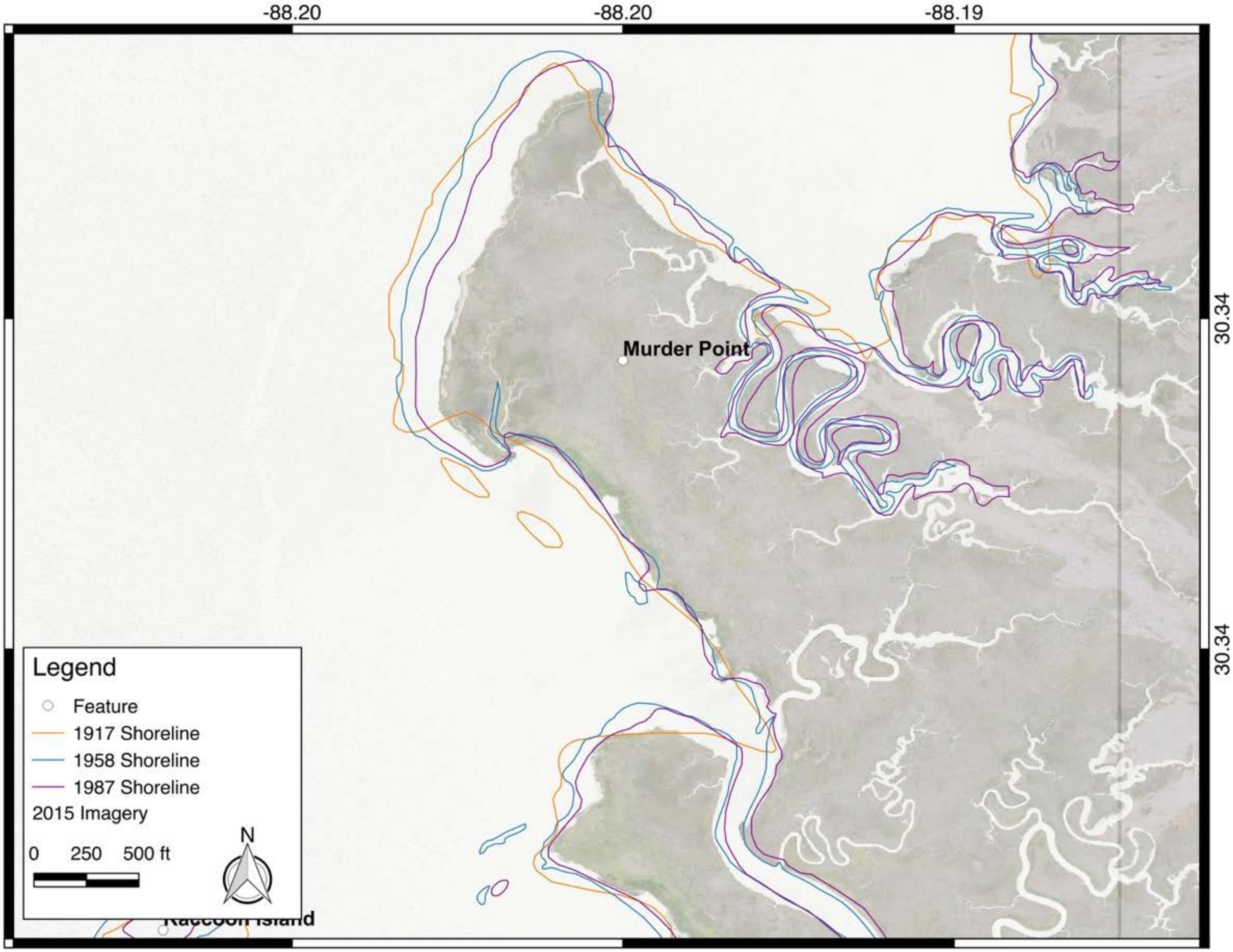


Figure 3.31 Historical shoreline positions near Murder Point in Fowl River Bay

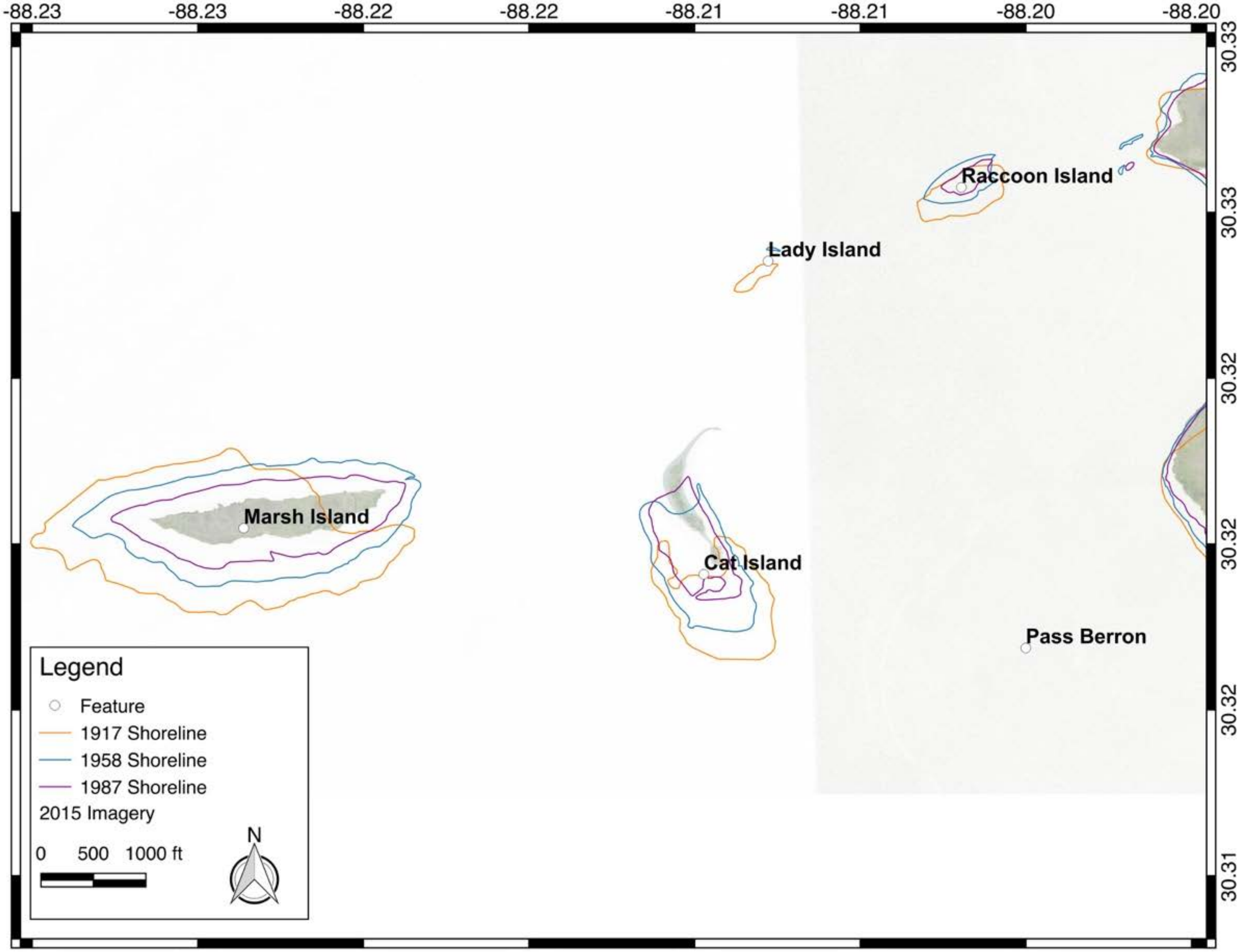


Figure 3.32 Historical island shorelines and locations in lower Fowl River Bay

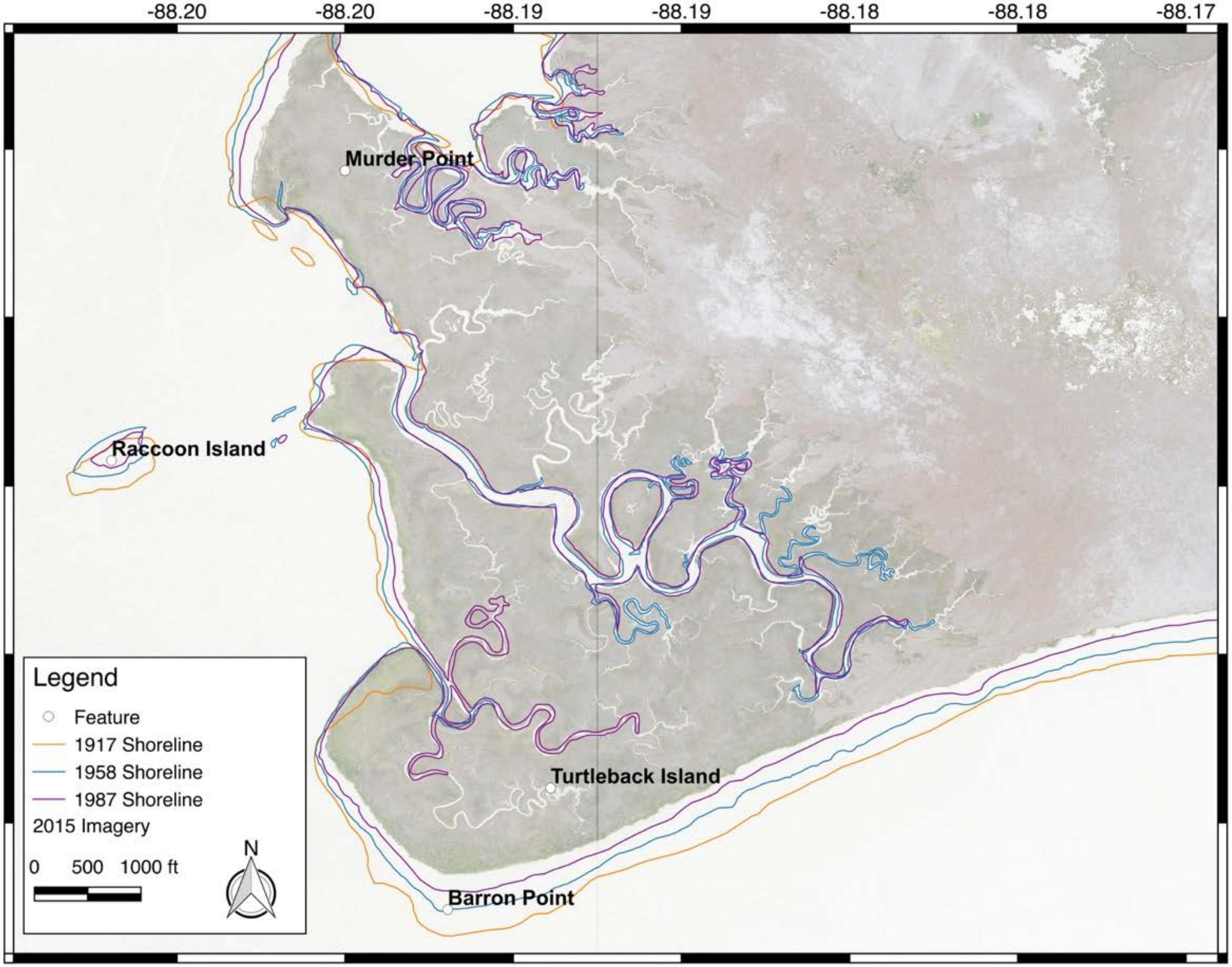


Figure 3.33 Historical shoreline positions near Barron Point

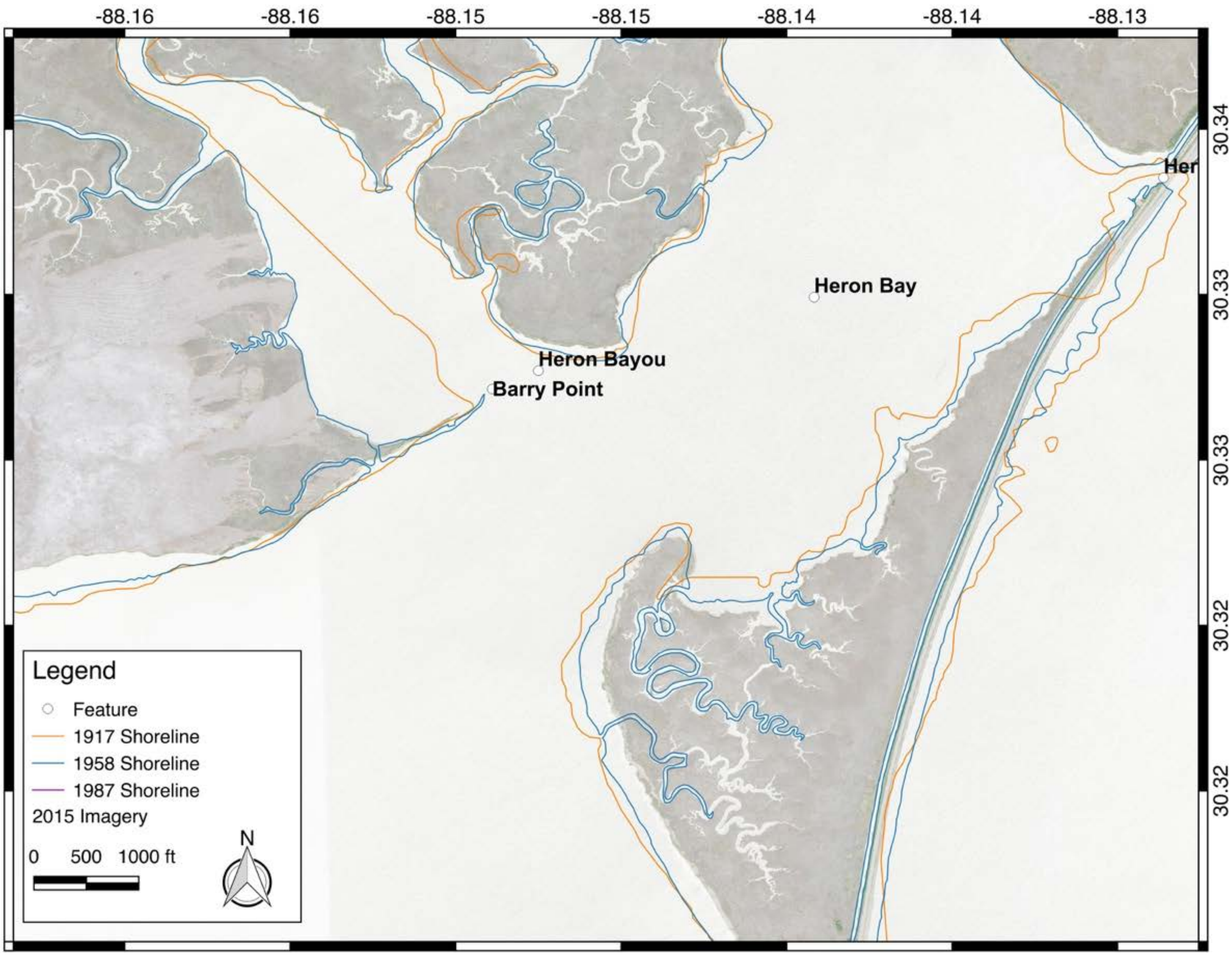


Figure 3.34 Historical shoreline positions in Heron Bay

3.5.3 Shoreline Vulnerability

Natural shorelines in the West Fowl River watershed are vulnerable to short-term and long-term natural stressors like tropical storms, hurricanes, sea level rise, and subsidence. These shorelines are also vulnerable to anthropogenic influences including boat wakes and reduced sediment inputs to the coast. Aside from the episodic erosion due to storms or boat wakes, the long-term driver of shorelines within Portersville Bay, Fowl River Bay, Heron Bay, and along West Fowl River will be relative sea level rise (RSLR).

The current RSLR trend at the NOAA/CO-OPS station on Dauphin Island is 3.6 mm/yr (~1.2 ft per century). Over the past century, the relative rise in sea level may be close to the same amount: 1.2 ft. The mostly low topographic relief of marshes makes them particularly susceptible to flooding. Therefore, a 1.2-ft change in mean sea level (MSL) can drive significant changes in the marsh position and/or composition. Projecting changes to the marsh edge under moderately accelerated sea level rise scenarios, like the US Army Corps of Engineers Intermediate Scenario, shows substantial contraction of the marsh above the mean higher high water (MHHW) tidal datum at years 2050 and 2100 as demonstrated in the progression of images shown in **Figure 3.26 – Figure 3.28**. The most vulnerable marshes will be those that cannot migrate to higher elevations due to armoring or other linear barriers (e.g., roads), and they may convert to open water.

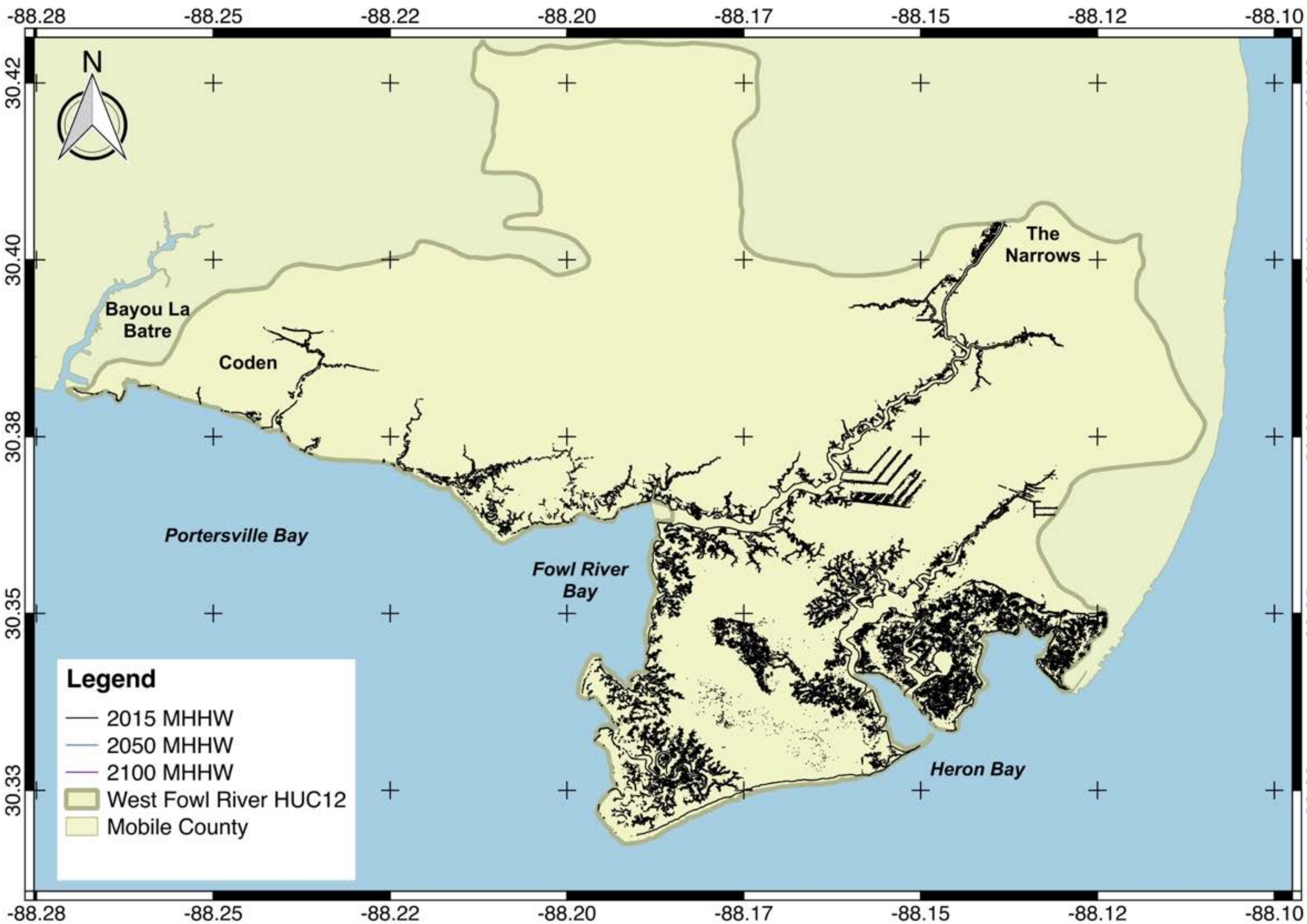


Figure 3.35 Approximate location and extent of the 2015 MHHW tidal datum in the West Fowl River watershed (black line)

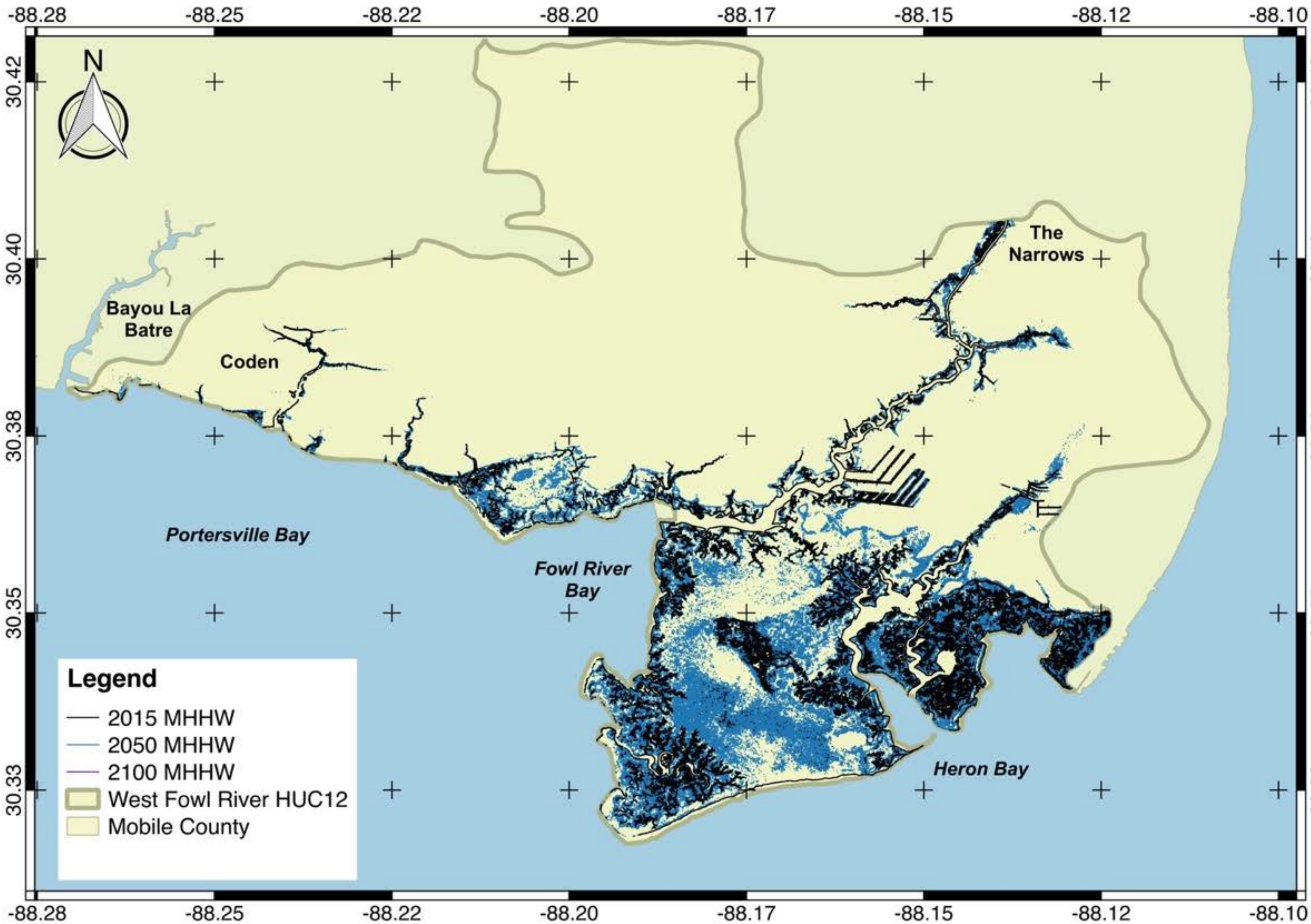


Figure 3.36 Approximate location and extent of the 2015 (black) and projected 2050 (blue) MHHW tidal datum in the West Fowl River watershed

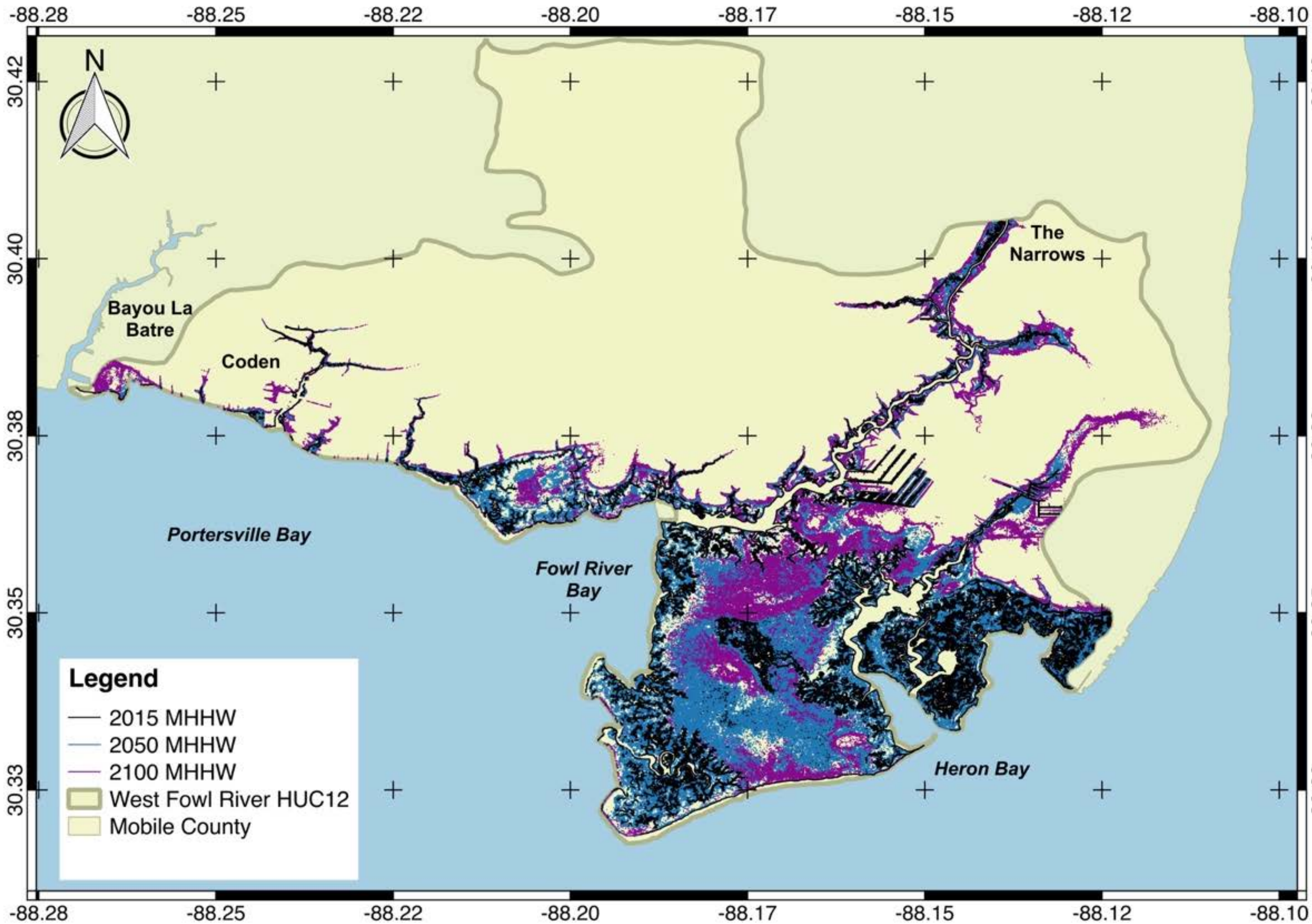


Figure 3.37 Approximate location and extent of the 2015 (black), 2050 (blue), and 2100 (purple) MHHW tidal datum in the West Fowl River watershed

3.6 Access

The Watershed is fundamentally connected to City of Mobile and thus the question of access considers both residents' needs and visitor's potential desires to experience the broader Watershed, as well as areas beyond the Watershed boundaries. With regard to connectivity, the main roads into south Mobile County are I-10 and state highway 90. The West Fowl River watershed is approximately 12 miles south of I-10, and primary access to the Watershed is on SR 188 and SR 59. The Coastal Connection Byway (a nationally designated scenic byway that connects cultural, historic, and environmental highlights along the Alabama Coast) is approximately 130 miles long traversing two Alabama Counties – Mobile and Baldwin. The Coastal Connection Byway passes through the Watershed and the communities of Heron Bay, Delta Port and Coden on SR 188.

3.6.1 Property Ownership

Less than 2% of the land area of the West Fowl River Watershed has been designated as residential development, and this is generally limited to small subdivisions and residences along West Fowl River, its tributaries and along roadways. These communities/ subdivisions are predominantly located along West Fowl River and along Bellingrath Gardens Road as well as along Bayou Coden and Hemley Road. Other population centers include Delta Port, Heron Bay, and Bayou Jonas.

Although a substantial amount of property in the southern portion of the watershed **Figure 3.39**, especially south of highway 188, has been acquired for preservation purposes, there are a number of strategic tracts that could be acquired by purchase or by easements for use as parks, nature observation sites, public access/orientation sites, environmental education, and visitor orientation. It is strongly recommended that detailed studies be completed to determine the most advantageous parcels for easements and acquisitions to support public access, provide for future recreational and educational opportunities, and preserve critical habitats.

3.6.2 Pubic Access and Recreation Opportunities

The West Fowl River Watershed covers more than 20,000 acres in southeastern Mobile County. The majority of the watershed is relatively undeveloped with the exception of residences along West Fowl River and its many tributaries, including Bayou Coden, Bayou Como, Bayou Jonas, Bayou Sullivan, Delchamp's Bayou, Diablo Bayou, Grand Diablo Bayou, Heron Bayou, Little Bayou, and Negro Bayou. All of these areas are tidally influenced.

The majority of residences (both permanent and second homes) have direct access to the waterways and a large majority have small private boat launching facilities on site. Residents who may not have a landing site on their property usually have access to launching sites of neighbors or relatives. Based on the feedback from stakeholder surveys, a desire for increased recreational opportunities, such as hiking and bike trails, nature observation, and wharfs that reach out into the bay with fishing and boat access (including canoes and kayaks) was expressed.

The Watershed's public access is limited to only a few fee-use locations along Coden Bayou, and one fee-free public facility at Delta Port. However, there are a number of strategic tracts that could be acquired to improve public access throughout the Watershed and create a more cohesive story of watershed, cultural, and ecological connections through improved trails and public open space. A highlight of the current access to the West Fowl River is the Delta Port Marina, which was recently rebuilt by the State of Alabama and the complex has a fishing pier, two courtesy docks, a kayak launch, forty unmarked parking spots, and portable restrooms **Figure 3.40 and 3.41**.

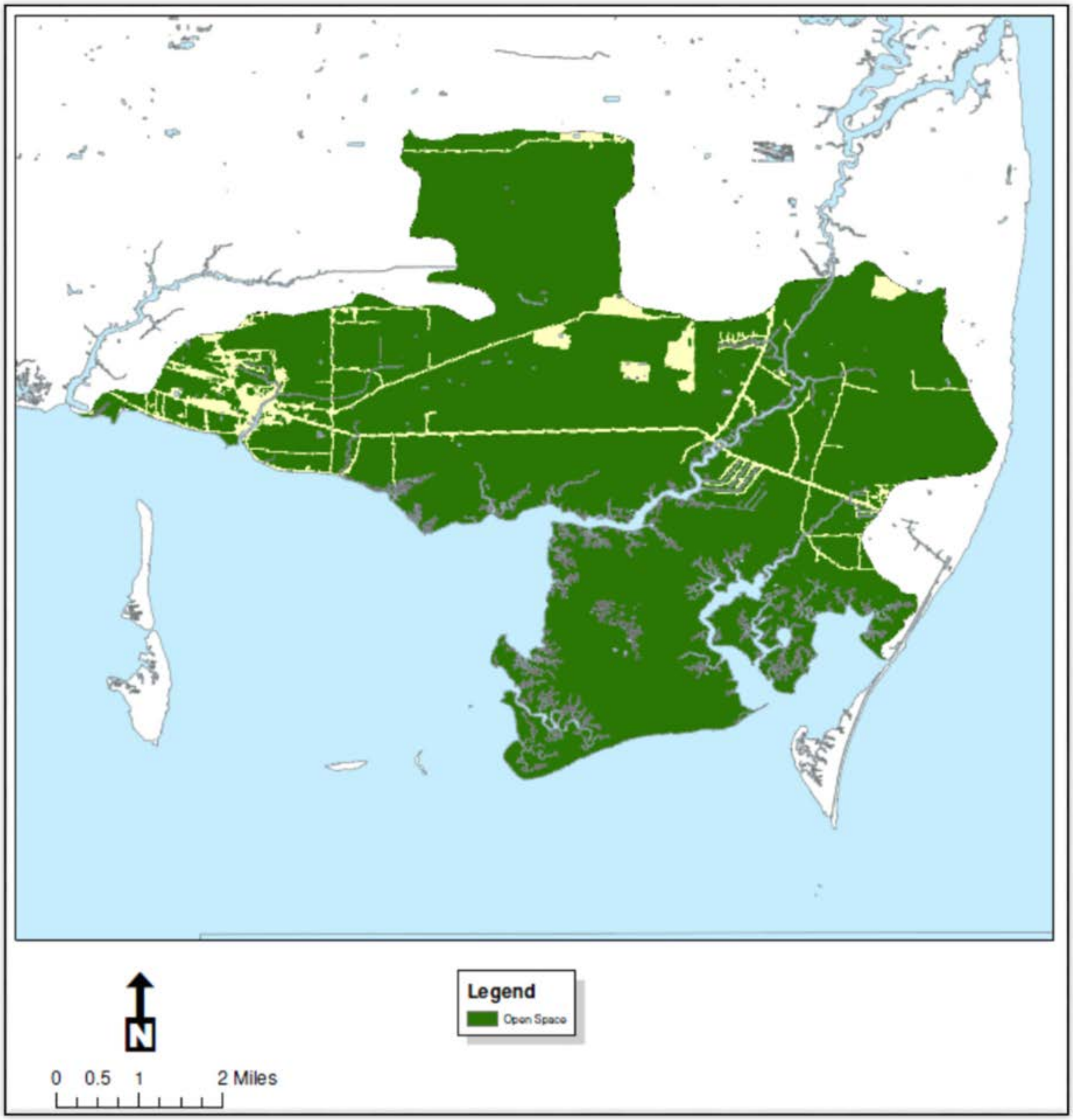


Figure 3.38 West Fowl River Watershed Open Space Areas

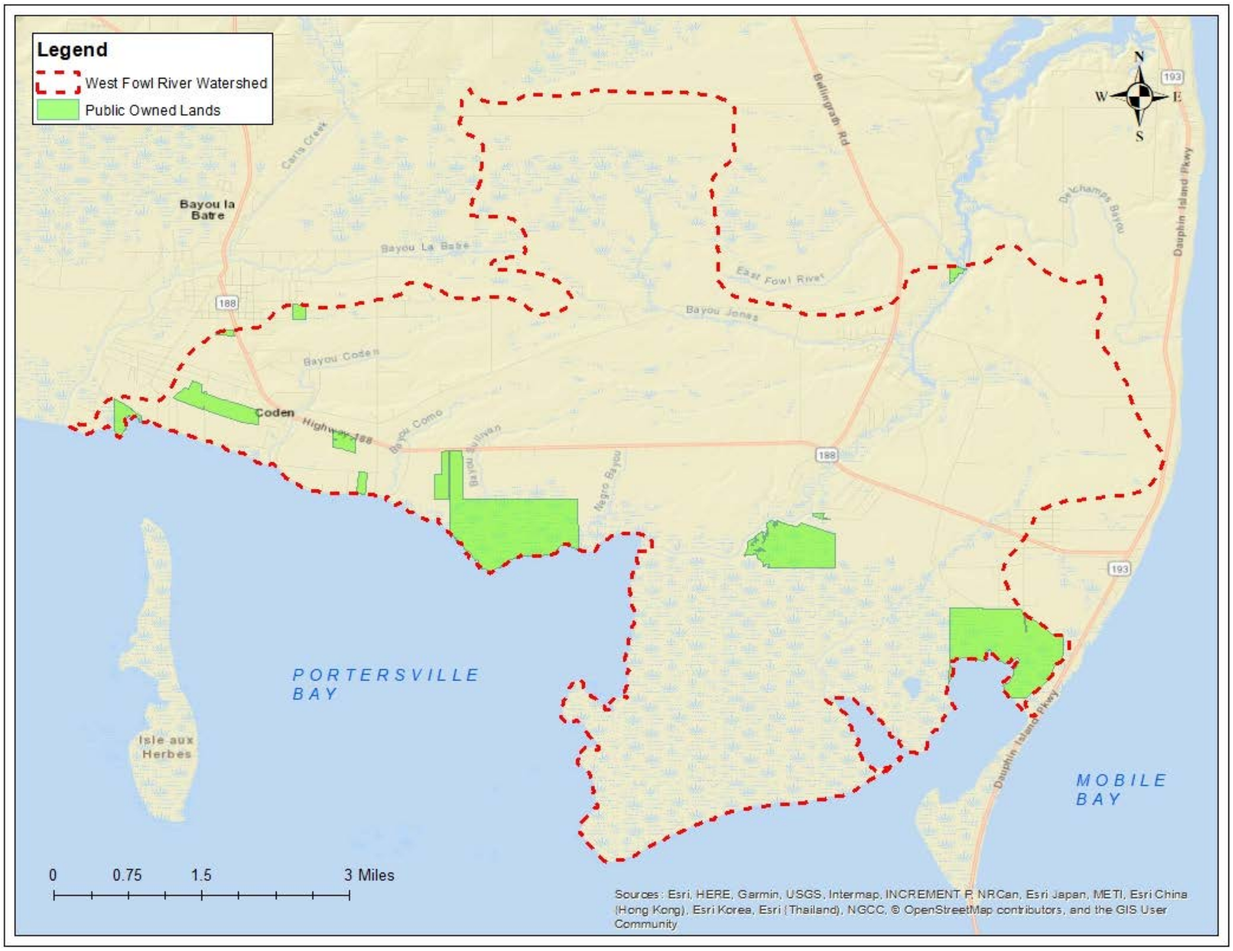


Figure 3.39 Public owned lands

3.6.2.1 Parks and Open Space Access

There are very few public parks within the Watershed. Rolston Park, the former location of a nationally renowned hotel, is considered one of the highlights along the previously mentioned Coastal Connection Byway (SR 188). Before the fire that destroyed the hotel in 1927, the hotel could boast of guests than ranged from presidential candidates, politicians, and maybe their most famous visitors, Josephine and Clarence Allen and Booker T. Washington. Now the park can boast of newly renovated picnic pavilions, a walking path, playgrounds, and a pier with water access.

Figure 3.40 Aerial view of Delta Port Marina on the West Fowl River (Google Earth)

Figure 3.41 Boat launch and accessory piers at Delta Port Marina (Picture OutdoorAlabama.com)

Figure 3.42 Rolston Park

Larger parcels within the Watershed that are publicly held lands could provide opportunity for bird or wildlife-watching (Portersville Bay and Heron Bay Wetland Tracts). These areas could be incorporated in the Alabama Coastal Birding Trails system. Rolston Park and Delta Port Marina are the only existing facilities within the Watershed that provides recreation and open space access. Within each of these locations, there are opportunities to showcase and interpret the Watershed through signage, maps, and stewardship or water quality treatment practices that highlight their relationship with the Watershed (stormwater best management practices).

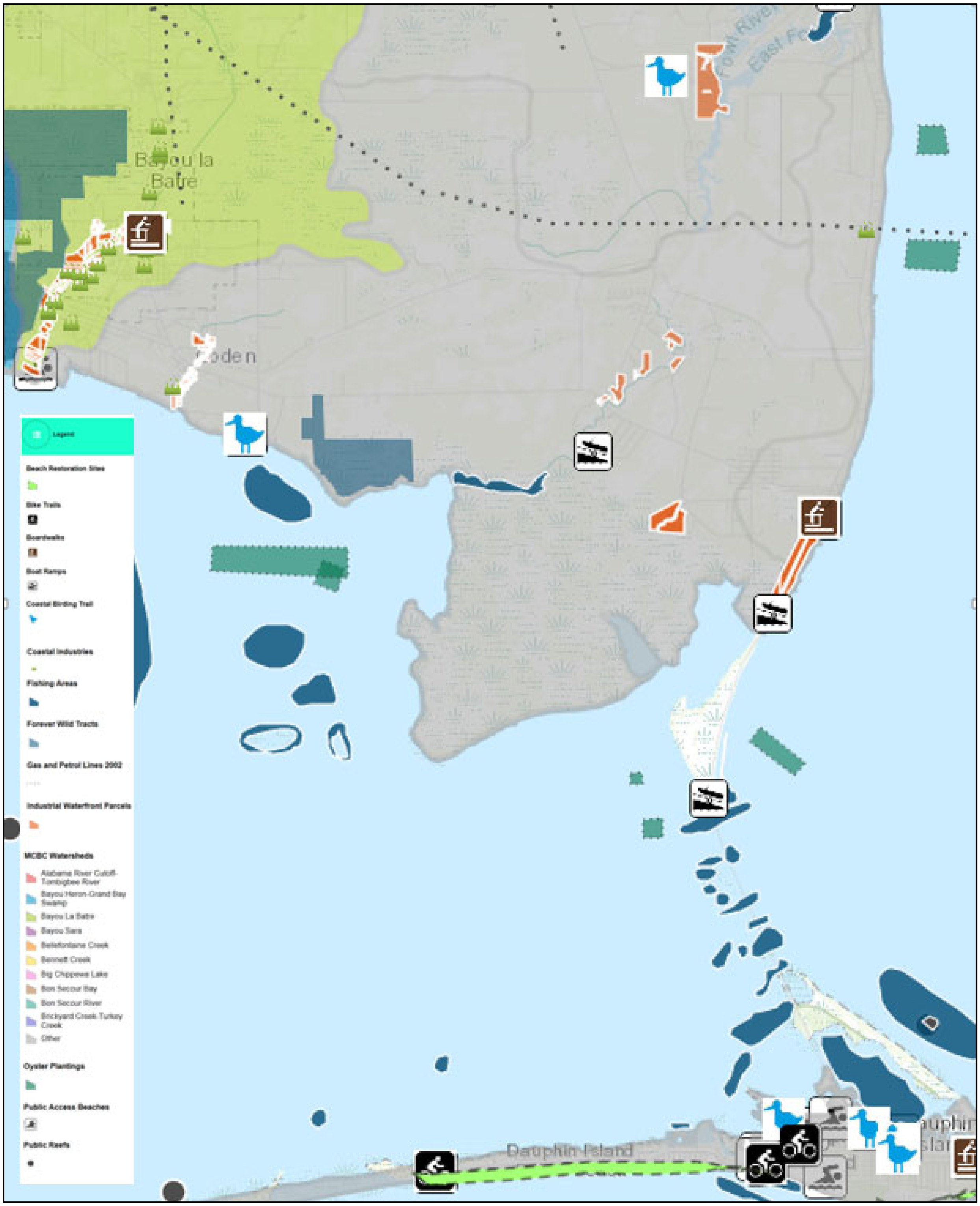


Figure 3.43 Recreational areas within the West Fowl River Watershed. Source: Alabama Coastal Marine Planning Tool

3.6.2.2 Trails- Connectivity and Circulation (Greenway and Blueway Network)

A site visit by the project team during this planning effort explored the opportunity for a kayak/canoe Blueway trail along the Bayou. It was determined that it would be a great way to experience the native wildlife and natural systems that define the Bayou. Further study and interviews with the community are needed to understand the viability of such a trail, and the extents to which the trail could reach into the upper reaches behind private property.

Figure 3.44 Kayak fishing the West Fowl River

Later sections discuss the potential of a Greenway/Multiuser Trail along Shell Belt Road. A few roads, including SR 188, in the Watershed are important parts of the Alabama Coastal Birding trail and popular cycling routes (based on data acquired online mapping from Strava labs of cycling routes in the region).

Forever Wild's Portersville Bay and Heron Bay tract are located along the Dauphin Island / Bayou la Batre loop of the Alabama Coastal Birding Trail. These properties are along the southern edge of the Watershed and include over 900 acres of land managed by the ADCNR State Lands Division for recreational opportunities including bird watching and wildlife observation. Habitats found within this site include coastal marsh, maritime forest, and piney flatwoods representative of the northern Gulf Coast. Spring and fall migration offer the greatest opportunity for birding. (The Alabama Coastal Birding Trail 2012)

3.6.2.3 Regional Connectivity

There are a number of important natural areas/refuges and access points that are located outside of the Watershed that provide great connections to open space and natural resource areas via the Coastal Connection or regional biking routes. These include:

- Point aux Pins to the west
- Bellingrath Gardens to the north
- Dauphin Island to the south
- Grand Bay National Wildlife Refuge and Grand Bay Savanna (further to the west of the Forever Wild tract along the state line)
- Coffee Island and Cat Island habitat recovery project to the south
- Helen Wood Park Oyster restoration south of Mobile
- The Mississippi Sand Hill Crane National Wildlife Refuge
- The Nature Conservancy has a few areas in southern Alabama, including Dennis Cove, north and west of Mobile, Rabbit Island Preserve (near Perdido Key), and Splinter Hill Bog, north east of Mobile, and west of Bayou la Batre in Mississippi the TNC also has the Red Creek Mitigation Area and the Old Fort Bayou Mitigation Bank.

The City of Bayou la Batre, to the west of the community of Coden, is technically not within the Watershed but is very closely linked to the communities within the Watershed. There are further opportunities to celebrate the regional history, ecology, and cultural heritage by enhancing connections between Bayou La Batre and the Watershed's communities, and their shared natural and cultural heritage.

3.7 Historical, Cultural and Heritage

3.7.1 Existing Data or "A Cultural Drawn to Pristine Coastal Resources"

The rich histories of the City of Mobile and coastal communities such as the City of Bayou La Batre have been thoroughly researched and documented. The contributions of Native Americans date back over 8,000 years and the impacts of French and Spanish explorers and colonizers are well documented from the 1600's forward.

A few families residing in the West Fowl River Watershed can trace their family heritages back to colorful Spanish, French, Native Americans, or even Confederate roots. However, little documented history is available concerning the original settlers, subsequent population growth, or cultural fusions within the West Fowl River Watershed area.

The West Fowl River Watershed does not lend itself to simple descriptors when it comes to defining its culture and heritage.

- There is no municipal structure anywhere in the watershed to provide political support or direction and no municipal facilities with which to identify.
- Residential development is low density and located predominantly along its many waterways.

- Home ownership is substantially split between permanent residents and those who enjoy second/vacation homes in the watershed.
- There is tremendous diversity in home styles and values and few real subdivisions to provide citizen "identity."
- Except for those engaged in the seafood industry, few residents are employed within the watershed predominantly because there are no substantial employers.
- Residents who are employed outside the watershed are employed in a wide array of careers and enjoy a wide array of income possibilities that support wide ranging life-styles.
- There is no k-12 school within the watershed, so the community has no educational facility to provide a sense of "community."
- There is no set of cultural parameters by which to identify the community at large (i.e. Cajun, Vietnamese, French, etc.)

On its face, this tremendous community diversity and seeming lack of cohesive cultural elements would appear to be a negative attribute. In reality, however, this diversity is the true strength and definition of the West Fowl River Watershed. It is the very nature of the watershed that is the binding force of its stakeholders.

In almost all cases, residents have been drawn to the area by its pristine beauty, low-density population, easy access to water related recreation and seafood, and its easy access to the more metropolitan areas for shopping, health care, and education. Questionnaires and other research indicated that a very large portion of the population was initially drawn to the watershed and continues to remain part of it because the area's natural beauty, abundance of waterways, access to recreational or commercial seafood. The attraction and the binding identity between West Fowl River Watershed stakeholders is the joy of living in one of the last remaining unspoiled coastal Alabama ecosystems.

This includes:

- Those whose family incomes are directly related to seafood production and harvesting. Many family owned operation are focused on harvesting crabs and naturally grown oysters. Other seafood operations have pioneered "off-bottom" oyster production.
- Those who are attracted to the rather unspoiled landscape
- Those who want to live on the water or have immediate water access without the tourist related issues experienced on Dauphin Island, Gulf Shores or Orange Beach.
- Those who do not wish to live within a municipality and be governed by zoning and other restrictive ordinances.

With the exception of ExxonMobil, Williams, and Panernergy, the watershed boasts only a few small businesses and industries and most of these are aligned with either seafood harvesting and production or small boat building and repair. At least two medium sized cattle farms are located within the watershed as well as a limited degree of row cropping and tree farming operations. The vast majority of residents, who are not retired or are not employed in the immediate area, are willing to commute to work sites in other parts of Mobile County or to municipalities in more distant areas such as Pascagoula, MS. Many of these residents are employed in such professions as healthcare, education, manufacturing, and sales. Again, this diversity makes it difficult to "generalize" the residents and their culture but the diversity is obviously a substantial part of the watershed's sustainability in terms of it community fabric.

An example of this sustaining strength is the way the watershed stakeholders bounced back after Hurricane Frederic in 1979, Hurricane Katrina in 2005, and the BP Deepwater Horizon Oil spill in 2010. Each of these disasters was devastating to the ecology of the area as well as to its inhabitants. Jobs were lost, family incomes were decimated, children's educational programs were disrupted, and many families found it necessary to migrate temporarily or permanently to other locations to seek stability. However, the population of the watershed is about the same today as before any of these events. There is something about the watershed that continues to attract a cross section of people in all professions and in all income levels.

Almost all of these stakeholders live in constant awe and appreciation for the watershed's natural biological diversity, its critical role as a nursery for the regions seafood production, its destiny as a buffer for areas to the north. It is this appreciation for the watershed's natural wonders that seems to be the binding force between people of different backgrounds, different income levels, different professions and different educational pursuits. There is a sense among all of these stakeholders that the West Fowl River Watershed is a most unique natural environment and all stakeholders should have a commitment to protecting and nurturing it.

3.7.2 Cultural and heritage or "Transitioning of Cultural and Heritages"

During the West Fowl River Watershed study, residents repeatedly emphasized that protecting the environmental quality of the watershed was the only way to protect the genuine history and culture of the area. Residents stressed that constant environmental monitoring, ongoing research and implementation of sound protective measures were absolutely required because the pristine environment of the West Fowl River Watershed is what attracted most of them in the first place. In other words, the culture of the West Fowl River Watershed is a mutual commitment to respecting and protecting the local environment so that future generations could derive the same types of human fulfillment and satisfaction that are inherent in its beauty, diversity and opportunity.

This cultural commitment to the watershed's environmental protection is illustrated in the fact that residents have little opposition to providing public park facilities and public water access points so that visitors can enjoy the area, as long as increasing the usage does not create a negative impact on the environmental health of the waterway. It is fully recognized that for the watershed to a) continue providing direct livelihoods to families who draw their immediate incomes from it, b) provide ample opportunities for recreational boaters and fishermen, and c) support the ecological beauty and diversity from which so many draw inspiration, the Watershed must be shared and cautiously protected.

4 Identification of Critical Areas and Issues

This section presents the critical areas within the West Fowl River Watershed and identifies issues to be addressed by the implementation program.

4.1 Water Quality

One of the most critical components of a healthy watershed is water quality. The quality of water can impact many components of the watershed, including supporting habitats for plants and animals; providing sources of irrigation water for farms and ranches and drinking water for residents; and providing aquatic recreational opportunities for the community.

4.1.1 Water Quality Issues

The following water quality issues were identified as the most critical to the overall health of the Watershed:

- Stormwater Runoff
- Nutrients
- Trash
- Sedimentation
- Pathogens

4.1.1.1 Stormwater Runoff

Stormwater runoff is an issue affecting many areas of the Watershed and can be a primary source of pollutants, including trash, nutrients, pathogens, and chemicals which can negatively affect local waterbodies. Excess water quality pollutants in the Watershed commonly produce elevated nutrient and pathogen levels and low dissolved oxygen concentrations. These can reduce the abundance and health of all aquatic organisms in the Watershed. Elevated nutrients and pathogens can also affect human health and welfare by making the water unsafe for human contact and producing algal blooms that limit recreation.

Within the Watershed there is limited infrastructure in place to manage stormwater runoff. Much of the watershed is characterized by vegetated ditches and swales with no best management practices (BMPs) in place to help manage pollutants. Similarly, developed areas of Coden Bayou, Delta Port, and Heron Bayou have limited to no stormwater infrastructure or BMPs to help manage runoff and prevent pollutants from entering the river, bayous, and other waterbodies.

Figure 4.1 Gullying and erosion at Zirlott Road in the eastern Watershed from stormwater runoff

4.1.1.2 Nutrients

Nutrient enrichment is one of the leading causes of water quality impairment in the State and the entire nation, and the quantity of nutrients reaching surface waters has dramatically increased over the past decades (United States Environmental Protection Agency (USEPA) 2009). Nitrogen and phosphorus loadings to a water body can impact water quality by stimulating plant and algal growth, which subsequently may result in depletion of dissolved oxygen, degradation of habitat, harmful algal blooms, impairment of a water body's designated uses, and impairment of drinking water sources (Water Environment Research Foundation (WERF) 2010).

Eutrophication in general is excessive richness of nutrients in a water body, frequently due to runoff from the land, which causes a dense growth of plant life and death of animal life from lack of oxygen. Eutrophication can be exacerbated by land uses (Gill *et al.* 2005) or other anthropogenic activities. The accelerated eutrophication caused by human activities is termed "cultural eutrophication". Increased nutrients associated with eutrophication can increase algal growth (algal blooms) (Smith *et al.* 1999), in turn increasing turbidity, particulate organic matter, and dissolved organic matter.

As presented in **Section 3.2**, TN to TP ratios would be expected be either nitrogen limited (TN:TP < 10) to co-limited by both nitrogen and phosphorus (TN:TP between 10 and 30) within the West Fowl River, Portersville Bay or Herron Bay. However, the lack of statistically significant relationships between both nutrients (when both could be tested) and chlorophyll-a in the three systems suggest that phytoplankton growth is not solely limited by availability of nutrients. Based on data from the West Fowl River, it appears that phytoplankton values are typically less than 5 µg / liter at salinities higher than 15 psu. These results suggest that offshore, higher salinity waters might be tidally flushed to such a degree that phytoplankton levels are kept in check by reduced residence times. These results do not indicate direct evidence of a nutrient enrichment problem in the West Fowl River, Portersville Bay or Heron Bay.

Therefore, Based on maximum and mean values, it does not appear that the waters of West Fowl River, Portersville Bay or Heron Bay have problematic levels of chlorophyll-a, suggesting that phytoplankton growth is not overly stimulated by nutrients.

4.1.1.3 Trash

Trash is an endemic problem throughout the Watershed. It comes from numerous residential and commercial sources and can end up in the local waterbodies through both intentional and unintentional means. Anything that is discarded or blown into the Watershed will eventually be conveyed to the river, wetlands, or bayous by stormwater runoff. Regardless of its source, trash can significantly impact upland and coastal habitats and diminish the quality of recreational activities throughout the Watershed.

Figure 4.2 Trash along Bayou Coden shoreline

Figure 4.3 Trash dumped along Henry Johnson Road

4.1.1.4 Sedimentation

Sedimentation is a natural process in which material such as sand and rock particles are transported by moving water downstream within the Watershed where the material can be deposited. Some of the primary sources of sedimentation are surface runoff from unpaved roads and streambank erosion, both of which are occurring within the Watershed.

Cook (2017) analyzed sedimentation within a 7,424 acre area of the Watershed and reports that, when compared with data from other watersheds in Baldwin and Mobile counties, the West Fowl River project area has sediment loads which are on an average 20% below the geological erosion rate. The geological erosion rate is that natural rate of erosion that would have occurred if there were no human impacts to the watershed. Cook offers that only 40% of the land use/ cover is made up of developed land and agriculture activities within the project area. This factor along with extensive buffering provided by wetlands and marshes may have detained and filtered the runoff to minimize turbidity within the river and tributaries (see **Figure 6** in **Appendix C**).

Figure 4.4 Unpaved roads in the lower Watershed

Figure 4.5 Denuded area along the Industrial Shoreline

4.1.1.5 Pathogens

As presented in **Section 3.2.1**, the results of the DISL/FDA efforts support the contention that the watershed is the dominant source of fecal coliform bacteria in Fowl River Bay, as opposed to in-water sources such as bird roosting sites. However, the interpretation of results focused on cattle grazing and bird roosting is compromised by the single days' worth of data. The overall results suggest that human activities on the watershed are likely increasing the load of bacteria into Fowl River Bay, and that increased rainfall on the watershed would likely cause increased bacteria levels in the bay. The finding that rainfall appears to be trending towards higher levels over the past few years **(Figure 3.15**) suggests that the issue of fecal coliform bacteria in Fowl River Bay may not improve over time.

Highlights of the DISL/FDA findings include the following:

- Highest abundances of fecal coliform bacteria were from the river, indicating that activities on the watershed were likely the most important (not only) source of bacteria to the bay
- The lowest levels of fecal coliform bacteria were found at outfall of the City of Bayou La Batre's wastewater treatment plant, indicating that the City's plant is not a significant source of bacteria to the bay
- Carbon and nitrogen isotope values suggested that human activities likely increased fecal coliform loads from the watershed, in particular "unprocessed" sewage that could be coming from failing septic tank systems
- Fecal coliform bacteria were elevated in areas in close proximity to both cattle grazing sites and bird roosting sites, but concentrations rapidly diminished with distance from these sources, which suggests some combination of die-off and mixing might moderate their potential influence
- Samples taken close to cattle grazing sites had higher levels of fecal coliform bacteria than samples close to bird roosting sites, but the significance of this result is severely limited by the fact that samples were collected on one day only for both potential sources.

4.1.2 Pollutant Source Assessment

Maintaining water quality can be challenging since it is impacted by activities within the Watershed and surrounding areas. Chemical and physical constituents from runoff, aerial deposition, and soil and sediment transported through the aquatic system can have negative impacts on water quality within the watershed.

The following section presents potential sources of pollutants into the receiving waters of the West Fowl River Watershed.

4.1.2.1 Nonpoint Sources

Nonpoint source pollution comes from many different sources, as opposed to point source pollution, which can be directly attributed to a specific source, like an industrial discharge. Nonpoint source pollution generally comes from runoff from overland flow, atmospheric deposition, and other diffuse sources. These nonpoint sources of pollution can convey natural and anthropogenic pollutants into waterbodies.

Many pollutants are grouped into the general term “gross pollutant”, which is used to describe trash and organic debris like decaying branches, leaves, vegetation, and grass clippings. Gross pollutants were commonly observed throughout the Watershed. Gross pollutants can block drainage systems, resulting in decreased flows and localized flooding, and are a primary concern in the Watershed. Removing these pollutants from the watershed and surface water system will be an essential element of Watershed and River restoration efforts, improving the water quality and aesthetics of the area.

4.1.2.1.1 Agriculture

Agricultural runoff can be an important source of nonpoint source pollution and a primary source of erosion and sedimentation. The primary agricultural nonpoint source pollutants are nutrients, sediment, animal wastes, salts, and pesticides. Agricultural activities also have the potential to directly impact the habitat of aquatic species through physical disturbances caused by livestock or equipment. As presented in **Section 2**, agricultural lands make up approximately 5.4% of the Watershed (1,104 total acres).

Figure 4.6 Agricultural runoff

4.1.2.1.2 Cropland

Depending on crop type and management, croplands are a potentially significant source of nutrients, sediment, and pesticides in a watershed. Croplands can experience increased erosion, delivering sediment loads and attached pollutants to receiving waterbodies. Fertilizer and pesticide applications to crops increase the availability of these pollutants (USEPA 2003).

Agricultural croplands, generally located in the west central portion of the Watershed, are a minor land use in the headwaters of Bayous Coden and Como.

Cook (2017) reports, when compared to sediment transport rates and water-quality data in watersheds in Baldwin and Mobile counties, streams in sample points within the West Fowl River Watershed were generally below the geologic erosion rate load.

Figure 4.7 Gullying on agricultural lands

4.1.2.1.3 Livestock

Livestock operations can be a significant source of nutrients and bacteria and can increase erosion in a watershed. Streambank erosion can be caused by a reduction of woody vegetation along the stream caused by intensive cattle grazing or when livestock trample streambanks. Major surface water quality problems associated with bacteria have been linked to grazing animals, particularly when they are not fenced out from streams and farm ponds. Livestock on rangeland can contribute pollutants to the land that are picked up in runoff, whereas livestock in streams deposit nutrient and bacteria loads directly to the streams.

Livestock operations are present in the Watershed along the headwaters of Bayous Coden, Como and Sullivan with resent additions along the eastern riparian areas of the West Fowl River. The interpretation of results presented in **Section 3.2.1,** focused on cattle grazing and bird roosting with the overall results suggesting that human activities within the watershed are likely increasing the load of bacteria into Fowl River Bay, and that increased rainfall on the watershed would likely cause increased bacteria levels in the bay.

4.1.2.1.4 Wildlife

Wildlife is a natural background source of pollutants and can contribute to bacteria or nutrients in the Watershed. Birds, feral hogs, and other animals can be a source of pathogens that can be hazardous to human health. Although some studies suggest that these types of pathogens may pose less risk to humans than exposure to water contaminated with human sewage (Wagner *et al.* 2016). Wagner *et al.* (2016) reports that in predominantly rural watersheds, wildlife can contribute about half of the bacteria sampled.

4.1.2.1.5 Silviculture

Silviculture can be a significant source of sediment and other pollutants to a waterbody. The primary silviculture activities causing increased pollutant loads are road construction and use, timber harvesting, site preparation, prescribed burning, and chemical applications. Without adequate controls, forestry operations can cause in-stream sediment concentrations and accumulation to increase because of accelerated erosion.

Silviculture activities can also cause elevated nutrient concentrations as a result of decaying organic matter and prescribed burns. Organic and inorganic chemical concentrations can increase because of fertilizer and pesticide applications. Harvesting can also lead to in-stream accumulation of organic debris, which can lead to hypoxic conditions. Other waterbody impacts include increased temperature from the removal of shade-providing riparian vegetation and increased streamflow due to increased overland flow, reduced evapotranspiration, and runoff channeling (USEPA 2008).

4.1.2.1.6 Septic Systems

Septic systems can contribute significant nutrient and bacteria loads to receiving waterbodies because of system failure and surface or subsurface malfunctions.

Many of the septic systems in the Watershed have already been removed through the Coastal Impact Assistance Program (CIAP), and are connected to the WWTF system. The Energy Policy Act of 2005 established CIAP, which authorizes funds to be distributed to Outer Continental Shelf (OCS) oil and gas producing States for the conservation, protection, and preservation of coastal areas, including wetlands. The State of Alabama is one of six states eligible to receive CIAP funding and have directed some of that funding to a septic to sewer program for South Mobile County. Other communities in neighboring areas will be connected as part of the next phase of the CIAP-funded program that is ongoing (Lagniappe 2014).

4.1.2.1.7 Urban Runoff

Urban or developed areas typically experience greater magnitudes of stormwater runoff than more rural areas due to their higher percentages of impervious area. Without opportunities to infiltrate, runoff from developed areas transports pollutants to waterbodies.

As presented in **Section 2**, approximately 6.37% (1,305 acres) of the total land cover area within the West Fowl River watershed has some fraction of impervious surface. The majority of the total land cover area in the Watershed, 93% (18,934 acres), has no measurable level of impervious cover (IC). Models predict that when watershed IC exceeds 10%, stream quality is likely degraded, with the degradation increasing to severe when watershed IC exceeds 25%.

4.1.2.1.8 Streambank Erosion

Streambank erosion is the direct removal of banks and beds by flowing water, exacerbated by increased volumes and velocities of stormwater runoff associated with increased IC. Usually this type of erosion is initiated by heavy rainfalls, but it can also occur more gradually over time as a result of weathering. Erosion of stream or riverbanks causes increased sediment loads carried by or deposited in the water. Deposition of material downstream as flow slows causes problems on productive wetlands and shoaling in reservoirs. Other problems include reduction of water quality due to high sediment loads, light-blocking turbidity, and deposition of silt causing loss of native aquatic habitats, damage to public utilities (roads, bridges, and dams) and maintenance costs associated with trying to prevent or control erosion sites. Catchments with little vegetative cover and steep gradients will often have high rates of runoff that result in high-velocity stream flows. Stream channelization, dredging, or realignment to accommodate roads or rail lines leads to increased stream power and velocity, which in turn will increase the energy applied to stream banks. The erosive impact of these high-velocity stream flows will depend on the stability of the bank material. For instance, sand will erode more easily than gravel and silt will erode more easily than sand (USEPA 2008).

Figure 4.8 Eroding streambank along Bayou Sullivan

4.1.2.1.9 Atmospheric Deposition

Pollution from the air may deposit into water bodies, affecting water quality. Airborne pollution can fall to the ground in raindrops, in dust, or simply due to gravity. There are five categories of air pollutants with the greatest potential to harm water quality: nitrogen, mercury, other metals, combustion emissions, and pesticides. These pollutants all have the ability to settle into bodies of water damaging ecosystems and threatening public health. Both natural and anthropogenic processes can lead to air pollution. Driving cars, operating power plants, and spraying pesticides all release pollutants into the atmosphere (USEPA 2008).

A report by MBNEP, based on data compiled by the National Atmospheric Deposition Program and Mercury Deposition Network, reported that atmospheric mercury deposition in the Mobile Bay area occurs at intermediate levels when compared to other areas of the nation (Summersell 2008).

Nearby, Fowl River was listed on the State of Alabama 303(d) list for impairment from mercury concentrations. The recent Fowl River WMP reports that atmospheric deposition appears to be the source of mercury found in fish. In 2002, the State Health Department issued a fish consumption advisory, warning people not to consume fish from Fowl River, and that remained in effect as of 2015 (GMC 2016).

4.1.2.2 Point Sources

Point sources are regulated through National Pollutant Discharge Elimination System (NPDES) permits that allow discharges at specific locations from pipes, outfalls, and conveyance channels.

4.1.2.2.1 NPDES Permits

The Clean Water Act authorized the NPDES permit program which controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Individual homes that are connected to a municipal treatment system, use a septic system, or do not have a surface discharge do not need an NPDES permit. However, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters.

4.1.2.2.2 Construction General Permit

The State of Alabama's NPDES Construction General Permit requires developers/contractors to install and maintain BMPs on construction sites (one acre and larger) to minimize the discharge of sediment and turbid water. Mobile County is the local issuing authority for annual business licenses and land-disturbing permits within the majority of the watershed and is therefore responsible for ensuring construction erosion and sediment controls are properly implemented and maintained.

During field visits, a site was observed failing to properly implement BMPs (**Figure 4.9**). During each rainfall event, turbid water, sediment, and other pollutants from these sites may be transported to waterbodies in the surface water system. It is important that construction site requirements are enforced to prevent sediment from accumulating, reducing conveyance capacity, and adding to pollutant loads. Once sediment accumulates, removal is expensive and time consuming. In some cases, as water depth decreases from accumulated sediment, opportunistic, invasive vegetation can establish itself. Invasive/nuisance vegetation can be highly adaptable and aggressive, suppressing or completely out-competing local, native vegetation. Managing or completely eradicating established populations of nuisance species is also expensive and time consuming.

Figure 4.9 Failure to install BMPs in the upper Watershed

4.1.2.2.3 Industrial and Commercial NPDES Permits

A number of industrial and commercial companies are located within the west Fowl River Watershed, the majority of which includes company's engaged in shipyard building and repair services. Shipyard processes (including surface preparations, painting, metalworking, welding, fiberglass work, and cleaning) often produce various pollutants that can enter a water body if left unregulated. NPDES permits require industrial and commercial sites to capture pollutants, which would otherwise leave the sites via storm runoff and pollute local waters. However, issuance of a NPDES permit only ensures that a state's mandatory standards and the federal minimum standards are being met. **Table 4.1** provides the current NPDES permits for commercial businesses located within West Fowl River Watershed.

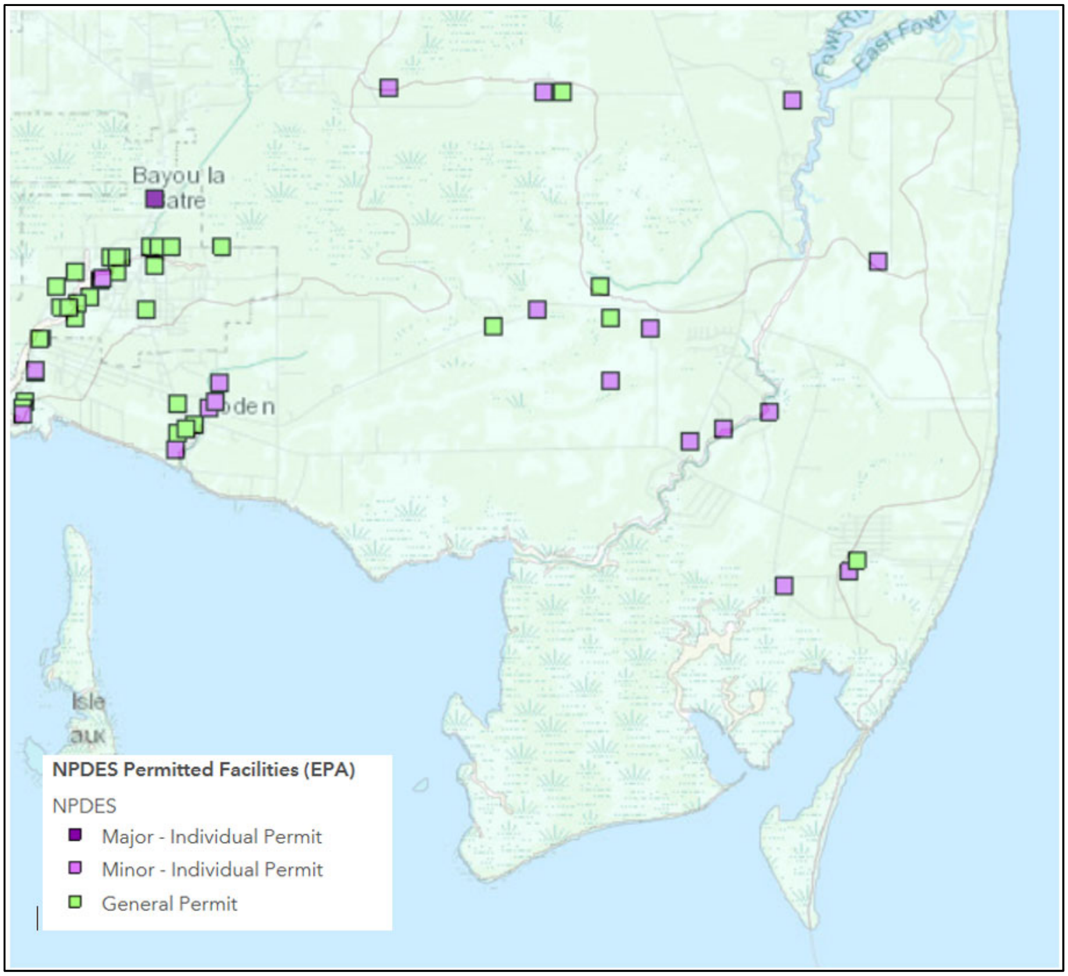


Figure 4.10 NPDES Permitted Facilities (EPA)

As previously mentioned in Chapter 3, elevated levels of mercury have been recorded within the West Fowl River. A potential source for the elevated metals could be the industrial processes that occur adjacent to the waterbody. Paint chips or fragments (containing antifouling compounds) produced from activities including sandblasting and/or stripping could wash into the Bayou Coden system if BMP's are not implemented sufficiently (**Figure 4.11** and **Figure 4.12**).

Table 4.1 Active NPDES permitted facilities within the West Fowl River Watershed (individual, general, and construction sites permits listed by ADEM)

Permit #	Facility	Address	Latitude	Longitude
ALP000411	3 MEN & A BOAT, LLC	4301 HERON BAY LOOP	30.38333	-88.16666
ALU002947	ANDREW SCOTT RUNGE	15390 MORRIS DRIVE	30.37023	-88.15611
ALG030076	BAYOU SHIPBUILDING & SERVICES, LLC	14562 SHELL BELT ROAD	30.389119	-88.265128
ALU910106	BLUE GULF SEAFOOD	SHELL BELT RD	30.383	-88.26004

Permit #	Facility	Address	Latitude	Longitude
AL0058530	CAPTAIN COLLIERS SEAFOOD	JOHNSON RD	30.385833	-88.228611
AL0070220	CODEN	14735 COMMODORE AVENUE	30.38357	-88.14349
ALD000443	FOREST CROWDER	15251 DAUPHIN ISLAND PKWY	30.372535	-88.11012
AL0063142	H AND M SEAFOOD	14765 E ARCHIE ZIRLOTT RD	30.38194	-88.15231
ALU001842	JOHNNY JOHNSON	SOUTHWEST OF MABRY ROAD		
ALG030019	MASTER BOAT BUILDERS, INC.	14979-A ALBA AVE.	30.37933	-88.24196
ALU920047	MILLER JOHNSON SEAFOOD	4310 HERON BAY LOOP	30.35932	-88.1424
ALG030029	RAYMOND AND ASSOCIATES LLC	14562 SHELL BELT ROAD	30.389119	-88.265128
ALG030018	RODRIGUEZ SHIPBUILDING INC.	14843 ALBA AVENUE	30.38227	-88.23873
ALG670197	SOUTHEAST SUPPLY HEADER LLC	1.1 MI W HWY 59 AT 6301 ROCK R		
AL0077038	ULTRA FRESH	14690 TOM JOHNSON RD	30.385058	-88.235425
ALG030026	WILLIAMS FRABRICATION	7320 HIGHWAY 188	30.38122	-88.23948
AL0072575	WILLIAMS MOBILE BAY GAS PROCESSING FACILITY	6000 ROCK ROAD	30.400556	-88.177222
AL0063134	YELLOWHAMMER GAS PLANT	13700 DAUPHIN ISLAND PARKWAY	30.4025	-88.130556

4.1.2.2.4 Phase I and II Stormwater Permits

The Municipal Separate Stormwater Sewer System (MS4) NPDES Program, administered by ADEM, requires certain designated municipalities and other entities to obtain an MS4 permit (either Phase I or Phase II). Phase I of the NPDES Program applies to large and medium MS4s and 11 industrial categories including construction sites disturbing five acres of land or more. Phase II of the NPDES Program applies to additional MS4s and construction sites disturbing equal to or greater than one but less than five acres of land. Portions of Mobile County are located within a Phase II MS4 permitted area and the corporate boundaries of the City of Mobile are covered under a Phase I MS4 permit (USEPA 2003).

Currently, there are only small portions of the watershed that are permitted MS4s within the watershed. The Mobile County's MS4 permit (Mobile County 2017) covers the areas between the City of Bayou la Batre's city limits and the Bayou Coden area within the watershed boundary.

Figure 4.11 Ship repair along the Bayou Coden shoreline

Figure 4.12 A ship in the process of being painted

4.1.2.2.5 CAFO Permits

Concentrated Animal Feeding Operations (CAFOs) are potential sources of pollutants to waterbodies. Manure and wastewater from these operations have the potential to contribute pollutants like nitrogen and phosphorus, organic matter, sediments, pathogens, hormones, and antibiotics to the environment.

There are currently no CAFOs located or permitted in the West Fowl River watershed (ADEM 2018).

4.1.2.2.6 Hazardous Waste

A hazardous waste is a waste with a chemical composition or other properties that make it capable of causing illness, death, or some other harm to humans and other life forms when mismanaged or released into the environment. Different categories of hazardous waste are classified based on the characteristics of the waste material (e.g. ignitability, corrosivity, reactivity, or toxicity).

There are currently no permitted landfills (construction/demolition or municipal waste) located within the Watershed.

4.1.2.2.7 CERCLA Sites

The Superfund Program was created by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), amended by the Superfund Amendments and Reauthorization Act (SARA) and is administered by the EPA. The acts established authority for the government to respond to the release/threat of release of hazardous wastes, including cleanup and enforcement actions. Long-term cleanups at National Priority List sites last more than a year while short-term /emergency cleanups are usually completed in less than a year. The Office of Superfund Remediation and Technology Innovation, under the Office of Solid Waste and Emergency Response provide the policy, guidance, and direction for this program (USEPA 2008).

EPA does not currently list any CERCLA sites within the Watershed (EPA 2018).

4.1.2.2.8 RCRA Sites

The Resource Conservation and Recovery Act (RCRA) regulates hazardous and non-hazardous wastes that may impact the Watershed. This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. The RCRA also sets forth a framework for the management of non-hazardous wastes.

There are currently ten RCRA sites located within the Watershed (EPA 2018).

Table 4.2 Active RCRA permitted facilities within the West Fowl River Watershed

Handler ID#	Facility	Address	Latitude	Longitude
ALD982164584	EXXONMOBIL Production Company-Mary Ann_823 Gas Treating & Processing Facility	5201 Old Rock Road	30.3915	-88.1649
ALR000025171	Gulfstream Natural Gas station 410	6301 Rock Road	30.393	-88.1872
ALR000048223	Mobile Bay Gas Plant	5300B HIGHWAY 188	30.389449	-88.226395
ALR000024240	PHI, Inc. Theodore Base	6000 A Deakle Road	30.42702	-88.20874
ALR000042523	Royal's Junk Yard	7831 Highway 188	30.379169	-88.226295
ALR000034769	TETLP- Coden	5300-B Highway 188	30.398823	-88.1724
ALR000000059	Transcontinental Gas Pipeline Company, LLC	5600 Rock Road	30.399901	-88.17747
ALR000048280	Tri-State Williams-Williams Station	6000 Rock Road	30.39901	-88.17747
ALR000011676	Williams Mobile Bay Gas Processing Facility	6000 Rock Road	30.400556	-88.177222
ALD983174822	Yellowhammer Gas Plant	13700 Dauphin Island Parkway	30.4025	-88.130556

4.1.2.2.9 Brownfields

Brownfields are largely abandoned properties where redevelopment may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant.

ADEM (2017) does not currently list any active brownfield properties within the Watershed.

4.1.2.2.10 Underground Storage Tanks

Underground storage tanks (USTs) have the potential to leak with no visible evidence until serious environmental pollution has occurred. The Groundwater Branch of ADEM administers and provides technical support for regulatory programs related to groundwater protection or cleanup. This Branch directly administers the UST Program and the Underground Injection Control Program.

ADEM maintains a list of USTs, which is available on their website. While not all of the facilities on that list included geographic location, the following were identified within the Watershed (**Table 4.3**).

Table 4.3 UST facilities located in the Watershed

ACCOUNT NO.	SITE ID COUNTY	SITE ID NO.	SITE NAME
13959	97	2379	Maranatha Grocery
15488	97	7827	Zirilott Grocery
15693	97	7179	Bayou Standard
17749	97	12892	Port Stop
19538	97	17121	Mary Ann Plant
19547	97	17142	Transmitter Site
21661	97	2187	Coden Grocery
23801	97	17113	Yellowhammer Gas Plant
23801	97	17114	Fairway Field
24953	97	12892	Burn's Corner Store
10449	97	7180	Corner

4.2 Habitats

Naturally occurring vegetative communities within the Watershed are typical of those found adjacent to Mississippi Sound in the northern Gulf of Mexico and are described in detail in **Section 2**.

4.2.1 Degraded Streams & Wetlands

The cumulative stream network system of the Watershed (approximately 27 miles) drains to the south and east thorough the mouths of Bayou Coden and the West Fowl River into Portersville Bay. As described previously, sedimentation is a necessary and natural process involving the detachment, transport, and deposition of particulate matter within the water column or substrates of waterways including streams, rivers, impoundments, and wetlands. This process impacts stream communities through a variety of direct and indirect processes on both channel morphology (channel scouring and filling) and impairment of water quality, including increased stream water column turbidity and altered water chemistry, as well as introducing chemical contaminants and other pollutants.

Most observed stream and wetland impairments occurred at the road-stream crossings. Road systems typically occupy a relatively small portion of the landscape, yet their construction and maintenance has a great impact on water quality and aquatic ecosystems (Gucinski *et al.* 2000). Of the multiple sources of stream-bound sediments, one of the most pervasive is the road-stream crossing. This direct connection between roads and streams introduces risk of exposure to toxic chemical materials (USFWS 2005).

Figure 4.13 Bank scour associated with a road culvert crossing At Saint Michael Road

In addition to excessive sediment inputs to streams and wetlands originating from unpaved roads, other observed negative water quality impacts associated with road-stream crossings were a result of elevated and/or closed bottom culverts.

Elevated and closed bottom culverts have the potential to create a migratory barrier to animal movement and alter the channel bed, hydraulic gradient bottom, and ability of the waterbody to transport water and sediment.

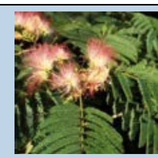
Closed bottom culverts prevent the natural aggradation and degradation of the channel bed. Instances of channel degradation or a lowering of the streambed gradient, results in hydrologic impairments (i.e., “hydraulic jumps” and a “backing” of water upstream of crossing impoundments) as well as migratory barriers to aquatic fauna, fragmenting and isolating populations and reducing access to vital habitats. The “backing” of water can result in a drastic reduction in stream velocity immediately upstream of the crossing, creating stagnant water, along with a reduction in sediment transport capacity resulting in deposition. Over-widened closed bottom culverts (i.e. greater than the channel’s bankfull width) result in a decrease in sediment transport capacity within the crossing promoting deposition of sediment and channel aggradation. This frequently results in necessity of routine maintenance of the crossing structure to remove excess sediment.

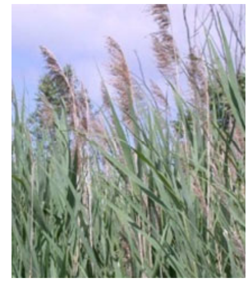
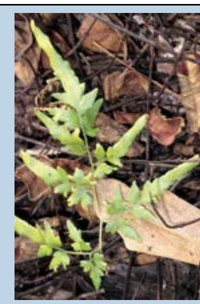
Figure 4.14 Elevated and clogged culvert crossing preventing upstream migration of aquatic organisms

4.2.2 Invasive Species

Non-native, invasive species can significantly impact natural systems and ecosystem function. Invasive/nuisance vegetation can be highly adaptable and aggressive, suppressing or completely out-competing local, native vegetation. Managing or completely eradicating established populations of nuisance species is also expensive and time consuming. Non-native/invasive species are commonly found in disturbed or degraded ecosystems that have been impacted directly or secondarily from anthropogenic activity. **Section 2** and **Table 4.4** below provide a list of potential invasive species found within the Watershed and surrounding areas.

Table 4.4 Observed invasive species in the Watershed

	Species	Occurrence	Photo (Source: AL Invasive Plant Council)
	Chinese tallow (*Triadeca sebifera*)	Typical of wetland ecosystems (disturbed and undisturbed), including frequently inundated wetlands and floodplains.	
	Chinese privet (*Ligustrum sinense*)	Typical of occasionally flooded wetland ecosystems, such as wetland hardwoods and floodplains. Common in areas adjacent to urban floodways and water courses.	
	Chinese wisteria (*Wisteria sinensis*)	Typical of disturbed upland ecosystems in urban environments around easements and Right of Ways.	
Plants	Persian Silk Tree/ Mimosa Tree (*Albizia julibrissin*)	Typical of disturbed upland ecosystems, specifically in Right of Ways and residential areas.	
	Air potato (*Dioscorea bulbifera*)	Typical of disturbed and urban upland ecosystems, specifically in easements, Right of Ways and residential areas. Tends to grow vertically within canopies and manmade structures.	
	Water hyacinth (*Eichhornia crassippies*)	Typical of open water ecosystems, especially in closed basin nutrient rich waterbodies. Can be found in streams and riverine systems.	
	Cogon grass (*Imperata 159ylindrical*)	Typical of disturbed upland ecosystems, specifically in Right of Ways, easements and residential areas.	
Plants	Kudzu (*Pueraria spp.*)	Typical of disturbed and urban upland ecosystems, specifically in easements, Right of Ways and residential areas. Tends to grow vertically within canopies and over manmade structures.	

	Species	Occurrence	Photo (Source: AL Invasive Plant Council)
	Common reed (*Phragmites australis*)	Typical of shorelines along open water and herbaceous wetland ecosystems, including brackish water environments. Can be found along roadsides and ditches.	
	Japanese honeysuckle (*Lonicera japonica*)	Typical of disturbed and urban upland ecosystems, specifically in easements, Right of Ways and residential areas. Tends to grow vertically within canopies and over manmade structures.	
	Japanese climbing fern (*Lygodium japonicum*)	Typical of disturbed upland and transitional ecotones, especially adjacent to managed right of ways, embankments and ditches.	
	Golden bamboo (*phyllostachys aurea*)	Typical of disturbed and urban upland ecosystems, specifically in easements, Right of Ways and residential areas where there is limited over-story and ample sunlight.	
	Torpedo grass (*Panicum repens*)	Typical of wetlands, ecotones and Right of Ways, especially along ditches. Can be found in standing water environments.	

4.2.3 Altered Hydrology

Apart from road-stream crossings, other observed stream impediments were a result of alternations to the natural dimension, pattern, and profile of waterbodies as well as their connectivity to the floodplain. These alternations can cause a variety of impairments to water quality, channel morphology, and quality of aquatic habitat. Specific impacts to waterbodies observed in the Watershed include floodplain fill from dredging and straightening (i.e., channelizing) of the stream channel. Both activities create incised channels characterized as having high bank erosion rates, lateral channel migration, and increased sediment supplies (i.e. bed aggradation and bar deposition) that often results in a loss of aquatic habitat.

Figure 4.15 Channelized and incised tributary to Negro Bayou

4.2.4 Salt Marsh Habitat

Salt marsh communities in the West Fowl River Watershed have been subjected to minimal erosion and biological degradation. Conservation and restoration of existing communities should be a priority of the management plan. One such effort is the acquisition of the Portersville Bay and Heron Bay wetland tracts through the Forever Wild Land Trust. These acquisitions were funded with financial support from the U.S. Fish and Wildlife Services; National Coastal Wetlands grant and are managed by the Alabama department of Conservation and Natural resources through its various divisions. The Heron Bay tract is located in the southeastern portion of the watershed and consists of 487 acres of coastal marsh, maritime forest, and piney flatwoods, of which 315 acres is coastal marsh. The Portersville Bay tract is located in the south central part of the watershed and consists of 470 acres of coastal marsh, maritime forest and piney flatwoods, of which 378 acres is coastal marsh. These tracts are managed as nature preserves to protect the coastal marshes along with recreational opportunities for bird watching and wildlife observation.

Additionally, salt marsh habitat is expected to decline as sea levels rises. According to the Sea Levels Affecting Marshes Model (SLAMM), between 3229 and 3655 acres of salt marsh communities are predicted to transform into tidal flat ecosystems by the year 2100. This prediction estimates an average of 66% less salt marsh habitat by 2100.

Figure 4.16 Evidence of filling of saltmarsh habitat at Lightning Point

4.3 Resiliency

Results of the SLAMM, Sea, Lake and Overland Surges from Hurricanes (SLOSH), and Sea, Lake and Overland Surges from Hurricanes plus Sea Level Rise (SLOSH+SLR) models provide some indication of the watershed's vulnerabilities as they relate to SLR, storm surge, and resiliency. The SLOSH results indicate that many of the watershed infrastructure will be impacted by Category 3 storm surge, and even more will be impacted by a Category 3 storm surge when incorporating the most conservative SLR projections (IPCC 2013 intermediate level). Essentially all of the areas within the floodplain is vulnerable to impacts from major storms and localized flooding events. As sea levels rise, so do local mean high water levels (MHWLs), so therefore floodplain delineations can change.

4.3.1 Vulnerability

The Intergovernmental Panel on Climate Change (IPCC) describes climate vulnerability as a function of the character, rate, and magnitude of the stressor, the sensitivity of the system to the stressor, and the ability of the system to adjust to the change, moderate potential damages, cope with consequences, and/or take advantage of opportunities. The specific vulnerability of a particular estuary depends on physical features such as elevation gradient, estuarine depth, size, geomorphology, and species composition.

As far as the Watershed's infrastructure, it is important to identify services and associated facilities that are critical or essential to normal daily operations following a disaster event. These are called "essential facilities" or "critical facilities," which typically include emergency services such as police, fire, and EMS; medical facilities such as hospitals, clinics, and elderly care centers; fueling stations; shelters; schools; hazardous material sites; wastewater treatment operations; and potable water supplies. Government facilities such as City Hall and Public Works are also essential to disaster response and recovery. In total, there are 5 government facilities and 1 educational facilities in the West Fowl River Watershed. A review of facilities in the Watershed reveals that several essential facilities are located within the 100-year floodplain (see **Figure 4.17** and **Table 4.5**). Specifically, the Bayou La Batre wastewater facility and Police Station, Community Center and Alabama Port Volunteer Fire Station are all located in the 100-year floodplain and are vulnerable to isolated flooding events and flooding associated with tropical storms and hurricanes.

Table 4.5 Essential facilities in the West Fowl River Watershed

Government Facilities	Address	100-Year Flood Zone	Evacuation Zone[1]
Bayou La Batre Public Works Department- Wastewater Plant	Railroad Street 36523	Yes	1
United States Postal Service	7970 Highway 188 36523	Yes	1
Coastal Response/ Community Center	7385 Highway 188 36523	Yes	1
Fire Stations			
Alabama Port Volunteer Fire Station	3290 Highway 188 36523	Yes	1
Police Station			
Bayou La Batre Police Department	8725 Delcambre St 36509	Yes	1
Schools			
Alba Middle School	14180 S Wintzell Ave 36509	No	1

1 The Evacuation Zone corresponds to the Evacuation Zone descriptions in Section 4.3.5

4.3.1.1 Flooding

The December 2015 update to the Mobile County Multi-Hazard Mitigation Plan indicates that flooding and hurricanes are among the highest hazard exposure rates in Mobile County, along with severe storms, tornados, droughts, and winter storms. Hazard exposure rates are statistical assessments identifying areas that are at risk and exposed to certain natural phenomena. A total of seventeen Federal disaster declarations have included Mobile County from 1973 to 2014.

Flood zones are commonly used to identify areas of risk in floodplain management. Flood zones and flood hazard areas are identified by the Federal Emergency Management Agency (FEMA). FEMA identifies an area of special risk as a Special Flood Hazard Area (SFHA). SFHAs are defined as areas that will be inundated by a flood event having a one-percent chance of being equaled or exceeded in any given year. During the span of a 30-year mortgage, a home in the one-percent annual chance floodplain has a 26% chance of being flooded at least once during those 30 years (USGS 2010). The one-percent annual chance flood is also referred to as the base flood or 100-year flood (FEMA 2016).

Much of the lower portion of the West Fowl River Watershed is identified as FEMA Flood Zone VE, which indicates a one-percent annual chance flood hazard area with storm-induced velocity wave action. Much of the area to the east of the West Fowl River and around Bayou Coden is located in FEMA Flood Zone AE, which indicates a one-percent annual chance flood hazard area. Most of the upper Watershed is identified as being in minimal flood hazard Zone X, with only those areas within the tributaries' immediate floodplain designated as Zone AE.

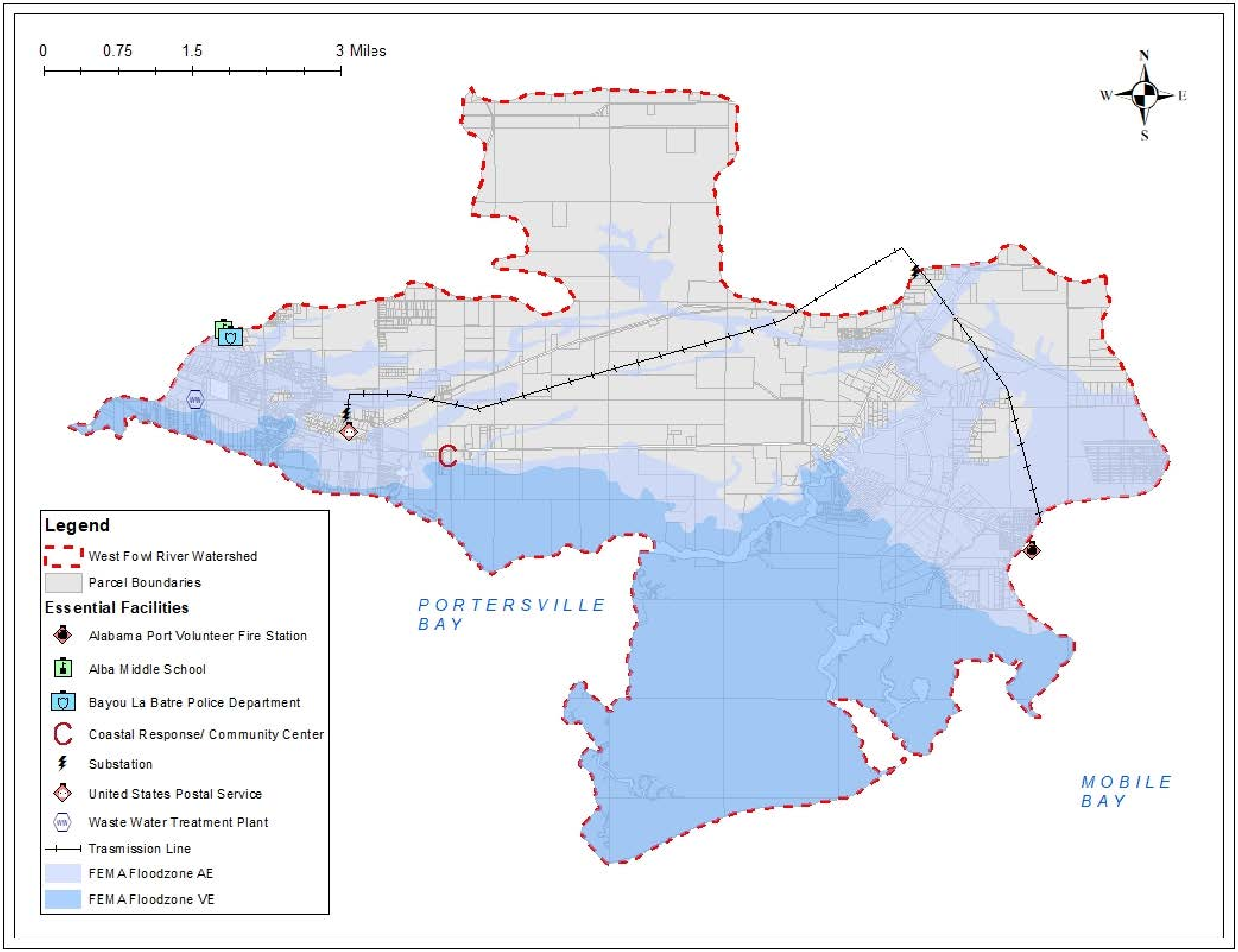


Figure 4.17 Essential facilities in the West Fowl River Watershed

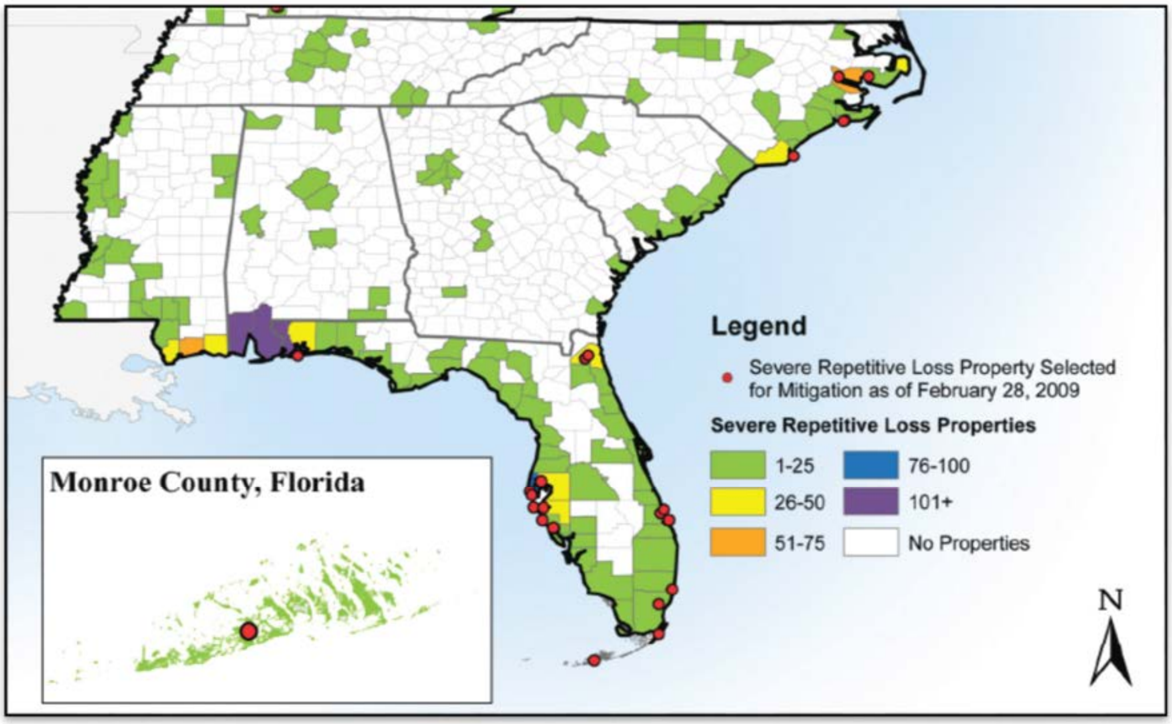


Figure 4.18 **Severe repetitive loss properties in FEMA Region IV, FEMA 2009**

4.3.1.2 Hurricanes

Unfortunately, the residents of the West Fowl River Watershed recognize the significant hazard represented by hurricanes to coastal communities through high tides, high winds, and flooding. In 2005, Hurricane Katrina sent nearly 14 feet of water over the Watershed, inundating homes and businesses (Elliott 2015). Flood waters and winds in excess of 100 miles per hour damaged or destroyed 65 percent of all occupied housing units. Public infrastructure and churches were heavily damaged or destroyed. The municipal wastewater treatment plant was flooded and sustained permanent damage. The Gadsden Times (Beyerle 2005) reported that virtually all residences in Coden were damaged or destroyed.

Hazard mitigation is an important concept that involves taking action to reduce or prevent future damage from a disaster. Hazard mitigation generally involves four primary elements: 1) identifying hazards, 2) assessing risks and vulnerabilities, 3) developing and prioritizing mitigation actions, and 4) implementing mitigation actions.

4.3.1.3 Sea Level Rise (SLR)

The Sea Levels Affecting Marshes Model (SLAMM) was developed by the Environmental Protection Agency (EPA) to evaluate the effects of sea level rise on marsh habitats. The model maps habitat distribution over time in response to processes including SLR, accretion and erosion, tides, and freshwater influence. Since tidal inundation from SLR is expected to be a major driver of habitat succession within the West Fowl River Watershed, a SLAMM Report was generated (**Appendix B**) and used to simulate macro-level habitat conversions in response to SLR and related geomorphologic processes.

SLAMM is based on the conceptual model that habitats change over the long-term in the response to the processes presented above. These processes provide the conceptual basis or framework for the habitat projection model, which utilizes the base environmental conditions and projects possible future conditions in the estuary. For the SLAMM analysis, a low SLR average scenario of 21 inches and a high SLR average scenario of 29 inches were utilized for the 2100 prediction.

To evaluate how habitats will evolve over time, existing habitat conditions are mapped by combining the National Wetlands Inventory (NWI; 2002) data with a map of imperviousness (National Land Cover Database (NLCD) 2011) to delineate between developed and undeveloped upland. Vegetation is then categorized into habitat types according to the SLAMM NWI habitat cross-walk.

Based on both SLR scenarios that were included within the SLAMM, some upland and freshwater swamp vegetation community types are projected to be converted to saltmarsh and open water habitats.Under both low and high SLR scenarios utilized, there is a loss of upland habitat and an increase of salt marsh, tidal flat, and open water acreage (acreages shown for both low and high scenarios in **Table 4.6**, however the modeled higher rates of sea-level rise predicts an accelerated land conversion rate. **Table 4.6** details the model results for habitat maps (year 2100) for low and high SLR scenarios. If habitat is allowed to convert, the model predicts a total of 79 acres of developed upland could be altered to fresh water wetland habitats.

4.3.2 Adaptation Planning

EPA's Climate Ready Estuaries: Synthesis of Adaptation Options for Coastal Areas (2009) describes adaptation strategies as physical changes, technological advancements, or management decisions. The document lists several potential adaptation strategies based on management goals common to estuarine programs, such as maintain/restoring wetlands, maintaining sediment transport, maintaining shorelines, invasive species management, preserving habitat, and maintaining water quality. An excerpt of several of the adaptation strategies for each potential stressor is located in **Table 4.7**.

Table 4.6 Habitat acreages for low and high SLR scenarios at 2100

Habitat	Model Acreage	Acreage in 2100		Acreage Difference 2100-2002	
	In 2002	Low	High	Low	High
Developed Upland	655	590	591	-63	-64
Undeveloped Upland	6,822	5,917	5,917	-905	-905
Freshwater Swamp	2,808	2,375	2,392	-433	-415
Freshwater Marsh	376	908	910	532	534
Salt Marsh	5,250	1,595	2,021	-3,655	-3,229
Tidal Flat	0	3,206	3,255	3,206	3,206
Estuarine Beach	45	7	7	-7	-7
Open Water	754	1,686	2,043	932	1,289

4.3.3 Evacuation Planning

The West Fowl River Watershed is located in Zone I of the Mobile County Zoning Evacuation Map. Zone I residents are strongly advised to evacuate the area in the event of a Category 1 hurricane or greater, especially for residents in mobile homes and low-lying, flood-prone areas. Zones to evacuate will be announced using local media. Residents of Bayou Coden, West Fowl River and Heron Bay are advised to take Highway 188 or Mobile County Road 59 to I-10 East to I-65 North (Mobile County Emergency Management Agency, 2016). Other items of note by the Mobile County Emergency Management Agency (2016) include:

- All southbound traffic will be halted, and all four lanes will be used for northern traffic.
- If necessary, the Governor can also direct reverse-laning for I-65.
- Road closures will be available on local media and on the www.dot.alabama.gov website.
- Please do not contact the Alabama State Troopers office unless you have an emergency or accident to report due to congestion on their phone systems as they need to keep access to all available telephone lines open.
- High winds and damaging rains are a danger to automobiles on raised highways and bridges. Drivers of RV's, busses and other high profile vehicles should use extreme caution.

The Zoning Evacuation Map is provided in **Figure 4.19**.

Table 4.7 Adaptation strategies for potential stressors in the West Fowl River Watershed

Adaptation Option	Climate Stressor Addressed	Additional Management Goals Addressed	Benefits	Constraints	Examples
Manage realignment and deliberately realign engineering structures affecting rivers, estuaries, and coastlines	Changes in precipitation; Sea level rise; Changes in storm intensity	Preserve habitat for vulnerable species; Maintain/ restore wetlands; Maintain sediments transport	Reduces engineering costs; protects ecosystems and estuaries; allows for natural migration of rivers	Can be costly	United Kingdom/ European Union
Land acquisition program- purchase coastal land that is damaged and use it for conservation	Altered timing of seasonal changes; Increases in air and water temperatures; Sea level rise; Change in storm intensity	Preserve habitat for vulnerable species; Maintain/ restore wetlands	Can provide a buffer to inland areas; prevents development on the land	Can be expensive; land may not be available	New Jersey Coastal Blue Ares (see text box page 10)
Integrated Coastal Zone Management (ICZM)- using an integrated approach to achieve sustainability	Changes in precipitation; Sea level rise; increases in air and water temperatures; Changes in storm intensity	Preserve habitat for vulnerable species; Maintain/ restore wetlands; Maintain water availability; Maintain water quality; Maintain sediment transport; Maintain shorelines	Considers all stakeholders in planning; balancing objectives; addresses all aspects of climate change	Stakeholders must be willing to compromise; requires much more effort in planning	European Union; Australia26
Incorporate consideration of climate change impacts into planning for new infrastructure (e.g. homes, businesses)	Sea level rise; Changes in precipitation; Changes in storm intensity	Preserve habitat for vulnerable species; Maintain/ restore wetlands	Engineering could be modified to account for changes in precipitation or seasonal timing of flows; siting decisions could take into account sea level rise	Land owners will likely resist relocating away for prime coastal locations	Rhode Island State Building Code 27

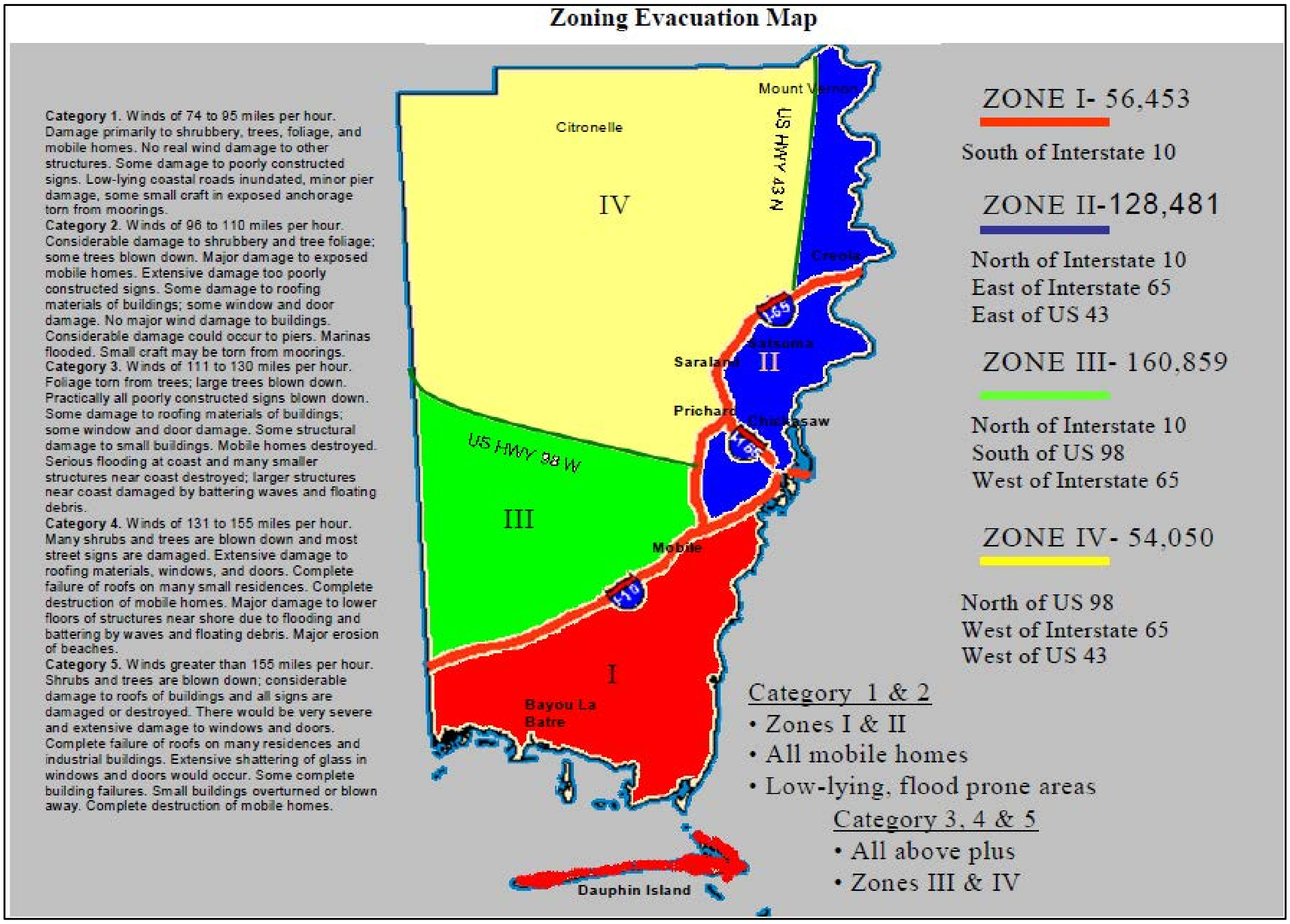


Figure 4.19 Zoning evacuation map for Mobile County

4.4 Coastlines

Shorelines within the West Fowl River watershed will continue to retreat in response to episodic erosion and long-term changes in MSL. The shoreline positions along West Fowl River have been relatively stable over the period of time for which vector shoreline position were available (1916 – present). Alternatively, there have been dramatic changes in shoreline position in the open water areas of the watershed, namely Portersville Bay, Fowl River Bay, and Heron Bay, including the complete loss of some small islands. Many of the marshes in these open water areas are not immediately constrained or threatened by an obstruction to migration. Efforts focused on conservation, preservation, and limiting shoreline armoring may prove useful in that regard.

There are some potential opportunities for shoreline restoration projects that can also improve the resilience of Coden Belt and Shell Belt Roads along Portersville Bay. Approximately 2 miles of shoreline (1.2 miles along Coden Belt Rd., 0.8 miles along Shell Belt Rd.) are currently armored with a rock revetment along those road segments paralleling the bay. These are excellent locations for living shorelines as alternatives to, or enhancements of, the current shoreline stabilization providing protection to the road. In addition to providing habitat value and roadway resilience to erosion and flooding, a restored marsh or sandy shoreline may also provide recreational opportunities for the local residents.

4.4.1 Bank and Shoreline Erosion

The erosional tendencies of shorelines within the Watershed are strongly dependent upon location. Shorelines along Portersville Bay experience much more long-term change than anywhere else due to the relatively lack of shoreline armoring as compared to other shorelines throughout the watershed. In addition, these shorelines are subjected to frequent natural and boat wake wave action. The natural shorelines susceptible to erosion in the upper reaches of the watershed are dependent upon changes in streamflow during storm events, not coastal processes.

As demonstrated in **Section 3**, there have been dramatic changes in shoreline position along portions of Portersville Bay, Fowl River Bay, Murder Point, Grand Point, and Heron Bay. Some shoreline retreat distances are approximately 500 – 1000 ft. In addition, the lessening and ultimate loss of some islands (Marsh Island, Cat Island, Lady Island and, Pass Berron, and Raccoon Island) in Portersville Bay is notable. The exact cause of retreat is unknown but likely attributable to tropical storms, hurricanes, long-term sea level rise, and a lack of available sediments. These areas are critical shorelines that can and should be restored to a historic position and appropriately stabilized with native materials and some limited use of structure to attenuate wave energy.

4.5 Access

4.5.1 Waterway Accessibility

The West Fowl River Watershed covers more than 20,000 acres in southeastern Mobile County. The primary waterway, West Fowl River, is approximately twenty (20) miles long and flows southerly and southwesterly from its origin with Fowl River into Heron Bay, Portersville Bay, and Mississippi Sound. The entire watershed is relatively undeveloped with the exception of residences along West Fowl River and its many tributaries, including Bayou Coden, Bayou Como, Bayou Jonas, Bayou Sullivan, Delchamp's Bayou, Diablo Bayou, Grand Diablo Bayou, Heron Bayou, Little Bayou, and Negro Bayou. All of these areas are tidally influenced.
The majority of these residences (both permanent and second homes) have direct access to the waterways and a large majority have small private boat launching facilities on site. Residents who may not have a landing site on their property usually have access to launching sites of neighbors or relatives.

The public's access to the many waterways is much more restrictive. Publicly available (service for fee) launching areas include only Jemison's Heron Bay Landing (Bait and Tackle) and Bayou Coden Landing. The only non-fee boat launch and landing in the West Fowl River Watershed is Delta Port Landing. Located at 5080 Green Drive off State Highway 188, this exceptional facility was recently rebuilt by the State of Alabama. The complex has a fishing pier, two courtesy docks, a kayak launch, forty unmarked parking spots, and portable restrooms.

Additional access points will be required throughout the watershed as more homes are constructed away from waterways and as more people from outside the area learn of the excellent fishing, crabbing, boating and "nature watch" opportunities afforded by the watershed. While access for such activities as boating, fishing, canoeing/kayaking are minimally available, structured areas for hiking, cycling, camping, birding, picnicking and swimming are not available. There are few public parks within the watershed. The public Rolston Park, located along Coden Belt Road, and Bayfront Park, located on Dauphin Island Parkway, provide the few locations for family style recreation but must be shared with other area regional residents and tourists/visitors.

4.5.2 Land Ownership

Less than 2% of the land area of the West Fowl River Watershed has been claimed for residential development, and this is generally limited to small subdivisions and residences along West Fowl River, its tributaries and along roadways. These communities/ subdivisions are predominantly located along West Fowl River and along Bellingrath Gardens Road as well as along Bayou Coden and Hemley Road. Other population centers include Delta Port, Heron Bay, Alabama Port, and Bayou Jonas.

Although a substantial amount of property in the southern portion of the watershed, especially south of highway 188, has been acquired for preservation purposes, there are a number of strategic tracts that could be acquired by purchase or by easements for use as parks, nature observation sites, public access/orientation sites, environmental education, and visitor orientation. It is strongly recommended that detailed studies be completed to determine the most advantageous parcels for easements and acquisitions to support public access, provide for future recreational and educational opportunities, and preserve critical habitats.

4.6 Heritage

Customarily, a region's culture and heritage are based on its predominant social forms, values, conventions, languages, religious beliefs, and customs. We tend to think of culture as a set of shared elements that are hard to express but easily recognized. For instance, one immediately identifies certain cultural elements if such terms as Cajun culture, southern culture or western culture are mentioned.

As stated previously, it is hard to identify the "culture" of the West Fowl River Watershed community due primarily to the fact that it was not populated by people with specific shared cultural backgrounds and traits. The watershed is an amalgamation of hard working people who have invested themselves in such diverse professions as seafood harvesting, boat repair, education, sales, manufacturing, etc. It has also been settled in great part by retirees.

However, there is a common thread that seems to permeate the psyche of almost all West Fowl River watershed stakeholders -an enlightened sense that the West Fowl River Watershed is one of the few remaining unspoiled areas in south Alabama and that it is vital to protect and maintain the watershed at all costs. While specific ways of expressing themselves may differ among stakeholders, the shared attitudes, shared values, and shared goals concerning the watershed form a very real culture with common goals and capacities.

Regardless of profession, income or background, West Fowl River Watershed stakeholders share a culture predicated on protecting a wonderfully productive and important habitat for future generations. This sense of common purpose is the real culture of the West Fowl Watershed.

4.6.1 Economic Diversity

The West Fowl River Watershed lies within the unincorporated area generally defined as Coden, Alabama and covers approximately 20,000 acres of land and water.

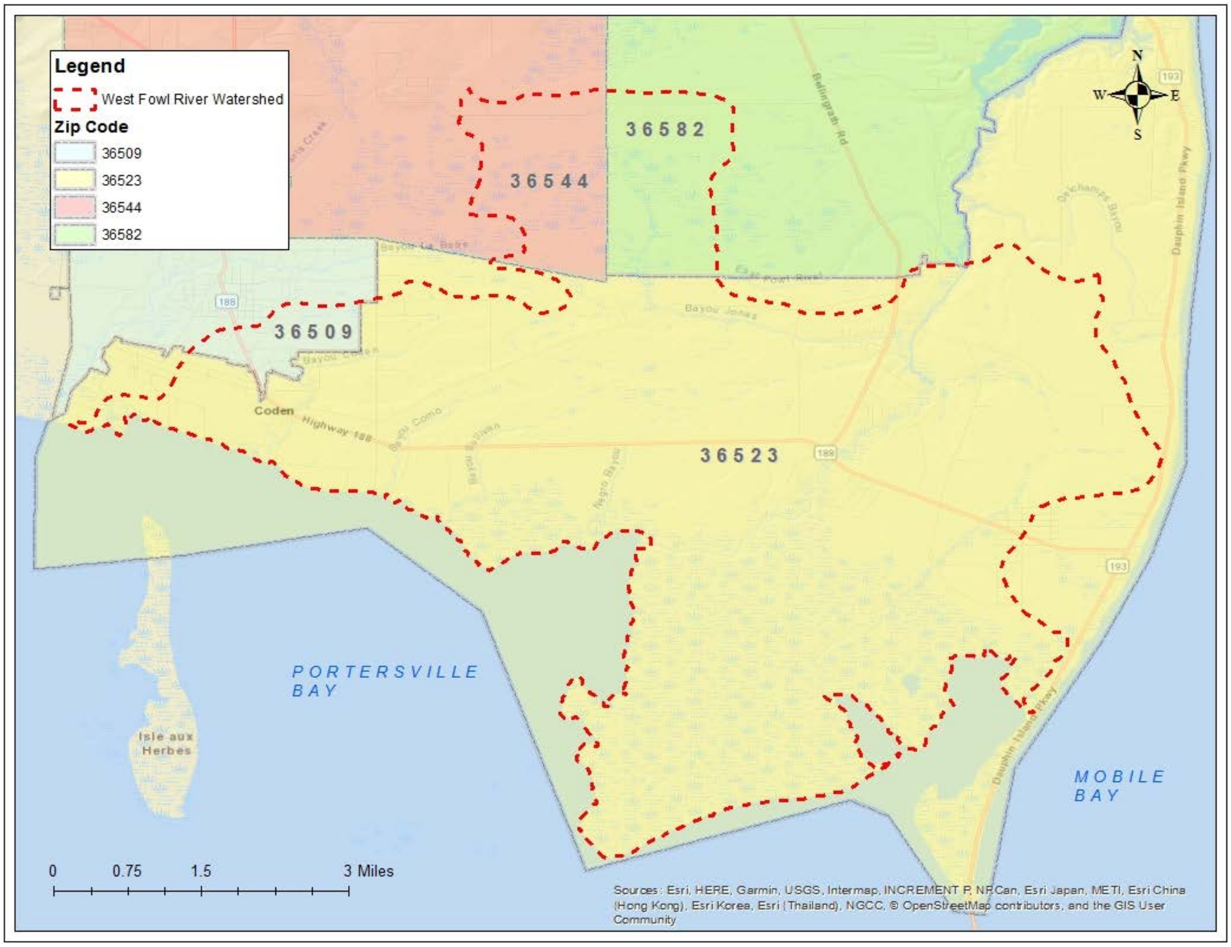


Figure 4.20 Zip codes located within the West Fowl River Watershed

Approximately 2,200 people, representing approximately 700 families, reside permanently in the watershed. Approximately 200 families maintain second homes or vacation homes within the watershed.

Job growth in the watershed and surrounding area has been negative over the past ten years. Only about 3.5% of the temporary and permanent populations make a living in the agriculture, forestry, fishing professions. The balance resides in the watershed for a variety of personal reasons but work in a broad spectrum of occupations outside the watershed.

4.6.1.1 The Boat Building Economy

Along Bayou Coden, on the western edge of the watershed, boatbuilding is the major contributor to the local economy. Substantial boat yards such as Master Boat Builders and Rodriguez Shipbuilding produce vessels that support the national and international offshore oil industry.

Figure 4.21 Shipbuilding facility on Bayou Coden

Growth of the boatbuilding industry along Bayou Coden is substantially limited due to the lack of waterfront property and the height of the Highway 188 bridge to the north.

The boat building industry in the West Fowl River Watershed, as in the adjacent Bayou La Batre Watershed, is cyclic in nature and responsive to national and international economics. Although the industry has been in a slump for the last two years, there are strong indications of a substantial rebound.

4.6.1.2 The Seafood Economy

As noted previously, there are numerous seafood producers, harvesters and processors located in the West Fowl River Watershed. Some are located on the southern part of the watershed along Portersville Bay. Others maintain sites along West Fowl River and its main tributaries. These businesses process crabs, shrimp, and oysters.

Figure 4.22 Seafood processing facility on the West fowl River

Oyster companies include those that harvest oysters grown on the bottom either from public reefs or from privately maintained reefs. Others lease state-permitted areas and grow oysters using “off-bottom” techniques. With assistance from Auburn University, these oyster farmers have been pioneering oyster growing and processing techniques with the intent to produce better looking and better tasting oysters that can be marketed at premium prices throughout the United States.

With the exception of natural gas harvesting from Mobile Bay and off-shore, seafood production/harvesting is the single largest commercial industry in the West Fowl River Watershed and indications are strong that the industry has substantial potential for growth. Sustainability of the seafood industry in the watershed will have not only have a major economic impact on harvesters and processors, but also on the entire supply chain of outfitters, workers, truck drivers and more. It is anticipated that growth of the off-bottom oyster industry will bring exponential economic benefits to the area as production approaches 2.5-3.0 million oysters per year.

Figure 4.23 Portersville oyster reef lease area

4.6.1.3 Agricultural Economy

Traditional commercial farming is not a substantial part of the economy within the Watershed. According to the Mobile County Conservation District, there are no identified row farms, active plant nurseries or substantial tree farms and only two modest sized cattle farms in the Watershed. Less than one percent of West Fowl River stakeholders are employed in agriculture related operations.

4.6.1.4 Mixed Employment

As stated previously, a substantial portion of the residents of the West Fowl River Watershed are not employed within the watershed. If not retired, residents are employed in the same cross section of professions and industries as one might find among residents of almost any urban area. These include, but are not limited to areas such as the following:

- Educational services
- Health care and social assistance
- Retail trade
- Manufacturing

- Management services
- Entertainment, recreation, accommodation and food services
- Construction
- Transportation
- Finance and insurance
- Real estate

4.6.2 Tourism and Recreation

Data collected from stakeholders of the West Fowl River Watershed illustrated a margin of support for promoting greater use of the waterway's assets to promote tourism. Simultaneously, most responders expressed a strong protectionist view that it was incumbent on the West Fowl River stakeholders to take the lead in protecting and maintaining the watershed for use by both residents and non-residents.

Ecotourism and recreation that aim to be both socially conscious and ecologically sensitive was considered acceptable by stakeholders. This form of tourism, if implemented properly, is viewed as something that would foster public environmental education and be protective rather than exploitive. Most stakeholders related well to ecotourism as a means of educating the public to the value of natural resources but few related ecotourism to the creation of physical sites (parking areas, launching areas, restrooms, etc.) or saw ecotourism as an "industry" that put people to work and added to the economy of the area. In other words, ecotourism was innately a good thing, but the commercialization of ecotourism had negative connotations.

However, it should be anticipated that responsible ecotourism in the form of nature excursions, sightseeing trips, birding trails, hiking and biking trails, environmental instruction centers, canoeing, kayaking, sport fishing, rustic camping, and wildlife photography will grow substantially in the years ahead as more citizens from outside the waterway become familiar with its beauty and ecological wonders.

4.6.3 Working Waterfront

There is no single commercial zone within the waterway where large numbers of seafood boats or other commercial vessels dock and unload. These sites are spread throughout the navigable waterways. Although one should anticipate a trend toward further growth of seafood related operations, as well as small nature tours and fishing guide operations, there is no indication of a trend toward development of a traditional working waterfronts designed to commercial interests and tourism.

4.6.4 Cultural Preservation

Those citizens of the West Fowl River Watershed, who participated in this study's outreach questionnaires and interviews, expressed little concern for the preservation of typical cultural elements such as language, dress, foods, religions, or holidays.

The culture that almost every respondent identified was the "life-style" culture that called on each resident to understand the following:

- The ecology of the watershed is of critical importance as a nursery for fish and shellfish.
- On-going research within the waterway by federal and state agencies as well as non-profit organizations is critical to establishing environmental benchmarks and identifying biological and chemical aberrations before irreparable damage is inflicted.
- Each stakeholder in the watershed has a personal responsibility to maintaining the watershed's ecology for subsequent generations.
- There is an undeniable need to provide access to the watershed by tourists and visitors for recreational, educational and nature-appreciation reasons.

Preservation of the West Fowl River Watershed culture will depend entirely on the ability of stakeholders to make certain that the ecological balance of the watershed is maintained, that the public understands the undeniable value of the watershed, and that it is passed on to future generations without major blemish or degradation.

5 West Fowl River Watershed Goals and Objectives

The MBNEP has outlined the following goals and objectives for its watershed management planning efforts:

- Provide a roadmap for restoring/conserving the Watershed and improving water and habitat quality
- Chart a conceptual course for improving/protecting the things people value most about living along the Alabama coast:
  - Water Quality
  - Fish/ Habitats
  - Coastlines
  - Resiliency
  - Access
  - Heritage
- Provide a strategy for conserving and restoring coastal habitat types providing critical ecosystem services
- Develop a comprehensive plan to maximize environmental health and public benefit by identifying actions to improve the environment; promote community ownership, knowledge, and involvement in watershed management; provide additional accessibility; and restore and conserve priority habitats

5.1 Vision

The WMP Team carefully listened to the community and stakeholders to gain insight into their issues, needs, and concerns. Throughout this extensive public outreach and engagement process, the WMP Team has encapsulated what they heard from the community into this common vision for the Watershed:

Vision: *To transform the river and its watershed into a healthy and vibrant community amenity that supports a robust habitat; provides increased public access; serves as an economic engine supporting the seafood and shipbuilding industries and ecotourism; and celebrates and preserves the rich culture and heritage of the area.*

The West Fowl River contains three independent systems that are a key geographical feature of the Watershed and Coastal Alabama. Investing in its restoration and improvement will provide a sense of place for the local community, support their way of life, and attract visitors from outside of the area.

5.2 Goals and Objectives

5.2.1 Goals and Objectives Development

Input gathered from the West Fowl River Steering Committee, residents, and other stakeholders was used to shape the goals and objectives of the WMP. As part of this process, the following items were noted:

Success Factors:

To be successful, the WMP needs to provide:

- useful information for local and regional planning and management efforts.
- scientific validation of issues and concerns.
- a roadmap to fishable/swimmable river and bayou.
- increased recreational opportunities.
- increased preservation of habitats and open spaces.
- recommendations for multi-use, multi-benefit projects for a sustainable community.
- provide tools to increase community resilience.

Challenges and Concerns:

- **Water Quality**
    - Fishable, swimmable waterbodies
    - Limited water quality data
    - Watershed comprises of three independent systems
    - Waste water treatment plant (WWTP) outfall
    - Septic tanks
    - Trash
    - Sedimentation
    - Stormwater runoff management
    - Pollution impacts to aquaculture and fisheries
- **Fish/Habitats**
    - Pressure from land use changes and development
    - Lack of environmental planning
    - Many coastal wetlands in private ownership
    - Invasive species
    - Impacts/ habitat changes from Hurricane Frederick and future hurricanes
- **Coastlines**
    - Eroding banks along the "Narrows" between East Fowl and West Fowl Rivers

- Eroding shorelines along shell Belt and Coden Belt roads
- Loss of islands- Lady Island; Coffee Island; Cat Island; Dauphin Island

➢ **Resiliency**

- Previous and future impacts from hurricanes
- Loss of Islands: Lady Island; Coffee Island
- Sea level rise
- Funding

➢ **Access**

- Need more public access to water
- Much of the river and bayous are under private ownership
- Boat ramp improvements and expansion

➢ **Heritage**

- Small Community
- Conflicting users in the Watershed (shipbuilding, aquaculture, agriculture, petroleum industry)
- No formal local governmental organization in the watershed. Only Mobile County.
- Limited income opportunities
- Impacts from future development
- Preservation of natural and historic sites

Community Priorities:

➢ **Water Quality**

- Improve water quality
- Reduce trash in waterways
- Expand public sewer systems to all residents
- Control of industrial pollution

➢ **Fish/Habitats**

- Protect wetlands for nursery and breeding habitat
- Protect habitat of our seafood
- Ensure sustainable fisheries
- Wildlife refuge
- Preservation
- Keep area natural
- Acquire more greenspace

- Development of more oyster reef habitats

➢ **Coastlines**

- Maintain channel for boating
- Protection from erosion

➢ **Resiliency**

- Improvements in environmental health
- Become a more resilient community
- Funding

➢ **Access**

- More access points along the river and bayous
- Improve/ create non-fee use boat ramps to support recreational and commercial fishing
- More recreational trails near the river and waterways
- Increased recreational use
- More parks

➢ **Heritage**

- Promote working waterfront
- Diversify economy
- Integrate this regional planning efforts
- Ecotourism
- Promote Hwy 188 corridor
- Expand economy and job opportunities
- Cultural preservation (Indian mounds)
- Public engagement and awareness of WMP

All of the above community and public input was considered to create the goals below.

5.2.2 Community Goals

1. Improve water quality to support residents, public, and seafood industry.
2. Improve and protect habitats for the benefit of fish, wildlife, and residents.
3. Protect shorelines.
4. Make the community more climate resilient.
5. Provide more recreational opportunities in the Watershed and more access to the river and bayous.
6. Preserve and build on working waterfront heritage.
7. Gain a better understanding of the watershed's hydrology and water quality.

8. Continue to educate residents so they can be proactive in protecting the watershed and the ecosystem.
9. Consider land use planning and regulation changes to better control development.
10. Clean up the litter and garbage in certain areas.
11. Pave all dirt roads.

5.2.3 Community Objectives

To achieve the goals presented above, the following objectives were developed:

1. Eliminate sanitary sewer overflows and unpermitted discharges.
2. Improve WWTP collection system to reduce groundwater and surface water infiltration and inflow.
3. Improve watershed drainage system to manage stormwater runoff.
4. Reduce amount of trash in waterways.
5. Restore and protect streams and waterways to reduce and control sedimentation, improve habitats, and manage invasive species.
6. Implement engineering measures to restore natural watershed hydrology to the extent feasible.
7. Increase public access to the waterfront.
8. Develop greenway trails, blueway trails, and scenic destinations to attract and promote recreational and ecotourism activities.
9. Develop a water quality monitoring program
10. Create a community organization to work with county, state agencies and coordinate with other watershed programs.

5.3 Planning Alignment

In developing this plan, the WMP Team utilized a community-centered, comprehensive approach to watershed management planning. The WMP Team incorporated the U.S. Environmental Protection Agency (EPA)'s six steps in watershed planning with EPA's nine key watershed management elements into a broad overall watershed management approach for improvement and protection of the six things people value most about living along the Alabama coast (Water quality, Fish/Habitats, Environmental health and resiliency, Access, Culture and heritage, and Shorelines). The team also incorporated guidance from the MBNEP Comprehensive Conservation and Management Plan (CCMP), Clean Water Act Section 319, ADEM, as well as other regional planning initiatives. The goal was to establish a WMP that was founded on equitable and practical restoration and remediation alternatives. In developing this comprehensive, community-based approach, the WMP Team endeavored to provide a clear vision to guide the planning process while always keeping the end goal in view – restoring the ecological and cultural vitality of the Watershed and its community.

The following sections give a brief background of the planning and guidance principals that this WMP is based on.

5.3.1 EPA Six Steps in Watershed Planning

The EPA has identified six steps to follow during the watershed planning and implementation process. The development of this WMP involved steps one through four. Steps five and six guide WMP implementation. These six steps are inclusive of the nine key elements required by the EPA for the watershed planning process and are presented in the following section.

Step 1: Build Parnerships

Step 2: Characterize the Watershed

Step 3: Finalize Goals and Identify Solutions

Step 4: Design an Implementation Program

Step 5: Implement Watershed Plan

Step 6: Measure Progress and Make Adjustments

5.3.2 EPA Nine Elements

The EPA has also identified nine key elements of watershed planning that are included within the six steps of watershed planning. These nine elements are considered critical for achieving improvements in water quality and their relevant sections in this WMP are as follows:

a) Identify causes and sources of pollution (Sections 3 and 4)

b) Estimate pollution loading into the watershed and the expected load reductions (Section 4)

c) Describe managment measures that will achieve load reductions and targeted critical areas (Section 6)

d) Estimate amounts of technical and financial assistance and the relevant authorities needed to implement the plan (Sections 7 and 8)

e) Develep an information/education component (section 9)

f) Develop a project schedule (Section 7)

g) Decribe the interim, measurable milestones (Section 7)

h) Identify indicators to measure progress (Section 7)

i) Develop a monitoring program (Section 10)

6 Watershed Management Measures

In previous sections, the condition and challenges facing the West Fowl River watershed have been described. This section presents the management measures recommended for achieving the goals and objectives identified for the West Fowl River Watershed restoration plan. It is anticipated that successful facilitation of the West Fowl River Watershed Plan will be the responsibility of a cross section of all major Watershed stakeholder groups.

6.1 Restoration and Management Priorities

In Chapter 4, the critical areas and issues to address in restoration of the West Fowl River Watershed have been prioritized into the categories listed below. Structural and non-structural BMPs as well as strategies and goals will be identified. This comprehensive approach to watershed management will maximize benefits to upland agriculture, urban growth, seafood harvesting, boat building, and the overall quality of life for citizens in the watershed.

Water

Identifies actions to reduce point and non-point source pollution and remediate past effects of environmental degradation, thereby reducing outgoing pollutant loads into Portersville Bay, Mississippi Sound, and the Gulf of Mexico.

Coastlines

Assesses shoreline conditions and identifies strategic areas for shoreline stabilization and fishery enhancements.

Access

Characterizes existing opportunities for public access, recreation, and ecotourism and identifies potential sites to expand access to open spaces and waters within the watershed.

Fish

Identifies actions to reduce the incidence and impacts of invasive flora and fauna and improve habitats necessary to support healthy populations of fish and shellfish. Provides a strategy for conserving and restoring coastal habitat types; providing critical ecosystem services; and identified by the MBNEP's Science Advisory Committee (SAC) as most threatened by anthropogenic stressors. These habitat types: freshwater wetlands; streams, rivers and riparian buffers; and intertidal marshes and flats, were classified as most stressed from dredging and filling, fragmentation, and sedimentation, all related to land use change.

Heritage

Characterizes customary uses of biological resources and identifies actions to preserve culture, heritage, and traditional ecological knowledge of the watershed.

Resiliency

Identifies vulnerabilities in the watershed from accelerated sea level rise, storm surge, temperature increases, and precipitation and improves watershed resiliency through adaptation strategies.

As described in previous sections, water quality is critical to ensure the health of the watershed and for realizing the benefits from its varied uses. Based on data collected for the watershed, West Fowl River Watershed faces a number of contributors to water quality degradation including stormwater runoff, nutrients, trash, sedimentation, and pathogens.

The West Fowl River Watershed study also identified a number of specific water related activities that need to be undertaken to help address these issues including the following:

- Identifying, mapping and remediating zones within the watershed with high sediment and high nutrient yields/loadings
- Prioritizing erosion zones along West Fowl River and its tributaries and implementing restoration and bank stabilization to reduce sediments
- Reducing the number of unpaved roads
- Conducting detailed pathogen source tracking and identification efforts in areas of the Watershed with frequent high pathogen levels to distinguish between wildlife, livestock, pets, and human contributions in order to develop detailed plans to remediate pathogen sources.
- Extending and monitoring the current effluent outfall line
- Eliminating the volume of trash currently entering the waterway.

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- Extending and monitoring the current effluent outfall line
- Eliminating the volume of trash currently entering the waterway

6.2.1 Stormwater Runoff

Currently, the Watershed has limited mitigation measures in place to manage stormwater runoff. Effective stormwater management must utilize a combination of planning and regulations, infrastructure, and BMPs.

6.2.1.1 Stormwater Management for Developed Watershed Areas

Stormwater management for developed areas of the West Fowl River Watershed will be most effective if implementation includes both structural and non-structural BMPs. Installation of regional detention areas and improvements to existing infrastructure in the Watershed will function most effectively. If the County's planning and development regulations address on-site stormwater runoff and downstream flooding for future developments, this will be instrumental in managing stormwater and water quality for the watershed in the future.

6.2.1.2 Stormwater Management Requirements for New Development

In addition to the implementation of structural management measures, adopting stormwater management regulations for development will ensure that regional management measures and existing infrastructure function properly. Modifying the County's Zoning Ordinance Regulations and Comprehensive Plan to include enhanced stormwater management for new development is a recommended measure for mitigating runoff. It is not feasible to expect that regional BMP measures implemented by the County will be able to collect, treat, and attenuate all sub-basins within the watershed. Requiring onsite stormwater treatment facilities ensures that the effects of new development on water quality within the Watershed are mitigated. In addition, developing requirements for stormwater attenuation based on impervious cover for new developments reduces the risk of flooding to downstream properties.

6.2.1.3 Stormwater Discharges

The Watershed has relatively few structural BMPs in place for treatment of stormwater runoff. Developed area's stormwater runoff contains nutrients from fertilizers and pesticides applied to green spaces such as yards and agricultural fields. In addition, stormwater contains oils, petroleum, and hydrocarbons associated with vehicular traffic, which is collected by storm drains in streets and parking lots. Implementing areas for regional treatment prior to allowing stormwater collected by stormwater infrastructure to discharge into the Watershed's surface waters can drastically improve water quality for the Watershed. As described previously, it is recommended that the County enhance regulations for new development that would require onsite water quality treatment facilities prior to discharging into the surface waters within the Watershed.

6.2.1.4 Sustaining Watershed Hydrology by Promoting Low Impact Development (LID)

Hydrology is the scientific discipline concerned with the occurrence, distribution, and circulation of water and its interactions with living things. Urbanization modifies any watershed's natural hydrology by reducing the volume of surface water that can infiltrate the soil and increasing the volume of stormwater runoff. Increased runoff erodes streambanks, washes large quantities of trash, sediments, and other pollutants into waterways and damages stream bottoms.

Additional urbanization and development within the Watershed will result in additional adverse impacts on water quality. However, these impacts can be minimized by adopting measures to sustain the Watershed's hydrology. Such management measures are referred to Low Impact Development (LID).

Low Impact Development (LID) is an interdisciplinary systematic approach to stormwater management that can result in improved stormwater quality, improved health of local water bodies, reduced flooding, increased groundwater recharge, more attractive landscapes, improved wildlife habitat, and improved quality of life for residents. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treats stormwater as a resource rather than a waste product. Successful implementation of LID recreates a more natural hydrologic cycle in a developed watershed. Suggested LID techniques for new residential developments with potential pollutant load reductions are presented in **Table 6.1**, and recommended retrofits for existing developed areas are presented in **Table 6.2**.

Table 6.1 Recommended LID practices (ADEM 2014)

Practice	Pollutant Removal			Cost
	Sediment	Nitrogen	Phosphorous	
Bioretention Cells	80 – 85%	40 - 50%	45 - 60%	medium/high
Constructed Stormwater Wetlands	80 – 85%	30 – 40%	40%	medium/high
Permeable Pavement	99%	65 – 80%	42 – 80%	high
Swales	35 – 80%	20 – 50%	20 – 50%	low
Level Spreaders and Grassed Filter Strips	40 – 50%	20 – 30%	20 – 35%	low
Rainwater Harvesting	Reduces flooding and erosion			medium
Green Roofs	Decrease runoff and peak flows			high
Riparian Buffers	60 – 85%	30%	35 – 40%	medium

Table 6.2 Recommended retrofit LID practices (ADEM 2014)

Practice	Pollutant Removal			Cost
	Sediment	Nitrogen	Phosphorous	
Rain Gardens	Phosphorus and nitrogen removal			low
Curb Cuts	Directs runoff to primary stormwater control measure			medium
Disconnected Downspouts	Directs runoff to primary stormwater control measure			low
Retention Cells (where land is available)	80 – 85%	40 – 50%	45 – 60%	medium/high

Development of one or more demonstration projects in the Watershed could help illustrate for stakeholders that LID practices can provide substantial community benefits while improving water quality and minimizing flooding. Working with an appropriately qualified engineering firm, several types of demonstration projects using The *Alabama LID Handbook* recommendations could be completed. This would encourage, through education and outreach, the use of LID practices that could greatly enhance Watershed protection.

Recommended LID management measures for the West Fowl River Watershed include, but are not limited to the following:

- Bioretention swales and cells
- Constructed stormwater wetlands
- Rainwater harvesting

Bioretention Swales and Cells

Bioretention swales are gently sloping drainage ditches filled with vegetation that are designed to remove silt and other pollution from stormwater and surface water runoff (Gibney 2015). Large underutilized parking areas may be suitable for partial pavement removal and replacement with natural vegetation, as well as installation of a bioretention swale as shown in **Figure 6.1. Figure 6.2** displays four different types of swale designs.

Figure 6.1 Example of bioretention swale in a parking area at Auburn Research Park; Auburn, AL (ADEM 2014)

Bioretention cells (BRCs) are depressions on the surface that capture and store stormwater runoff for a short period. BRCs remove pollutants by the processes of absorption, filtration, sedimentation, volatilization, ion exchange, and biological decomposition and can dually support flood- and drought-tolerant native vegetation habitats (ACES 2016b). **Figure 6.3** provides a profile of a typical BRC, while example applications of BRC's are presented in **Figure 6.4**.

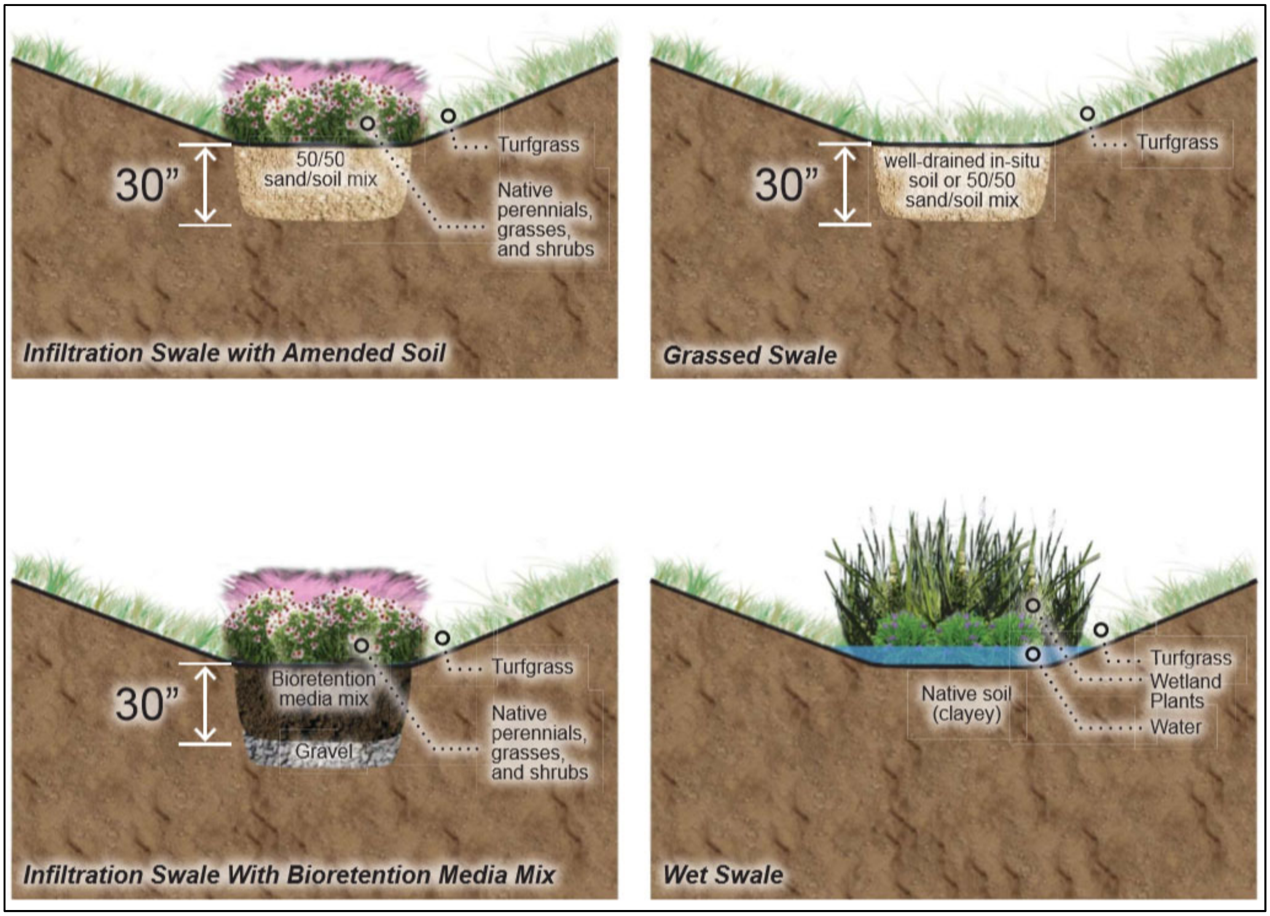


Figure 6.2 Examples of bioretention swales (ADEM 2014)

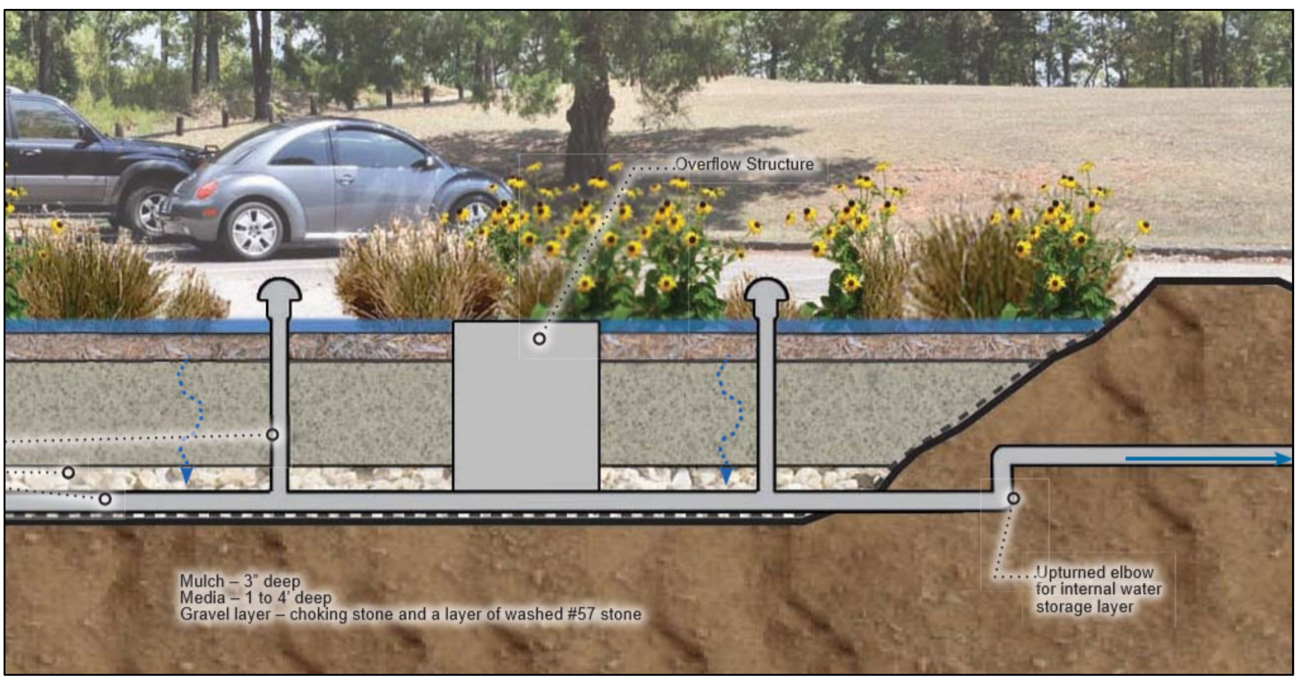


Figure 6.3 Example of typical BRC profile (ADEM 2014)

Constructed Stormwater Wetlands

Constructed stormwater wetlands (CSWs) function like natural wetlands to treat stormwater by using biological, chemical, and physical processes to promote infiltration, cycle nutrients, and filter and decompose pollutants (ACES 2016b). **Figure 6.5** provides a cross section of a CSW, while an example application of a CSW is provided in **Figure 6.6.**

Figure 6.4 Examples of implemented BRCs adjacent to development in Railroad Park; Birmingham, AL

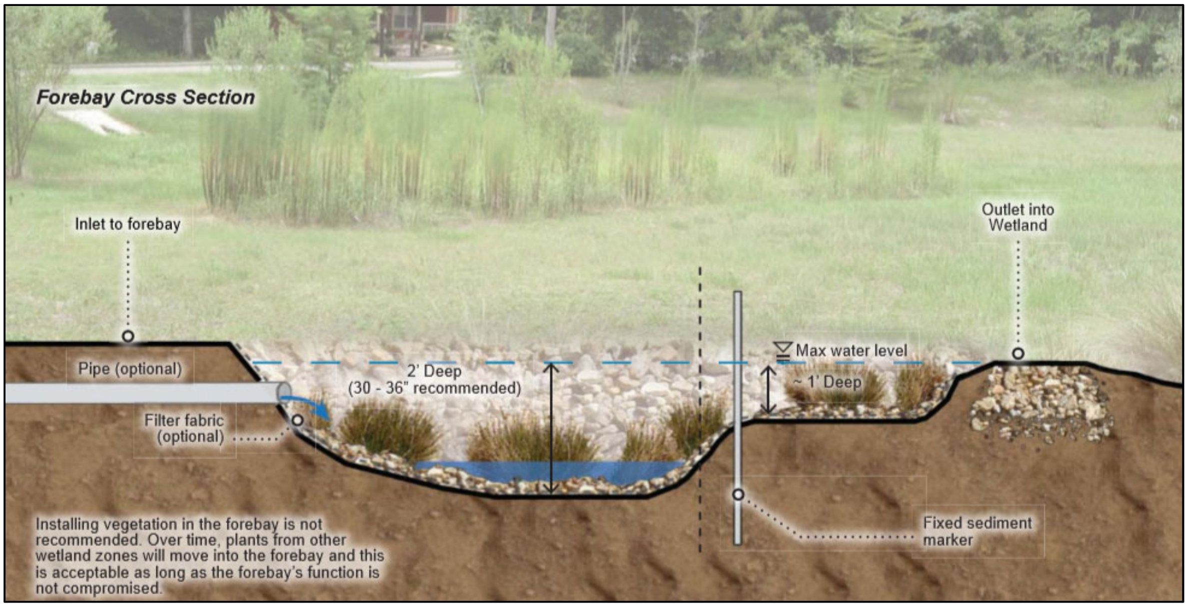


Figure 6.5 Example of CSW cross section (ADEM 2014)

Figure 6.6 Example of CSW at Hank Aaron Stadium; Mobile, AL

Rainwater Harvesting

Rainwater harvesting involves the collection of rainwater for reuse, typically from a rooftop, and can be used as a form of runoff management from impervious surfaces. The communities of Bayou Coden, Delta Port, Heron Bay, and the entire West Fowl River Watershed would both greatly benefit from increased rainwater harvesting. Numerous funding sources are available that assist communities with planning and funding tools that incorporate LID practices such as rain barrels and rain gardens in landscaping and streetscaping, as shown in **Figures 6.7** and Figures **6.8**.

Figure 6.7 Example of rain barrel harvesting residential rainwater

Figure 6.8 Example of rain garden (EPA: Green Infrastructure Guide)

6.2.1.5 Monitoring of Permitted Discharges

As previously described in Section 4, a number of industrial and commercial companies are located within the West Fowl River Watershed and a current list of authorized discharges was provided in **Table 4.1**. The development of an interactive map of all permitted discharges within the Watershed is recommended. This would provide a comprehensive review of the types of waste streams and water quality data from these point-source discharges as well as allow Mobile County to identify and enforce violations of permitted discharges.

6.2.1.6 Unpermitted Discharges

In **Chapter 3** it was noted that the West Fowl River Watershed has relatively enriched mercury concentrations. The presence of mercury may be attributed to atmospheric deposition due to air pollution and is therefore difficult to mitigate.

6.2.2 Agricultural BMPs

Several BMPs can be utilized in agricultural areas to minimize the pollutant load entering tributaries to the West Fowl River Watershed through stormwater runoff. Appropriate BMPs for mitigating downstream impacts are relatively simple and do not require significant costs for implementation.

6.2.2.1 Agricultural Best Management Practices for Stormwater Runoff

In the West Fowl River Watershed, rural and agricultural areas also comprise a significant portion of the Watershed area as described in **Chapter 3**. Practices associated with these areas present the first potential for pollutants to enter the watershed system but they also present a significant opportunity to mitigate and improve overall water quality in the system.

Developing an educational and outreach program to educate landowners and provide incentives for implementation of BMPs into agricultural practices could result in a significant improvement of water quality downstream. Examples of agricultural BMPs that should be encouraged within the Watershed include:

- Livestock exclusion from wetlands/streams and protection of riparian buffers along Streams
- Increased use of cover crops to decrease soil erosion and nutrient leaching, improve infiltration and increase soil organics
- Improved nutrient management through increased use of precision agriculture application of fertilizer and pesticides
- Remediation of areas with high livestock numbers where manure runoff is found to be a source of pathogens associated with water quality issues

Appendix G includes the Alabama NRCS Conservation Practice Catalog and Alabama's Best Management Practices for Forestry, both of which provide a detailed description of various agricultural and forestry best management practices.

There are a number of conservation programs available for both public and private landowners through the NRCS and Farm Service Agency (FSA) including:

- Conservation Stewardship Program
- Environmental Quality Improvement Program (EQIP)
- Emergency Watershed Protection Program (EWP)
- Regional Conservation Partnership Program (RCPP)
- The Watershed and Flood Prevention Operations Program (WFPO)

Through these various programs, there are a number of conservation practices promoted by the NRCS that are on-going throughout the Watershed for various agricultural activities including:

- Cropland: Contour farming, crop residue management, cover crop, crop rotation, field borders, terraces, tile outlet terraces, sod waterways, gully structures, conservation tillage, and sediment retention structures.
- Grassland: Pasture management, controlled grazing, weed control, stream crossing, gully structures, livestock exclusion, and cropland conversion.
- Forestland: Tree planting, planting desirable species, control burning, control undesirable invasive species, water breaks, gully structures, access roads

6.2.2.2 Conservation Buffer Strip

Conservation buffer strips are narrow strips of permanent vegetation left adjacent to streams in order to provide a barrier between fields and surface waters without significantly reducing the usable area for cultivation. Buffer strips slow stormwater runoff, trap sediments, and agricultural chemicals by providing an area for enhanced infiltration prior to runoff entering the upper tributaries and streams.

In addition, conservation buffer strips can reduce sedimentation created by wind erosion in adjacent fields. Buffers create a zone of natural habitat, mitigate the temperature of the adjacent streams, stabilize streambanks, minimize erosion, and create a barrier between livestock and surface waters. If properly installed and maintained, buffer strips have the potential to remove up to 50% of nutrients and pesticides, up to 60% of non-human pathogens, and up to 75% of sediments. In addition, conservation buffers can provide shelter for livestock during high winds or extreme temperatures. **Figure 6.9** provides an example of a conservation buffer strip adjacent to a stream. **Tables 6.3 and 6.4** provide a summary of the potential riparian buffer restoration sites in the West Fowl River Watershed.

Figure 6.9 Conservation buffer strip adjacent to stream. Source: USDA NRCS

Table 6.3 Potential conservation buffer locations in the west Fowl River Watershed

Location for Riparian Buffer Restoration			
Site Name	General Location	Latitude	Longitude
CB-1	Tributary of Bayou Coden, W of Hemley Rd and N of Marcus Rd	30° 23' 28.89" N	88° 13' 31.31" W
		30° 23' 44.27" N	88° 12' 47.10" W
CB-2	Unnamed tributary of Bayou Coden W of Marcus Road and N of Roack Rd	30° 23' 20.60" N	88° 13' 6.81" W
		30° 23' 25.27" N	88° 12' 31.13" W
CB-3	Tributary of Bayou Como, S of Rock Rd	30° 22' 54.19" N	88° 13' 00.97" W
		30° 23' 14.42" N	88° 12' 17.03" W
CB-4	Unnamed tributary of the West Fowl River, W of Zirloot	30° 22' 59.67" N	88° 08' 28.05" W
		30° 22' 52.67" N	88° 08' 23.69" W
CB-5	Unnamed tributary of the West Fowl River, E of Commodore Ave	30° 22' 51.30" N	88° 08' 37.34" W
		30° 22' 57.80" N	88° 08' 29.62" W
CB-6	Tributary of Bayou Sullivan, At Bayou St and N of Hwy 188	30° 22' 39.31" N	88° 12' 36.93" W
		30° 22' 47.10" N	88° 12' 31.18" W

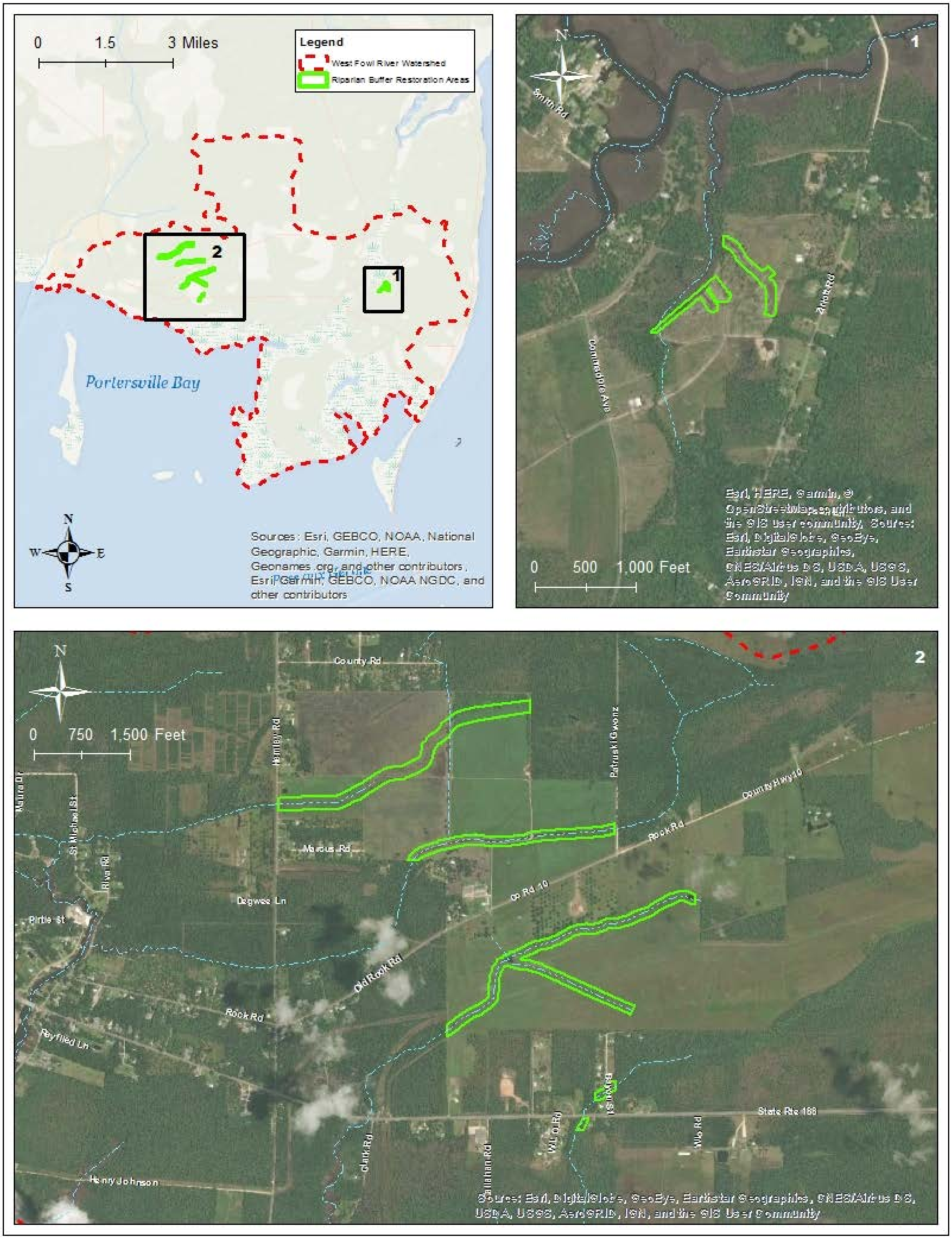
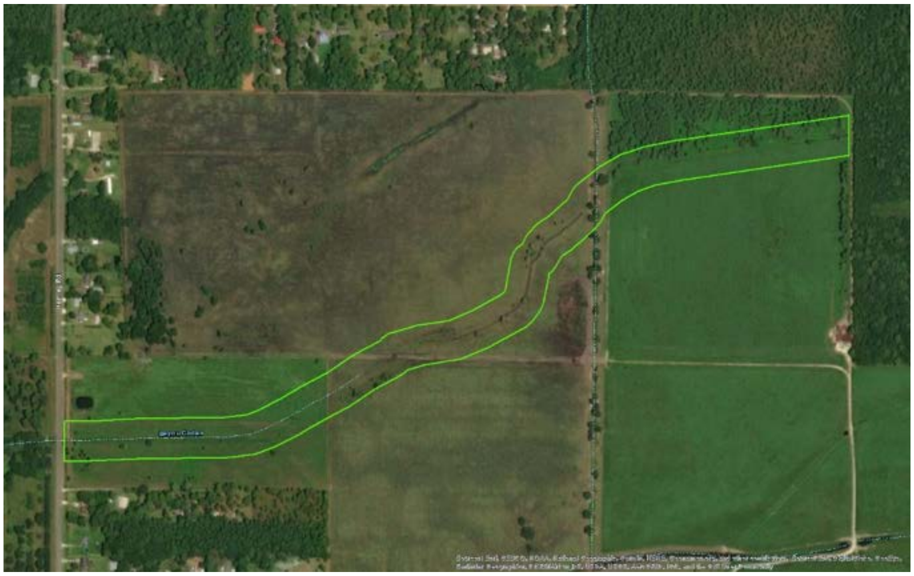
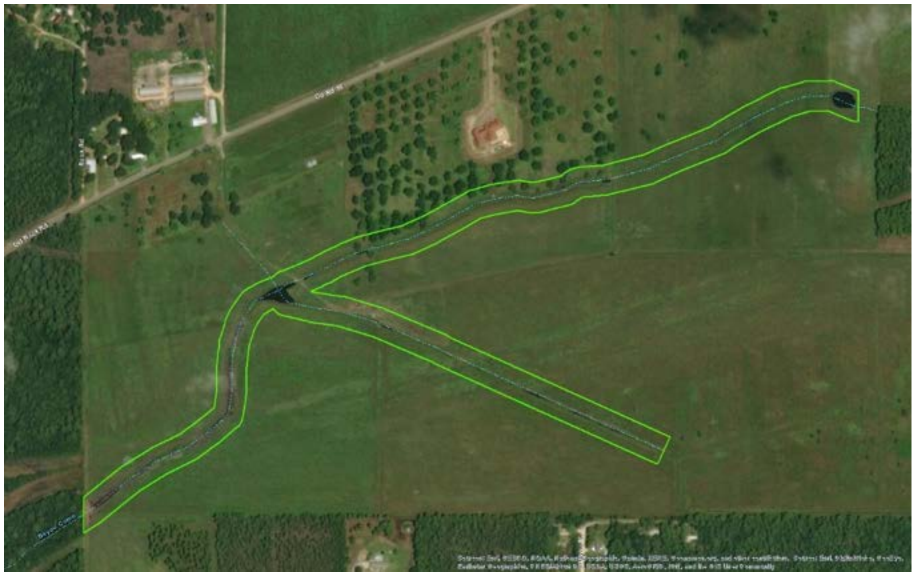


Figure 6.10 Riparian Buffer Restoration Location Map

Table 6.4 Location diagrams of potential conservation buffer locations

Site Name	Location Diagram
CB-1	
CB-2	

Site Name	Location Diagram
CB-3	
CB-4	

Site Name	Location Diagram
CB-5	
CB-6	

6.2.2.3 Livestock Exclusion System

A livestock exclusion system consists of permanent fencing to prevent livestock from grazing and accessing critical areas such as streams, wellheads, and wetlands (see **Figure 6.11**). Excluding livestock from stream banks prevents degradation to vegetation, which is vital to stabilizing banks and preventing erosion. In addition, it prevents livestock from entering surface waters, which has the further benefit of reducing risk of introducing non-human pathogens to the Watershed.

Figure 6.11 Livestock exclusion from wetlands/streams and protection of riparian buffers along streams. Source: Conservation Ontario

Figure 6.12 Rangeland along Gwonz Road with no livestock exclusion BMPs to protect the waterway

6.2.2.4 Alternate Water Sources

Alternative cattle water sources are strategically located freshwater sources for livestock such as upland excavated ponds, wells, or watering troughs that provide adequate drinking water supply located away from critical surface waters (see **Figure 6.13**). Implementation of alternate water sources in conjunction with a livestock exclusion system significantly reduces the risks of sedimentation and non-human pathogens entering the upper tributaries by preventing livestock from accessing streams.

Figure 6.13 Livestock solar well. Source: U.S. Fish and Wildlife Service, Partners for Fish and Wildlife

6.2.2.5 Fertilizer Application

Applying fertilizer to fields is a commonly used practice to enhance the production of crops. However, fertilizers can also add an excess of nutrients to the Watershed system. Simple practices used in the application of fertilizers can reduce the amount of resulting nitrogen and phosphorus that are conveyed into adjacent streams.

When and where fertilizer is applied can have a significant effect on the risks to surface waters. The following are recommended guidelines regarding the application of fertilizers:

- Apply fertilizers when soils are not saturated and during or immediately following planting allows optimum conditions for absorption by crops and minimizes transport into groundwater and surface water runoff

- Provide a sufficient buffer (i.e. 50 feet) from streams and wetlands to minimize the risk that nutrients enter surface waters
- Apply small quantities of fertilizer at the roots of crops through the use of drip irrigation as it provides the benefits of maximum absorption by the root system and significantly minimizes risk of runoff into surface water conveyances
- Follow appropriate application rates. The application of fertilizers is beneficial only to the point at which crops can adsorb the nutrients; once plants have reached their intake limit, the crops stop responding to sub sequential applications
- Crop rotation can minimize the amount and cost of fertilizers required by allowing the nutrients in a fallow field to replenish naturally through the decay of organic matter.

6.2.2.6 Pesticide Application

The application of pesticides is similar to that of fertilizers with regards to risk and the overall health of the Watershed. The following are recommended guidelines regarding the application of pesticides:

- Apply pesticides when soils are not saturated and not immediately prior to a rain event in order to minimize risk
- Many pesticides do not persist for long periods of time in the environment, therefore, if applied during dry conditions, it is possible that the chemicals have time to degrade prior to being collected by runoff and conveyed into surface water conveyances
- Pesticides should be stored in roofed enclosures where they are not exposed to rainwater, and in clearly labeled, closed containers.

6.2.3 Sediment

Suspended sediment is defined as the portion of a water sample that can be separated from the water by filtering. Sediment may be composed of organic and inorganic particles that include algae, industrial and municipal wastes, urban and agricultural runoff, eroded material from geologic formations, or streambed particles that are too large or too dense to be carried in suspension by stream flow. These materials are transported to stream channels by overland flow related to stormwater runoff and cause varying levels of turbidity. Suspended sediment loading within the West Fowl River Watershed was identified as a priority issue based on studies by the GSA, data provided by the ADEM and the AWW organization, public perception, and input from the Steering Committee.

6.2.3.1 Unpaved Roads Stabilization

As described in previous sections, unpaved roads located on both private and county right of way are considered to be a major source of sedimentation in the Watershed. **Figures 6.14 and 5.15** are examples of the amount of sediment that could potentially enter a wetland/ waterway from a single unpaved road. The stabilization of unpaved roads either from paving or other stabilization actions will greatly reduce the likelihood of sediment entering the Watersheds various waterways. **Figure 6.16** and **Table 6.5** identify unpaved roads in the Watershed that are candidates for stabilization practices given their location either bisecting or occurring adjacent to streams and wetlands. The length of each unpaved road recommended for stabilization practices was determined by the potential for sediment to enter a waterway.

Figure 6.14 Unpaved road sedimentation into adjacent wetlands, Henry Johnson Road

Figure 6.15 Gully roadside along Zirlott Road

Table 6.5 Unpaved road candidates for stabilization practices

Road Name	Latitude	Longitude	Waterbody Impacted	Approximate Length (ft)
Zirlott Road	30° 23' 20.42 " N	-88° 08' 11.32" W	West Fowl River	2,600
McGraw Blvd	30° 22' 19.40" N	-88° 09' 23.91" W	West Fowl River	1,700
Lossing Road	30° 22' 34.64" N	-88° 09' 44.09" W	West Fowl River	1,600
Clark Road	30° 22' 27.87" N	-88° 13' 16.66" W	Bayou Como	2,650
Rock Road	30° 23' 33.83" N	-88° 11' 58.71" W	Bayou Como	6,300
Callahan Road	30° 22' 24.75" N	-88° 12' 53.55" W	Bayou Sullivan	2,460
Bayou Street	30° 22' 47.18" N	-88° 12' 32.61" W	Bayou Sullivan	1,220
Henry Johnson Street	30° 22' 30.00" N	-88° 13' 54.43" W	Bayou Coden	4,600
St. Michael Street	30° 23' 25.91" N	-88° 14' 7.65" W	Bayou Coden	2,970
Johnson Road	30° 21' 38.40" N	-88° 08' 09.46" W	Heron Bay	3,910
Williams Street	30° 21' 28.21" N	-88° 08' 02.47" W	Heron Bay	2,150

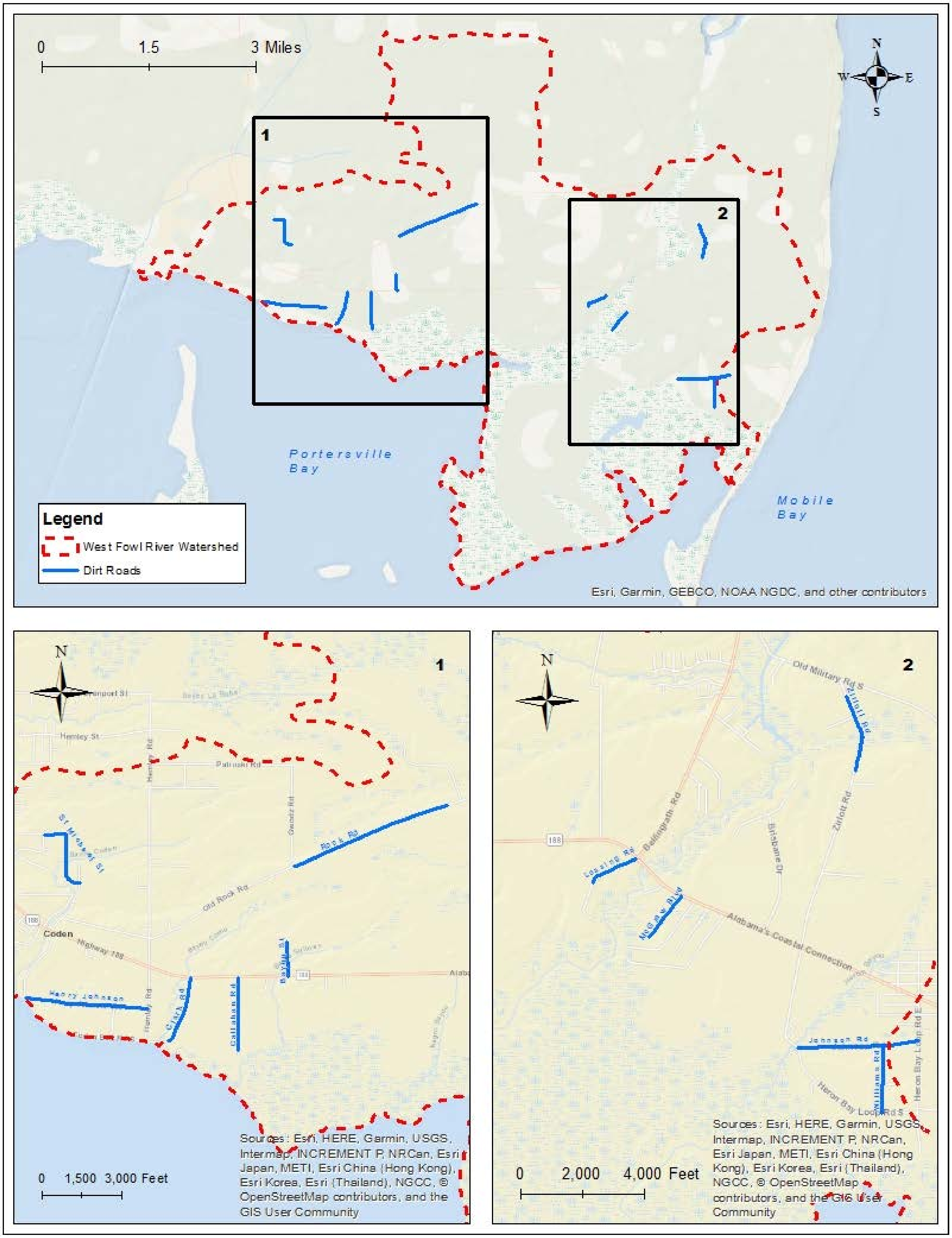


Figure 6.16 Location of unpaved road candidates for stabilization practices

Paving including roadside stormwater treatment is the most expensive unpaved road stabilization technique. There are, however, numerous techniques that may be applied to unpaved roads that reduce and/or eliminate their potential to adversely affect water quality. These efforts include the use of a Driving Surface Aggregate (DSA) or comparable, less erosive aggregate material, road contouring (raising and reshaping the road profile), installing grade breaks, and incorporating additional, properly located drainage outlets (i.e. diversion of material away from stream) (Scheetz 2008).

Driving Surface Aggregate

An aggregated surfaced road is an unpaved road that is primarily surfaced with materials derived from stone such as gravel or crushed rocks and greatly increases the stability, traffic support capability, and resistance of roads to erosion. A typical aggregate road is constructed in three layers (see **Figure 6.17**)(USFWS 2005):

- Surface Course – an 8 inch thick, uniformly graded gravel or crushed stone layer that is placed on top of the aggregate base.
- Base Course – An 18 to 24 inch thick layer comprised of compacted gravel and crushed stone and a minimal amount of fines (clay and silt) that produces a strong, stable matrix and drains freely.
- Subgrade – The bottom layer roadbed made up of the native soil materials found along the road or fill brought in to fill depressions.

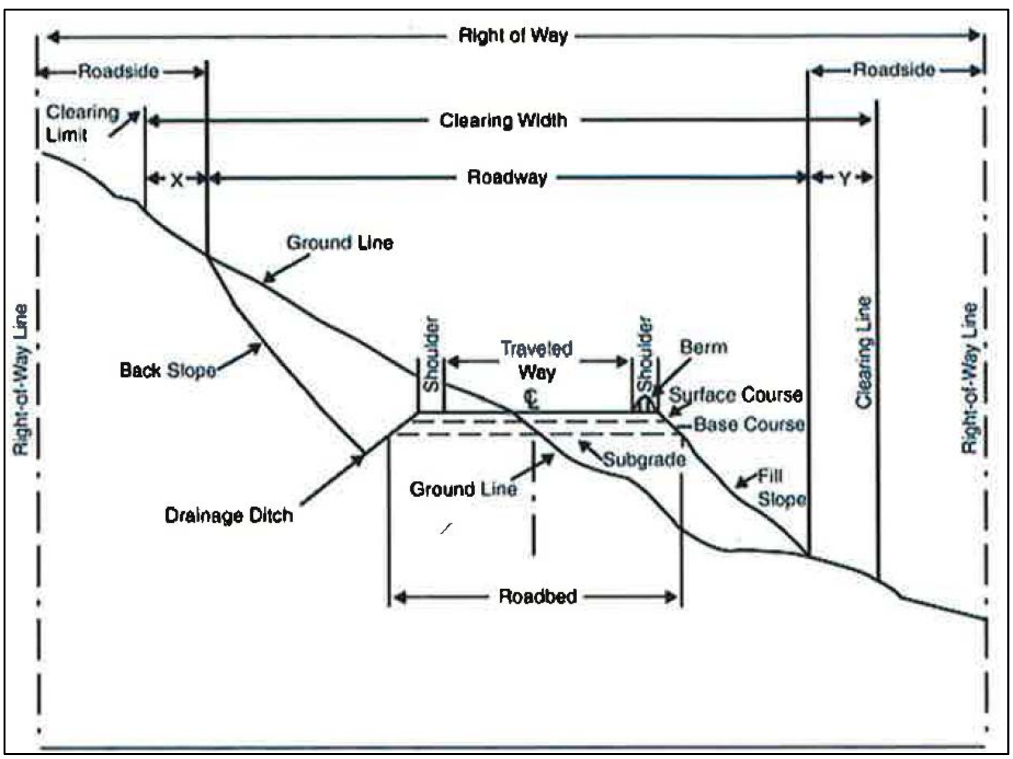


Figure 6.17 Roadway components

Road Contouring

Proper road contouring creates a configuration that facilitates the movement of runoff into established roadside drainage systems (preferably vegetated swales or drainage outlets) and provide a cohesive road surface that will resist erosion and safely support trafficking requirements. To effectively remove water from the roadway, the surface must uniformly slope towards one edge (outsloping) or have a center section that is higher than either edge (crowning).

Outsloped roadways avoid concentrating water flows by draining toward the downhill or shoulder where it may then be dispersed over and adsorbed into the receiving slope area below the road, preferably vegetated slopes and into a natural outlet. The primary advantage of road crowning is that the volume of runoff is split, ideally to a vegetated swale, and thereby reduces the erosive potential to a single roadside area, drain, or outlet. **Figure 6.18** depicts outsloped and crowned road configurations.

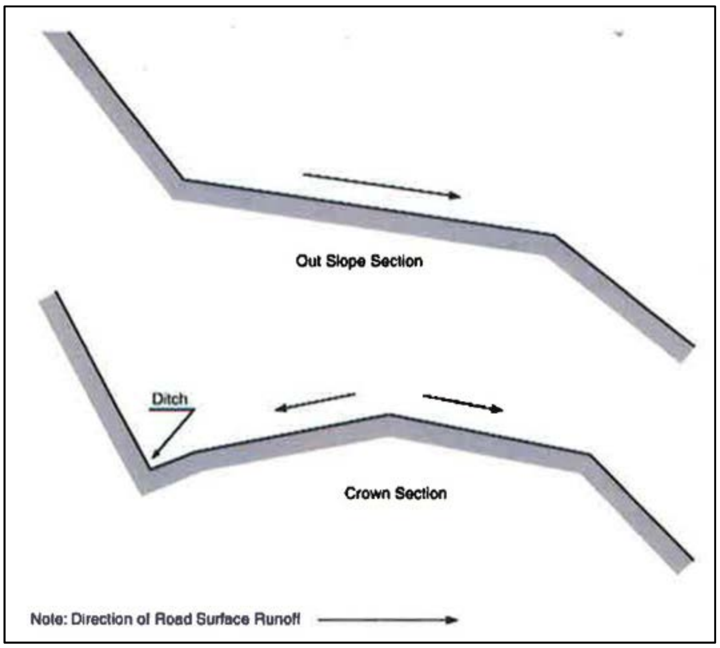
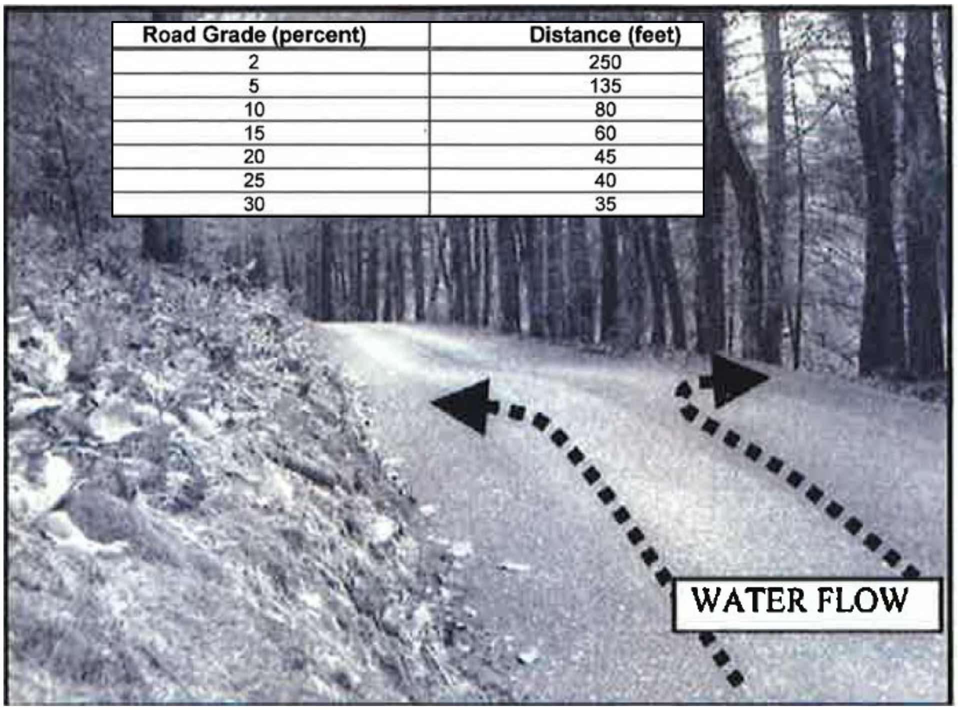


Figure 6.18 Outsloped and crowned road configurations (USFWS 2005)

Grade Break

A grade break is a small intentional increase in road elevation on a downhill slope, causing water to flow off the roadway surface and into road drainage features or natural drainage areas, thereby preventing road material erosion. Multiple grade breaks placed in succession are highly effective on long sloped roads to remove water from the road surface and prevent buildup of erosive water volume and velocity. **Figure 6.19** depicts a grade break as well as recommended distances between grade breaks.



Road Grade (percent)	Distance (feet)
2	250
5	135
10	80
15	60
20	45
25	40
30	35

Figure 6.19 Slope grade break (Center for Dirt and Gravel Road Studies) and recommended distance between grade breaks (Kochenderfer 1970)

Drainage Outlets

The best type of roadside drainage system is one that directly moves stormwater off the road and into natural, vegetated roadside drainways (areas of standing grasses, forbs, shrubs, trees, and over ground litter layers that effectively function as infiltration sinks and filtering buffers). In addition to vegetated roadside drainways, turnouts, a transitional excavated depression that intercepts and conveys roadside runoff to a stable discharge outlet, and sediment basins, an excavated holding pond that is used to capture and detain runoff, are effective in converting a concentrated flow of runoff to non-erosive sheet flow. Areas subject to a high volume and velocity of runoff may utilize energy dissipators (i.e. riprap or geosynthetic structure) to control erosion at the outlet (USFWS 2005).

6.2.3.2 Gully Restoration

Due to the types of soils and topography of the upper Watershed, these areas are prone to gully formation. Proper land management, including the agricultural BMPs described previously can prevent gully formation. However, additional measures are recommended to address erosional gullies where they have already formed. Low flow gully areas can be stabilized by shaping and filling with dirt to establish more gentle slopes, promoting the establishment of vegetation. Slopes no greater than 3:1 are recommended for best results in establishing vegetation. In addition to filling and shaping, installation of properly spaced check dams can reduce water velocity and subsequent erosion in high flow gullies (see **Figure 6.20**).

Figure 6.20 Agricultural gully stabilized with rip-rap check dams

6.2.3.3 Enforcement of NPDES Permits

Erosion and sedimentation from construction sites contribute to watershed degradation nationwide. Despite the relatively small area of disturbance compared to the overall watershed area, construction sites act as major contributor to sedimentation because the erosion potential on bare or disturbed land is typically 100 times greater than the erosion potential of agricultural lands. The National Pollutant Discharge Elimination System (NPDES) regulates erosion and sedimentation from construction sites in which greater than one acre of land is disturbed or construction sites, which are part of a larger plan of development, which totals more than one acre. Compliance is a performance-based regulatory system. This means that the Permittee has the ability to choose what (if any) erosion control measures are utilized during construction. However, compliance requires elimination of any non-point source discharge of sediment from the construction site.

ADEM NPDES CONSTRUCTION STORMWATER INSPECTION REPORT AND BMP CERTIFICATION

RESPOND WITH "N/A" AS APPROPRIATE. FORMS WITH INCOMPLETE OR INCORRECT ANSWERS, OR MISSING SIGNATURES WILL BE RETURNED AND MAY RESULT IN APPROPRIATE COMPLIANCE ACTION BY THE DEPARTMENT. IF SPACE IS INSUFFICIENT, CONTINUE ON AN ATTACHED SHEET(S) AS NECESSARY. PLEASE TYPE OR PRINT IN INK.

Item I.

Permittee Name:	Facility/Site Name:
Permit Number:	County:
Facility Entrance Latitude & Longitude:	Phone Number:
Facility Street Address or Location Description:	

Item II.

List name of current ultimate receiving water(s) (indicate if through MS4) and the number of disturbed acres which drains through each treatment system or BMP: Add additional sheet(s) if necessary.

Receiving Water	Disturbed Acres	Discharge Point #	Representative Outfall
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO

Item III.

1. ☐ YES ☐ NO Did discharges of sediment or other pollutants occur from the site? If "Yes", please list a description of the discharge(s) and their location(s):

2. ☐ YES ☐ NO Were BMPs properly implemented and maintained at the time of inspection? If "No", please provide location(s) and descriptions of BMPs that need maintenance:

3. ☐ YES ☐ NO Are BMPs needed in addition to those already present onsite at the time of inspection? If "Yes" please provide a description and location of additional BMPs that are needed:

4. ☐ YES ☐ NO Have any BMPs failed to operate as designed? If "Yes", please provide location(s) and description of BMP(s) that failed:

5. ☐ YES ☐ NO Were there BMPs required by the CBMPP that were not installed or installed in a manner not consistent with the CBMPP? If "Yes", please provide a description and location where the BMPs were not installed or installed incorrectly:

Item IV.

The Permittee shall conduct turbidity monitoring in accordance with Part V of the permit:

1. ☐ YES ☐ NO Is this facility a Priority Construction Site?
2. ☐ YES ☐ NO Has the facility disturbed greater than 10 acres?
3. ☐ YES ☐ NO Was the site discharging at the time of inspection?
4. ☐ YES ☐ NO Samples collected, if "Yes", sampling data must be attached.

ADEM CSW Inspection Report Form 23 11/11 1 of 2

Figure 6.21 ADEM Form 023: Construction Stormwater Inspection Report and BMP Certification (ADEM 2018)

Issuance and enforcement of NPDES permits is typically managed by states. In Alabama, the Alabama Department of Environmental Management (ADEM) manages NPDES permits. It is the responsibility of the Permittee to perform periodic inspections of the erosion control BMPs throughout duration of construction. In addition, the Mobile County could include regulatory requirements regarding erosion control for new construction into the County Development regulations and require that these measures be included in local regulatory review prior to issuance of local development permits. **Figure 6.21** provides an example of the State's stormwater inspection report and BMP certification that could be adopted and utilized by the County for areas outside their MS4.

6.2.4 Management Measures for Human Sources of Degradation Factors

6.2.4.1 Pathogens

In West Fowl River and Portersville Bay, levels of enterococci bacteria were low enough to meet ADEM's standards for bodily contact and the promotion of fishing. However, Fowl River Bay fecal coliform bacteria exceed the shellfish harvesting criteria often enough that Fowl River Bay is classified as Conditionally Restricted for shellfish harvesting, meaning shellfish must be relayed to other water bodies before they can be brought to market. Agricultural BMPs to reduce the risk of pathogens from livestock in the Bayou's headwaters have been presented in previous sections. However, the presence of human markers as sources for bacteria within surface waters likely originates from three sources: sanitary sewer overflows within the urban wastewater system, vessel discharges, and unpermitted discharges from rural septic systems. A detailed pathogen source tracking and identification in areas of the Watershed with frequent high pathogen levels would distinguish between wildlife, livestock, pets and human contributions and is recommended to develop detailed plans to remediate pathogen sources. In addition to tracking and identifying pathogen sources, it is recommended that a pathogen monitoring program that will support development of a hydrologic model be developed to provide predictive capabilities of the occurrence of high levels of bacteria and implement a public advisory system that warns of potential health risks associated with whole body contact recreation during period of elevated bacteria concentrations (similar to the model used to close waterbodies to oyster harvest).

6.2.4.2 Vessel Discharges

The lower Watershed has an abundance of boat traffic, primarily associated with industry, that may directly contribute illicit discharges to surface waters. Currently there are no pump out stations within Bayou Coden and the West Fowl River. Therefore, it is recommended that a vessel pump out station be installed at the Delta Port Marina to provide boaters an alternative to discharging into Portersville Bay, West Fowl River or Bayou Coden. **Figure 6.22** is an example of a boat pump out station located at a marina.

Figure 6.22 Boat pump out station. Source: FDEP Clean Marina Program

6.2.4.3 Unpermitted Discharges from Septic Systems

Septic systems within the western portion of the West Fowl River Watershed system have already been connected to the City of Bayou La Batre's wastewater collection systems through the CIAP program. However, there are rural portions of the Watershed that do not have access to a wastewater collection system. Therefore, these areas continue to rely on septic systems for wastewater disposal. Aging septic systems or improperly installed and maintained systems are prone to leaking and contribute to the presence of pathogens in surface waters within the Watershed. An extension to the sanitary sewer collection system to allow more residents to abandon septic systems and connect to the City of Bayou La Batre's system is recommended. However, there are areas within the Watershed where this is not feasible. For areas where sanitary sewer collection system connections are not feasible, education and outreach for proper installation and maintenance of septic systems is recommended. **Figure 6.23** is an example of a discharge pipe in the Watershed with discharge to surface waters.

Figure 6.23 Discharge pipe to surface waters of unknown effluent

6.2.4.5 Trash

Chapter 4 identified trash as an endemic problem throughout the Watershed. Whether intentional or accidental, improperly disposed trash is likely to end up in surface waters of the Watershed. This not only negatively affects water quality and aquatic habitats, but also has a negative impact on recreational activity within the Watershed.

Figure 6.24 Trash located along roadside within the Watershed

Figure 6.25 Trash along the shoreline within the Watershed

Combating litter will take a multi-faceted approach that includes the expansion of existing programs, increased regulatory control and enforcement, and a relentless education and outreach campaign in order to treat the problem at its source. In addition to public outreach, active trash collection and removal efforts should be supported and enhanced as much as possible.

6.2.4.5.1 Acquisition of a Trash Boat

Acquisition of a trash boat to allow collection of trash and debris from the River and bayous would enable the County to maintain surface waters and further enforce violations. **Figure 6.26** is a photograph of the City of Mobile's litter boat actively patrolling a waterway.

Figure 6.26 City of Mobile litter boat. Source DRCR (2016)

6.2.4.5.2 Enforcement

Improved enforcement, including increased monitoring and fines for intentional violations for trash disposal is recommended in order to discourage improper waste disposal.

6.2.4.5.3 Zoning Restrictions for Waste/Debris Storage

Adoption of zoning restrictions which require waste and debris storage be located a minimum distance away from surface waters is recommended. Restrictions should also require that trash storage and debris areas be enclosed by a fence and/or be stored inside a container with a lid to prevent litter from blowing away and to prevent scavenging by animals.

6.2.4.5.4 Installation of Waste Transfer Stations

Installation of waste transfer stations provides an affordable and environmentally sound solution for communities to handle collected waste without convenient access to a landfill. Transfer stations provide a hub to manage community waste and to accept large waste items until trash can be sorted and transported for permanent disposal. A coordinated effort between citizens and Mobile County for the installation of waste transfer stations throughout the Watershed is a recommended measure for trash/debris management.

6.2.5 Education and Outreach

Litter and pollution reduction methods mentioned previously are only part of the long-term solution of improving water quality. Citizen education and increased awareness is the best management measure to treat impairments to water quality at its direct source.

6.2.5.1 Education Programs for Agricultural Activities in the Watershed

Development of an effective outreach and education program should be the first step in pursuing changes in the headwaters of the Watershed to incorporate Agricultural BMPs. An effective program would engage landowners, provide compelling evidence of the benefits for watershed management to the agricultural industry, provide technical assistance for identifying appropriate BMPs and implementation, and potentially provide financial incentives and assistance to cover the costs of implementation of structural BMPs. This educational endeavor should be conducted in conjunction with organizations and agencies currently working with the farming communities to assure maximum "buy in."

6.2.5.2 Education Programs Related to Trash Issues

Educational programs should be designed and implemented to help adult and youth stakeholders understand the importance of preventing trash in the waterway and to understand how they can be instrumental in the process. Programs should be designed for English-speaking stakeholders as well as those whose native tongue is not English (i.e. Cambodian, Spanish, Laotian, and Vietnamese). Litter and trash programs should include opportunities for stakeholders to participate in active coastal cleanup programs.

The MBNEP through their "Clean Water Future" campaign, "Keep Mobile Beautiful", and many others local organizations have worked tirelessly to educate the public about the environmental harm created by trash. As part of "Keep Mobile Beautiful", recycling drop-off centers were implemented to promote a cleaner environment. These organizations inform the public so people are aware that littering upstream negatively affects downstream systems. Supporting those efforts and encouraging the formation of similar campaigns will be an effective measure to combat trash throughout the West Fowl River Watershed.

6.2.5.3 Education Programs for Shipyards (Boatbuilders) and Commercial Seafood Operators

Educational endeavors should be implemented with boat builders and the owners of commercial seafood boats to encourage environmental awareness of their operations and illustrate ways in which each can help reduce litter, eliminate oil, chemical and other discharges.

6.3 Fish/ Habitat

Improving water quality in degraded streams, wetlands, and coastal salt marshes was identified in Chapter 4 as a priority in order to improve the overall health of the Watershed from its headwaters to Portersville Bay. Many conditions and factors affecting water quality have been discussed in previous sections. This section will focus on the importance of habitat restoration and the positive impact that natural species have on supporting ecosystem function and health.

6.3.1 Invasive Species

6.3.1.1 Field Survey of Invasive Species

The presence of invasive species within the Watershed disrupts natural processes and functions and often threatens native species by overtaking habitat. Identifying and mapping invasive species present within the Watershed is a necessary step in establishing an invasive species eradication program in order to restore habitat for native species.

6.3.1.2 Develop Invasive Species Eradication Program

Currently, there is no comprehensive program for (1) detecting infestations of invasive flora and fauna in the Watershed and (2) managing or eradicating them once they have been identified. Ongoing inventories of invasive species would be valuable in determining to what extent non-native species have impacted the Watershed and how best to manage eradication, maintenance of biodiversity, and management of threatened natural resources. A public-private collaboration program for the inventory, management, and monitoring of invasive species in the Watershed is recommended.

6.3.2 Channel Restoration

Alternations to the natural dimension, pattern, profile of waterbodies as well as their connectivity to the floodplain can cause a variety of impairments to water quality, channel morphology, and quality of aquatic habitat. Specific impacts to waterbodies observed in the Watershed include floodplain fill from dredging and straightening (i.e. channelizing) of the stream channel. Both activities create an incised channel that are characterized as having high bank erosion rates, lateral channel migration, and an increased sediment supply (i.e. bed aggradation and bar deposition) that often results in a loss of aquatic habitat.

Channel restoration involves a multifaceted approach that includes careful research, design, and engineering. Restoration efforts may include the re-connection and/or expansion of a floodplain, bank stabilization, reestablishing channel sinuosity, and installing energy dissipating structures to decrease water velocity and erosion.

Natural Channel Design

The process of channel restoration through natural channel design involves a multiple step approach including data collection, engineering and scientific assessment, design, construction, monitoring, and maintenance. The success of channel restoration is contingent upon sound design methodology and implementation. The restoration approach follows specific published guidelines and methods endorsed by numerous institutions and regulatory agencies including the EPA, U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS), and the North Carolina Stream Restoration Institute.

Identification and Assessment of Impaired Channels

The identification and thorough assessment of an impaired channel is the first step in the restoration and design process. Visual observations, coupled with the initial analysis of maps and aerial photos, will help identify priority problem areas and develop a broad understanding of the general conditions within the system.

Site specific data is necessary for documenting the baseline condition of the channel as well as providing sufficient information to classify the channel through the Rosgen Classification of Natural Rivers (Rosgen 1994). This classification methodology will provide a basis for analyzing and interpreting data on channel form (cross-section, profile, and meander geometry), existing condition (lateral and vertical stability and sediment supply), and factors that may influence channel morphology (bank erosion potential, streambank and riparian vegetation, debris and channel obstructions/armoring). Additionally, this information will provide insight as to how the system might respond to direct channel or floodplain alterations and/ or indirect changes to the hydrologic and sediment regime.

Identification and Assessment of Reference Channels

Following evaluation of an impaired channel, stable channels in close proximity to and within the same watershed as the impacted channel should be identified and assessed with regard to their quality and value to the restoration project. These stable channels are referred to as a reference reach.

The existing conditions data from the impaired channel can be compared to data collected from stable reference reaches of the same Rosgen stream type functioning at full potential. A reach functioning at full potential will exhibit its best morphologic condition. This morphologic condition includes a set of desired or preferred characteristics that can be quantitatively described relative to channel size (moderate-low width/depth ratio) and shape (symmetric in crossover reaches, asymmetric in meander bends), channel bed stability (neither aggrading or degrading), bank stability (low bank erosion potential and low lateral migration rates), and sediment supply (comparatively low rates). This comparison will provide the degree to which the existing conditions in the impaired channel differ from those morphological values exhibited by the stable reference reach.

Channel Design

Once data describing existing conditions of the impaired channel and reference data from reference channels has been collected and analyzed, a detailed restoration design of the impaired channel may begin. The design should involve a multidimensional approach based on empirical, analytical, and natural channel principles. The empirical approach incorporates equations derived from regional data sets of various channel characteristics of dynamically stable systems. The analytical approach makes use of hydraulic equations and sediment transport functions to derive equilibrium conditions, and the principles of natural channel design focuses on the morphologic structure and fluvial function of a dynamically stable, natural channel as the model for efforts to improve channel structure and function. Utilizing this approach allows for the proper design of a stable dimension, pattern and profile of the channel that is based on reference reach data, incorporates restoration goals, and allows for flexibility to work within existing site constraints.

One crucial parameter of design is bankfull discharge. Bankfull discharge is calculated based on the anticipated one- to two-year rainfall event, drainage area for the project reach, land use within the drainage area, and substrate characteristics. The data are entered into a hydrologic model providing a bankfull flow rate target. Regional trend data collected from the reference reach should be used to corroborate the hydrology model. Utilizing the calculated flow rate, anticipated channel slope for the restored channel and projected channel "roughness," the size of the channel can be calculated to ensure overbank flow on an approximate annual frequency. Regional curves generated from recorded data are used to validate certain design criteria

The layout of the channel design is then prepared using available topographical data and data obtained from the reference and/or regional curve. Considering the characteristics of the land and potential constraints in the surrounding area, the layout design can follow four different approaches. The four priorities for restoration of impaired and incised channels were developed by Rosgen (1994) and include the following:

- **Priority 1:** Establish bankfull stage at the historical floodplain elevation.
- **Priority 2:** Create a new floodplain and channel pattern with the channel bed remaining at the present elevation.
- **Priority 3:** Widen the floodplain at the existing bankfull elevation.
- **Priority 4:** Stabilize existing banks in place.

Priority 1 Restoration: Establish bankfull stage at the historical floodplain elevation

For a Priority 1 restoration, the incised channel is re-established on the historical floodplain using the relic channel or by way of construction of a new morphologically stable channel. The channel is "lifted" to a higher elevation to connect with the historical floodplain, as illustrated in **Figure 6.27**. The new channel has the dimension, pattern, and profile characteristic of a stable form, and its floodplain is on the existing ground surface. The existing incised channel is either completely filled or partially filled to create discontinuous oxbow lakes and offline wetlands level with new floodplain elevation.

The surrounding land use may prohibit this restoration approach. Priority 1 restorations typically result in higher flood elevations and require sufficient land for meandering, posing a problem where flooding and land use issues exist. Constraints such as permanent culverts upstream and downstream of the restoration reach can also render this approach infeasible.

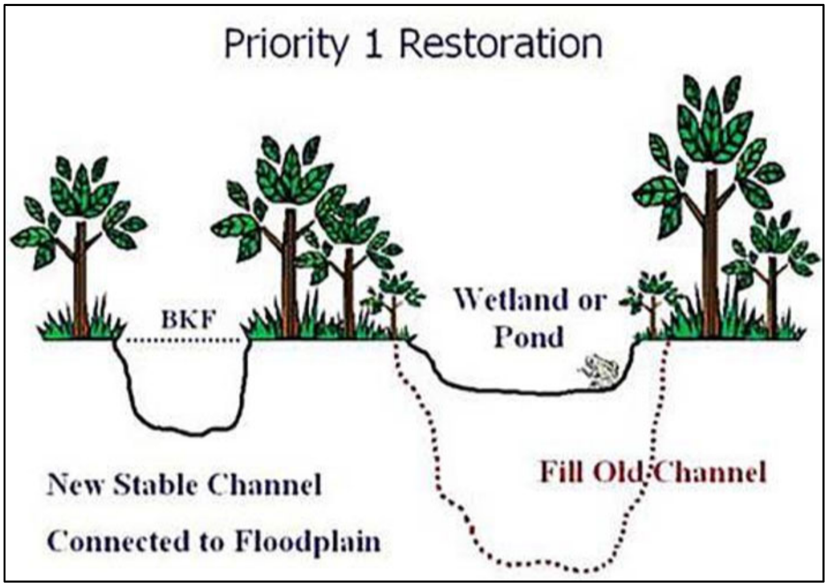


Figure 6.27 Conceptual cross section of Priority 1 restoration (BKF = bankfull) (Doll *et al.* 2003)

Priority 2 Restoration: Create a new floodplain and channel pattern with the channel bed at the present elevation

In a Priority 2 restoration, a new stable channel with the appropriate dimension, pattern, and profile is constructed at the elevation of the existing channel. A new floodplain is established, typically at a lower elevation than the historical floodplain, as depicted in **Figure 6.28**. The new channel is typically a meandering channel with bankfull at the elevation of the new floodplain. This type of project can be constructed in dry conditions while channel flow continues in its original channel or is diverted around the construction site.

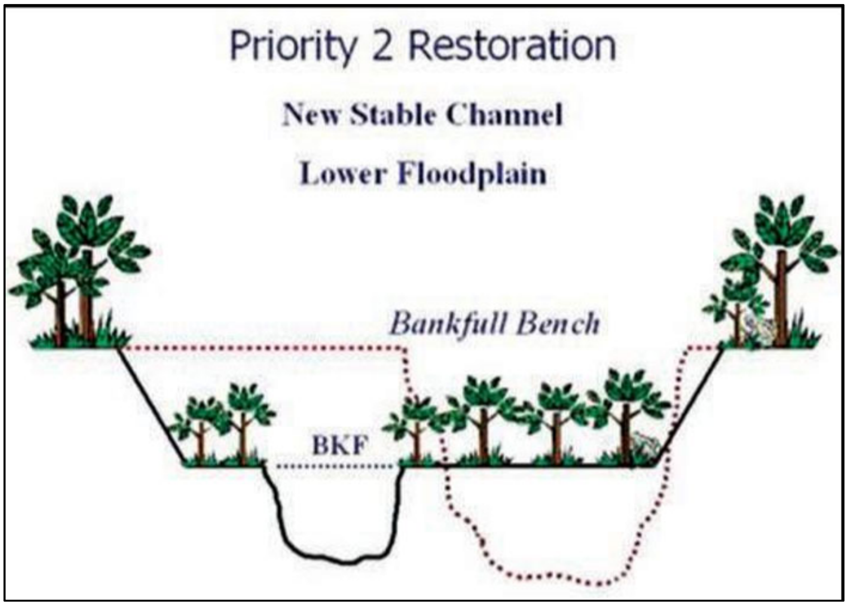


Figure 6.28 Conceptual cross section of Priority 2 restoration (Doll *et al.* 2003)

A major advantage of the Priority 2 approach is that flooding does not increase and may, in some cases, decrease as the floodplain is excavated at a lower elevation. Riparian wetlands in the channel corridor created by the excavation may be enhanced with this approach. Priority 2 projects typically produce more cut material than is needed to fill the old channel. This means that designers should consider the expense and logistics of managing extra soil material excavated from the floodplain. Surrounding land uses can limit the use of this approach if there are concerns about widening the channel corridor.

Priority 3 Restoration: Widen the floodplain at the existing bankfull elevation

Priority 3 restorations entail converting the existing unstable channel to a more stable channel at the existing elevation and with the existing pattern of the channel but without an active floodplain, as illustrated in **Figure 6.29**. This approach involves establishing proper dimension and profile by excavating the existing channel to modify the Rosgen stream classification. This restoration concept is implemented where channels are confined (laterally contained) and physical constraints limit the use of Priorities 1 and 2 restorations. A Priority 3 restoration can produce a moderately stable channel system, but may require structural measures and maintenance. For these reasons, it may be more expensive and complex to construct, depending on valley conditions and structure requirements.

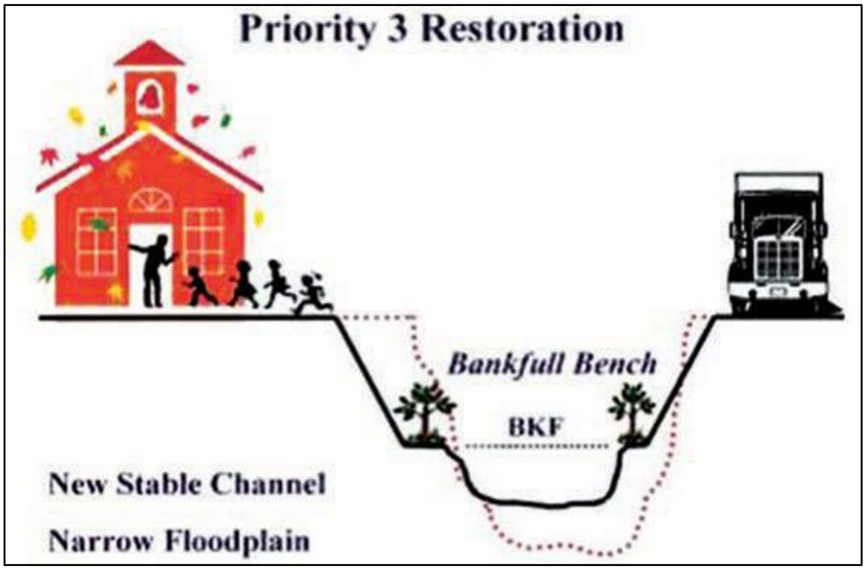


Figure 6.29 Conceptual cross section of Priority 3 restoration (Doll *et al.* 2003)

Priority 4 Restoration: Stabilize existing channel banks in place

In a Priority 4 restoration approach, the existing channel is stabilized in place utilizing stabilization materials and methods that have been used to decrease channel bed and bank erosion, including riprap, gabions, and bioengineering methods. Because this method does not address existing excessive shear stress and velocity that may have caused the impaired channel, it is considered high risk. This approach also limits aquatic habitat and is the least desirable option from a biological and aesthetic standpoint. **Table 6.6** summarizes the advantages and disadvantages of the four priorities for restoration of impaired and incised channels.

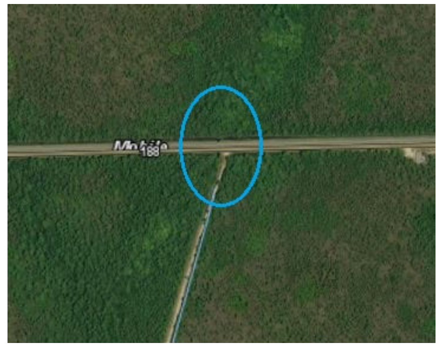
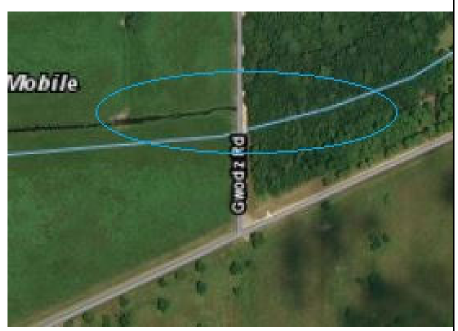
Table 6.6 Advantages and disadvantages of incised channel restoration options (Doll et al. 2003)

Priority	Advantages	Disadvantages
1	• Results in long-term stable channels • Restores optimal habitat values • Enhances wetlands by raising water table • Minimal excavation required	• Increases flooding potential • Requires wide channel corridor • Cost associated with excess soil disposal • May disturb existing vegetation
2	• Results in long-term stable channel • Improves habitat values • Enhances wetlands in channel corridor • May decrease flooding potential	• Requires wide channel corridor to implement • Requires extensive excavation • May disturb existing vegetation
3	• Results in moderately stable channel • Improves habitat values • May decrease flooding potential • Maintains narrow channel corridor	• May disturb existing vegetation • Does not enhance riparian wetlands • Requires structural stabilization measures
4	• May stabilize channel banks • Maintanis narrow channel corridor • May not disturb existing vegetation	• Does not reduce shear stress • May not improve habitat values • May require costly structural measures • May require maintenance

Several channel segments were identified as potential restoration areas within the West Fowl River Watershed. **Table 6.7** describes potential sites, type of possible restoration as well as their respective location. **Figures 6.30 – 6.45** provide general views of the potential sites recommended for channel restoration.

Table 6.7 Potential channel restoration sites

Location	Linear Feet (ft)	Priority Type	Location Diagram	Description
(1) Upper reach of Bayou Como 30° 22' 40.39" N -88° 13' 15.35" W	352	2 or 4		Channel appears to be channelized and incised resulting in lack of floodplain connectivity and eroding streambanks; extensive erosion at road crossing
(2) Upper western reach of Bayou Coden 30° 23' 23.77" N -88° 14' 31.67" W	473	2,3, or 4		Channel appears to be channelized and incised resulting in lack of floodplain connectivity and eroding streambanks; extensive erosion at road crossing
(3) Eastern reach of Bayou Coden 30° 23' 28.86" N -88° 13' 31.36"W	881	2,3, or 4		Channel appears to be channelized resulting in lack of floodplain connectivity and eroding streambanks; extensive erosion at road crossing and severe lack of riparian buffer

Location	Linear Feet (ft)	Priority Type	Location Diagram	Description
(4) Unnamed tributary of the Fowl River Bay 30° 22’ 43.53” N -88° 10’ 18.83” W	320	2,3, or 4		Channel appears to be channelized and incised resulting in lack of floodplain connectivity and eroding streambanks; extensive erosion at road crossing
(5) Upper eastern reach of Bayou Coden 30° 23’ 25.42”N -88° 12’ 31.38”W	3800	2,3, or 4		Channel appears to be channelized and incised resulting in lack of floodplain connectivity and eroding streambanks; extensive erosion at road crossing; and severe lack of riparian buffer

Channel Restoration Site (1)

Figure 6.30 Channel downstream of road crossing Bayou Como and Highway 188

Figure 6.31 Channel culvert crossing of upper Bayou Como at Highway 188

Channel Restoration Site (2)

Figure 6.32 Channel upstream of road crossing of Bayou Coden and Maura Drive

Figure 6.33 Channel downstream of road crossing Bayou Coden and Maura Drive

Channel Restoration Site (3)

Figure 6.34 Crossing downstream of Bayou Coden and Hemley Road

Figure 6.35 Crossing upstream of Bayou Coden and Hemley Road

Channel Restoration Site (4)

Figure 6.36 Crossing upstream of an unnamed surface water and Highway 188

Figure 6.37 Crossing downstream of an unnamed surface water and Highway 188

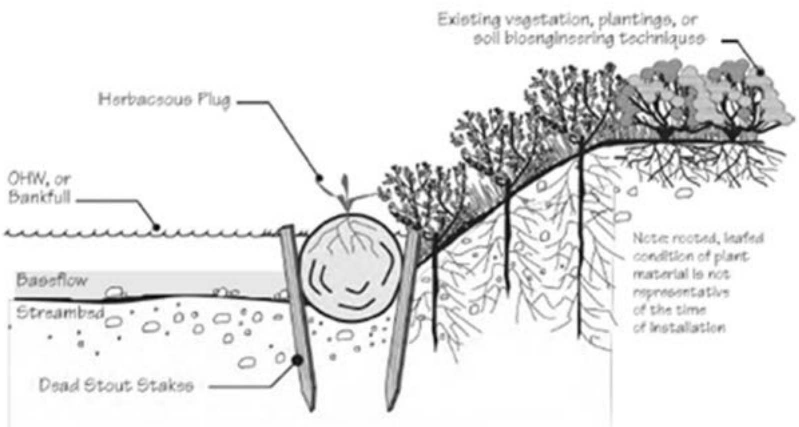
Channel Restoration Site (5)

Figure 6.38 Crossing upstream of Bayou Coden at Gwonz Road

Figure 6.39 Crossing upstream of Bayou Coden at Gwonz Road

6.3.2.1 Channel Bank Restoration and Stabilization

Long-term bank stability can be improved by increasing root density and rooting depth, decreasing the bank angle thereby eliminating undercutting, and maximizing surface protection. Eroding banks can be reshaped to reduce the bank angle allowing for a grade that best supports selected species for revegetation. Typically, this is a 1:4 ratio or better, though grading to the existing terrestrial slope can be a target. Typically this would consist of using an excavator to grade the banks so that the bank angle is reduced in order to minimize future bank failure and maximize vegetation colonization and persistence. Associated stabilization techniques using standard methods and natural materials should be used when reshaping the banks following these general guidelines and specified once a formal plan is developed. Once the bank is reshaped and stabilized, surface soils should be amended, planted, and landscaped as appropriate with the overall goal of maximizing root depth, density, and surface protection.



Coconut Fiber Roll

A coconut fiber roll (Coir™ log) is used to protect a bank's toe and to define an edge. It is a cylindrical structure composed of coconut husk fibers bound together with twine woven from coconut fiber. This product is most commonly manufactured in 12 in. diameters and lengths of 20 ft. However, purchases of prefabricated rolls can be expensive. Use stakes or duckbills to anchor it in place at the toe of the slope, generally at the ordinary high-water mark or bankfull level.

Applications and Effectiveness

- Protects slopes from shallow slides or undermining.
- Molds to existing curvature of the streambank.
- Traps sediment in and behind the roll.
- Produces a well-reinforced toe without much site disturbance.
- Lasts an estimated 6 to 10 years, according to manufacturer's claims.

Construction Guidelines

Inert materials

- Coconut logs (Coir™).
- Untreated twine.
- Cable and duckbill anchors.
- 5/16 in cable and cable clips.
- Dead stout stakes. Make dead stout stakes from 2.5- to 4-ft. long, sound, untreated 2- by 4-in. lumber. Cut each length diagonally across the 4-in. face to make two stakes. Use only sound lumber. Discard any stakes that shatter upon installation.

Figure 6.40 Coconut/coir fiber roll specifications for stabilizing eroding banks

Erosion control fabric made from biodegradable, natural materials such as coconut fibers should be installed as needed and held in place using wood stakes or similar biodegradable materials (see **Figure 6.40**). It is preferable to use erosion control fabric in all areas impacted by construction, though other landscaping measures reducing erosion pressure can be employed. Care must be taken in selecting vegetation that will tolerate local soil and water conditions while still achieving project objectives. For example, vegetation can be selected to incorporate a variety of plants with robust rooting structures and different seasonal flowering schedules to maximize flowering throughout the year. **Figure 6.41** is a general example of a bank along the West Fowl River that would be a candidate for bank stabilization and **Table 6.8** provides cost estimates for channel restoration and bank stabilization techniques.

Figure 6.41 General example of bank along the West Fowl River narrows ideal for bank stabilization

Table 6.8 Channel restoration cost estimates

Item	Unit	Unit Cost
16” natural fiber roll	Per foot	$20
18” natural fiber roll	Per foot	$22
Balled and burlapped trees	Per acre	$5,000
Bare root trees	Per acre	$1,000
Brush layering	Square yard	$150
Channel excavation	Cubic yard	$35
Clear & Grub- heavy	Per acre	$10,000
Clear & grub- light	Per acre	$8,000
Clear & Grub-medium	Per acre	$9.000
Coir Fiber Matting	Per foot	$5
Conservation plans	Per acre	$350
Container trees	Per acre	$2,000
Cover crops	Per acre	$25
Cover crop & straw mulching	Square yard	$1
Dozer	Per day	$850
Erosion control matting	Square yard	$3
Evergreen trees- 6 feet tall	Each	$175
Excavator	Per day	$600
Excavator	Per week	$1,400
Filler fiber	Square yard	$5
Grade controls	Per foot	$1,800
Hard bank stabilization	Per foot	$100
Herbaceous plants (1 gallon)	Each	$7
Hydraulic Dredging	Cubic yard	$5-$15
Invasive plant removal/control	Per acre	$250-$1,000
Labor crew	Per day	$200-$600
Live facine	Square yard	$30

Item	Unit	Unit Cost
Live stake	Each	$5
Log haul	Per log	$115
Mobilization	In & out	$8,000
Native deciduous tree (2.5" diam)	Each	$300
Natural channel design	Per foot	$5-$20
Planting	Per acre	$110
Rig	Per month	$200
Riparian thinning	Per acre	$900
Rootwad	Each	$500
Rubble removal	Per acre	$500
Shrubs (2-3 gallon container)	Each	$35
Silt fence	Per foot	$4
Sodding	Square yard	$50
Soft bank stabilization	Per foot	$50
Soil amendments	Per acre	$1,500
Stone toe protection	Per foot	$55
Stream cleanup	Per reach	$100
Stream diversion (pump)	Per day	$500
Wetland plants	Each	$10
Wetland restoration	Per acre	$1,000
Wetland seed mix	Per pound	$200
Project management	5%-10% of total budget	
Design and contingency	20%-30% of construction cost	

6.3.3 Preservation of Ecologically Significant Habitats

Over many decades, historical forests, wetlands, streams, floodplains, and other ecologically significant habitats have been lost to increases in development. Additional loss of critical habitats has occurred as a result of erosion caused by high flow events, boat wakes, and sea level rise. Although the loss and conversion of habitat is challenging and expensive to reverse, it is critical to protect and preserve remaining areas of ecological significance such as wetlands, streams and floodplains, which provide a natural filter for pollutants, pathogens, sediment, etc. Failure to protect these areas will exacerbate negative impacts described throughout this WMP. Examples of potential areas for habitat preservation in the West Fowl River Watershed are provided in **Figure 6.42.**

Potential wetland preservation areas in the West Fowl River Watershed are shown in **Figure 6.43** and further described in **Table 6.9**. These areas were identified as priority sites primarily due to their size as well as connectivity to other significant habitats. It should be noted that **Table 6.9** is not an exhaustive list for priority wetland preservation sites, and other wetland tracts that become available in the future for long-term preservation and protection should be pursued aggressively. The protection of these natural wetland areas will help to ensure that water quality and habitat conditions do not continue to degrade and the benefits currently provided by these areas are not lost.

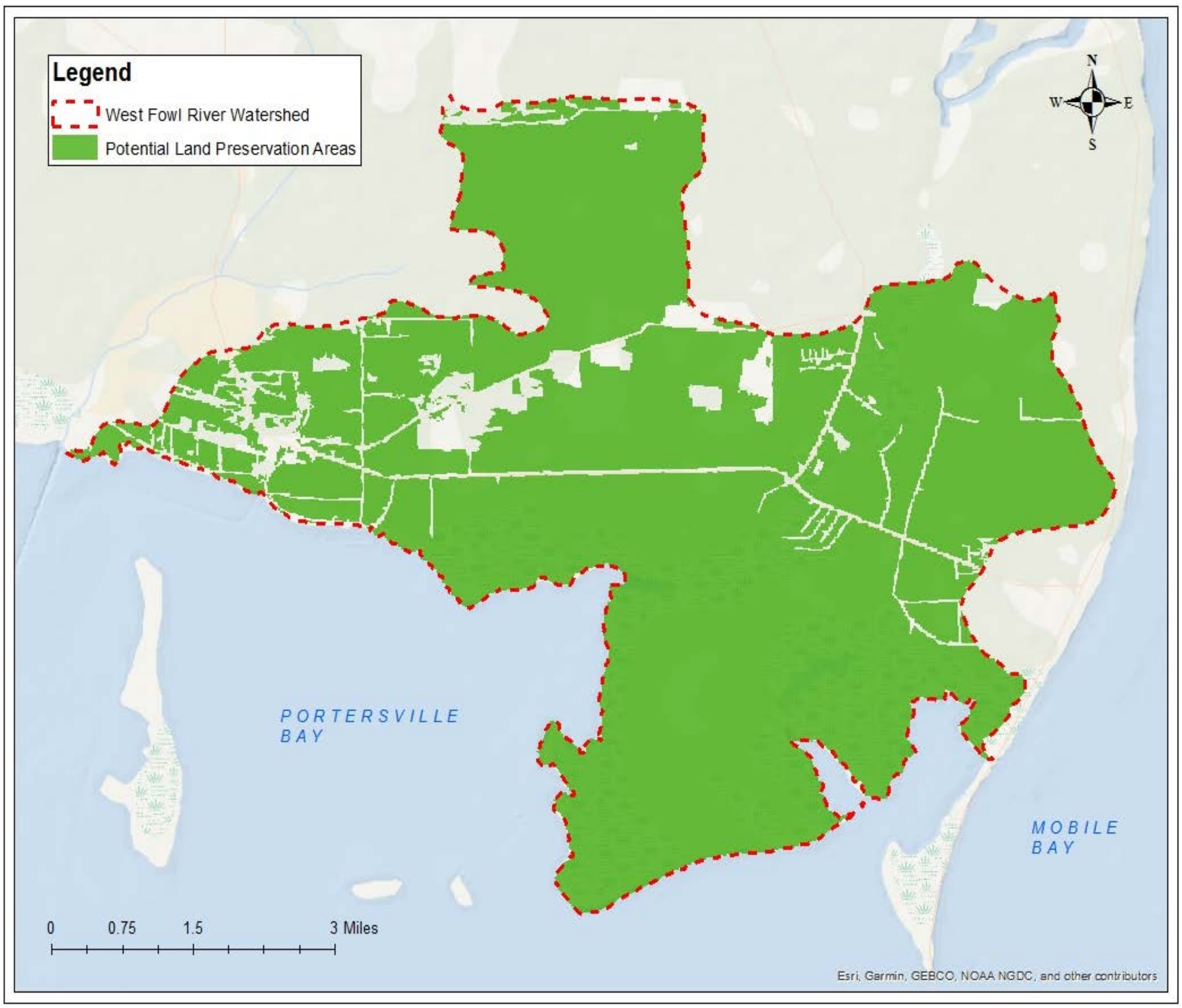


Figure 6.42 Potential areas for habitat preservation.

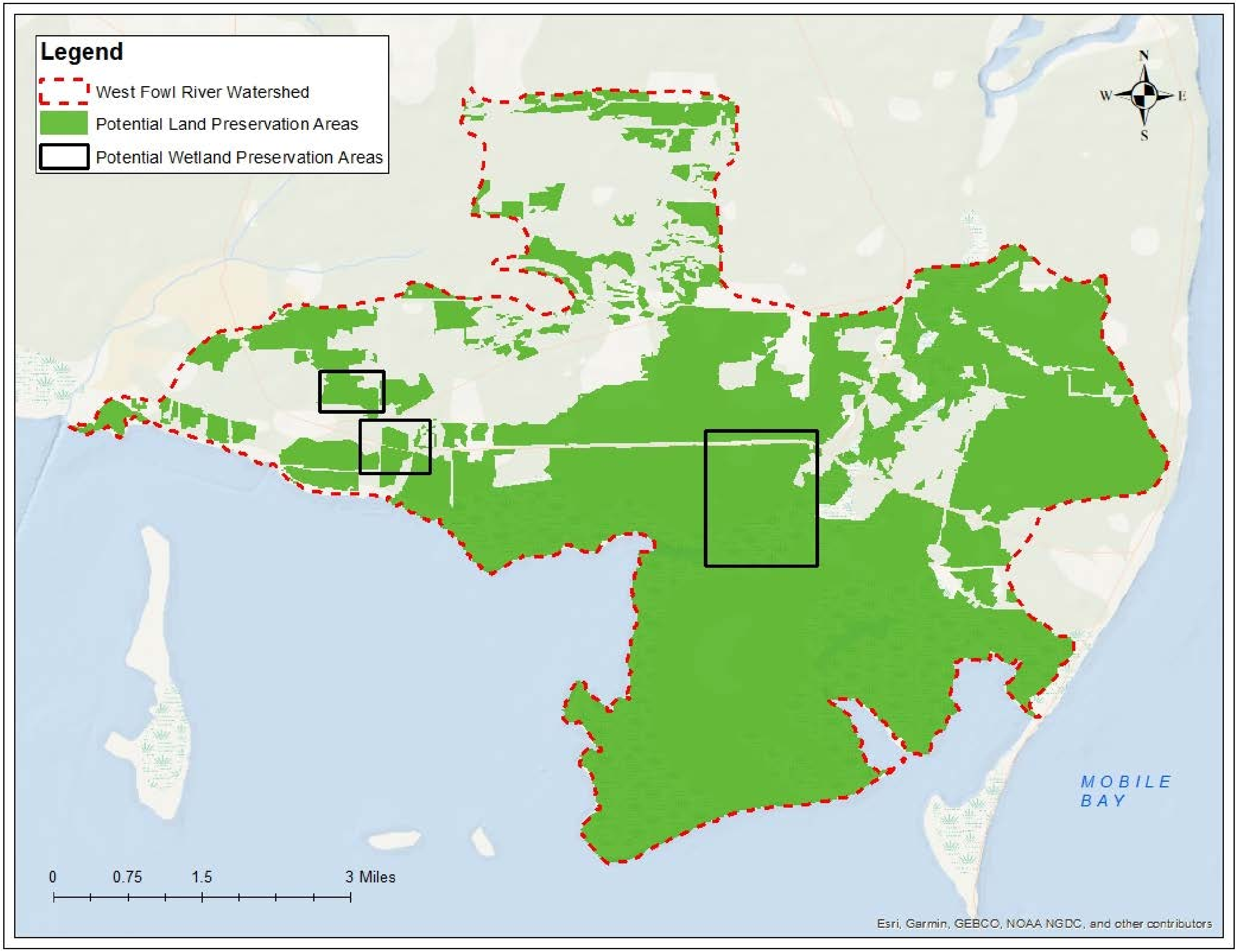


Figure 6.43 Potential areas for wetland preservation

Table 6.9 Potential areas for wetland preservation

Name	Location Map	Description
Upper Bayou Como		These parcels are some privately held wetland areas contiguous to the headwaters of Bayou Como. The wetlands systems are characterized as freshwater forested/ shrub wetlands dominated by broad and needle-leaved evergreen and wetland species with woody shrubs and persistent emergent wetland vegetation. The soils are temporarily flooded for brief periods during the growing season. This area consists of approximately 37.68 acres.
Upper Bayou Coden Property		This parcel is one of the few large bank owned tract in the headwaters of Bayou Coden. The wetlands are characterized as a freshwater forested system with a broad-leaved deciduous and evergreen needled-leaved forest that is briefly flooded for a few day to weeks during the growing season. This area consists of approximately 23 acres.
Lower West Fowl River Properties		These parcels are large predominately-undisturbed privately held wetland areas contiguous to the West Fowl River. These parcels would provide a complementary riparian buffer to the 197-acre ADCNR parcels on the opposite shoreline of the river. The wetlands systems are characterized as freshwater forested/ shrub wetlands dominated by broad-leaved deciduous and evergreen needled-leaved forests that are temporarily flooded for brief periods. This area also consist of approximately 38 acres of Estuarine and Marine wetland habitats that's contains persistent intertidal herbaceous emergent vegetation and in irregularly flooded This area consist of approximately 328 acres.

6.3.4 Bird Watching

Bird watching was identified in previous Chapters as a popular recreational activity within the West Fowl River Watershed. Channel restoration, property acquisition and habitat restoration will ensure that native birds within the Watershed continue to thrive and enhance the area for bird watching. Establishment of birding trails provide an opportunity to educate recreational users about the importance of the Watershed as habitat for native species and to the community's coastal industries. There are several large tracts of public lands located along the western portion of the Watershed, Rolston Park and the Portersville Bay Tract of Forever Wild holds various opportunities for birding. Recreation planning could include trails that connect the urban center to these preservation tracts for birding and for other wildlife observation. These western public tracts are part of the Alabama Coastal Birding Trail and habitat in the area is noted to be a premier location for sighting specific species. Connecting the urban center of Bayou La Batre to these Forever Wild tracts would also mean connecting visitors on the Alabama Coastal Birding Trail to the West Fowl River and thus has the potential for bringing ecotourism to the area.

6.4 Access

There is currently only limited access for recreational activities, both passive and active, in West Fowl River Watershed. Public access is limited to only a few locations within the Watershed, namely Lightning Point, Delta Port, and a few locations where kayaks and small boats can be put in. The need for more green space including parks, trails, nature observation stations, fishing piers, and small boat launches for kayaks and canoes has been identified as a management priority.

6.4.1 Master Recreational Use Plan

Development of a Master Recreational Use Plan would engage stakeholders in a review of existing recreational conditions and facilities throughout the watershed, analyze the needs and preferences of residents and visitors, and develop a prioritized plan for implementation. A Master Recreational Use Plan would also allow coordination of property acquisition of areas identified as critical habitat restoration/preservation areas as well as recreational opportunities.

This effort should also incorporate many of the previously identified natural areas/refuges and access points that are located outside of the Watershed which include:

- Lightning Point to the west
- Point aux Pins to the west
- Bellingrath Gardens to the east
- Dauphin Island to the south
- Grand Bay National Wildlife Refuge and Grand Bay Savanna (further to the west of the Forever Wild tract along the state line)
- Coffee Island and Cat Island habitat recovery project to the south
- Helen Wood Park Oyster restoration south of Mobile
- The Mississippi Sand Hill Crane National Wildlife Refuge
- The Nature Conservancy has a few areas in southern Alabama, including Dennis Cove, north and west of Mobile, Rabbit Island Preserve (near Perdido Key), and Splinter Hill Bog, north east of Mobile, and west of Bayou la Batre in Mississippi the TNC also has the Red Creek Mitigation Area and the Old Fort Bayou Mitigation Bank.

6.4.2 Public Access to Coastal Resources

Public access to coastal resources is important to the people who live near the coast. Increasing and improving public access to the natural resource is a goal of the MBNEP CCMP. Public access to the ecosystems people value most also exposes them to their surroundings and is critical to establishing a connection between people and the environment. Recommended accesses include water front parks, fishing piers, and boat launches for kayaks and canoes. In addition, the installation of pedestrian accesses, bike lanes, and walking trails that connect residential neighborhoods to the waterways are another important recommended measure to provide public access.

Currently, public access to coastal resources is limited because much of the waterfront in the West Fowl River Watershed is privately owned. However, a few areas have been identified along Portersville Bay and Heron Bay that are currently owned by the State (i.e. Portersville Bay and Heron Bay tracts). These locations could be enhanced for low impact recreational activities with amenities to include restrooms, picnic areas, hiking trails fishing access, and kayak launches/canoe launches.

6.4.3 Joint Recreational and Educational Opportunities

Creating access and recreational facilities along waterways also provides an opportunity for outreach and education for visitors who use these facilities. Signage, informational kiosks, visitor centers, guided tours, scenic trails, historical landmarks, or tours by boat are all platforms for informing recreational users about the community and its history, the Watershed, habitat, and local wildlife. This opportunity also has the potential of promoting the area and making the Watershed a destination for tourists.

6.4.4 Scenic Byway Loop to Lightning Point

Creating a scenic byway loop through the watershed and connecting the Scenic Byway Route 188 to Lightning Point is recommended for creating an eco-tourism trail. A scenic loop designated with signage would bolster tourism opportunities and allow visitors to observe the scenic coastlines and experience the coastal heritage of the area. This effort would dually highlight, Rolston Park, the areas historic landmark, as well as promote the concept of a working waterfront in the Bayou Coden community. By enhancing the facilities at Lightning Point and Portersville Bay tract in order to make the area a destination for visitors and attracting tourism-based businesses such as restaurants, boat rentals, shops, etc. This would be the first steps in establishing the Scenic Byway Loop and in creating a diverse economy in the southern watershed.

6.5 Heritage

The culture, heritage, and history of the people of the City of Bayou La Batre, Coden, Dixon Corner, Irvington, Heron Bayou and similar communities has revolved around the resources provided by the West Fowl River Watershed. There is little doubt that the future of the communities that make up the West Fowl River Watershed is in doubt in many ways. The challenges are immense but are outweighed by the opportunities if one will only step back and envision what the future can hold. With a little planning and visionary leadership, the West Fowl River Watershed can continue to provide the basis for a vibrant local economy – but perhaps an economy that looks slightly different from that of today.

The following recommendations would preserve the existing rich culture and heritage of West Fowl River and its natural resources while also creating new opportunities for outside visitors to experience and enjoy the uniqueness of the West Fowl River community.

- Implement a Clean Marina Program. This program is a voluntary certification program consisting of a partnership of private marina owners, local government facilities, and yacht clubs that provides guidance in BMPs for the boating community in order to protect state coastal and inland waters.
- Implement a Clean Water Future Program. This is another program that provides resources and assistance to communities for promoting BMPs to protect waterways.
- Designate a Historical and Heritage Trail. This trail would expand from the Scenic Byway Loop to Lighting Point trail. Promoting tourism based on the community's culture and heritage is a simple and inexpensive way to bring visitors to the area and help preserve history.
- Develop a Working Waterfront. As mentioned in previous sections, creating a working waterfront would provide an opportunity for a combination of commercial and industrial activity as well as tourism-based businesses along the waterfront. This would allow the commercial facilitates along Bayou Coden to maximize the economic opportunities provided by the working waterfront area and the cultural significance of the coastal shorelines.

The following properties were identified as possible locations that could dually serve as access points to the Watershed as well as sites for cultural enrichment opportunities. **Figure 6.44** is a location map of each property in the Watershed.

Property #1

General Description:	Undeveloped Lot with large live oaks and has marsh lands along the eastern property boundary and fronts the bay along the southern property boundary.
General Location:	Corner of Coden Belt Road and Henry Jonson
Property Size:	App. 23 acres; App. 1,100 ft. along the bay
City of Mobile Tax Key/ ID:	4701400003008
Significance of Property:	Habitat conservation and an excellent citizen access to the waterway for fishing, kayaking and family-oriented recreation

Property #2

General Description:	Undeveloped lots at the western edge of the mouth of Bayou Coden. Contains large amounts of marsh and wetlands. However it has received tremendous erosion and would be a good candidate for shoreline restoration similar to Lightning Point.
General Location:	Bayside of Shell belt Road at the west side Bayou Coden
Property Size:	App. 15 acres
City of Mobile Tax Key/ ID:	4701380001164, 4701380001165, 4701380001166, 4701380001167, 4701380005007, 4701380001168, 4701380005006, 4701380001168, 4701380005005, 4701380001170, 4701380005004, 4701380001171, 4701380005003, 4701380001172, 4701380005002, 4701380001173, 4701380005001, 4701380001173.001,

4701380005001.001, 4701380001173.002, 4701380005001.002, 4701012003037, 4701013000001

Significance of Property:	Shoreline restoration, habitat conservation, habitat enhancement, and public access (canoe and kayak) to Portersville Bay.

Property #3

General Description:	Undeveloped lot next to ADCNR (Portersville Bay Tract)
General Location:	Southwestern end of Callahan Road
Property Size:	App. 27.85 acres; 332 lf. of waterfront
City of Mobile Tax Key/ ID:	4803070000002.003
Significance of Property:	Habitat conservation, habitat enhancement, and public access (canoe and kayak) to Bayou Sullivan and Portersville Bay.

Property #4

General Description:	Undeveloped properties near the ADCNR Delta Port boat ramp.
General Location:	Across a canal from the Delta Port boat ramp at the end of Morris Drive
Property Size:	App. 2.75 acres; App 900 lf. of waterfront
City of Mobile Tax Key/ ID:	*4802101000008; 4802101000009*
Significance of Property:	Site for ecotourism, public access and educational/outreach programs.

Property #5

General Description:	Undeveloped lot with waterfront on the West fowl River
General Location:	Northeast corner of Highway 188 and Bellingrath Road.
Property Size:	App. 2 acres of larger parent parcel; App. 264 lf. of waterfront.
City of Mobile Tax Key/ ID:	4801022000026
Significance of Property:	Site for ecotourism, public access, and family-oriented recreation

Property #6

General Description:	Undeveloped lot with waterfront on the West Fowl River
General Location:	South end of Smith Road along the West Fowl River
Property Size:	App. 10.8 acres; App. 42 lf. of waterfront
City of Mobile Tax Key/ ID:	4308354000032; 4308354000032.003
Significance of Property:	Site for ecotourism, public access and educational/outreach programs

Property #7

General Description:	Undeveloped lots with waterfront on Heron Bayou
General Location:	Heron Bayou and Hwy 188
Property Size:	App. 5.5 acres
City of Mobile Tax Key/ ID:	4801122000061.005; 4801122000054
Significance of Property:	Site for ecotourism, public access and educational/outreach programs

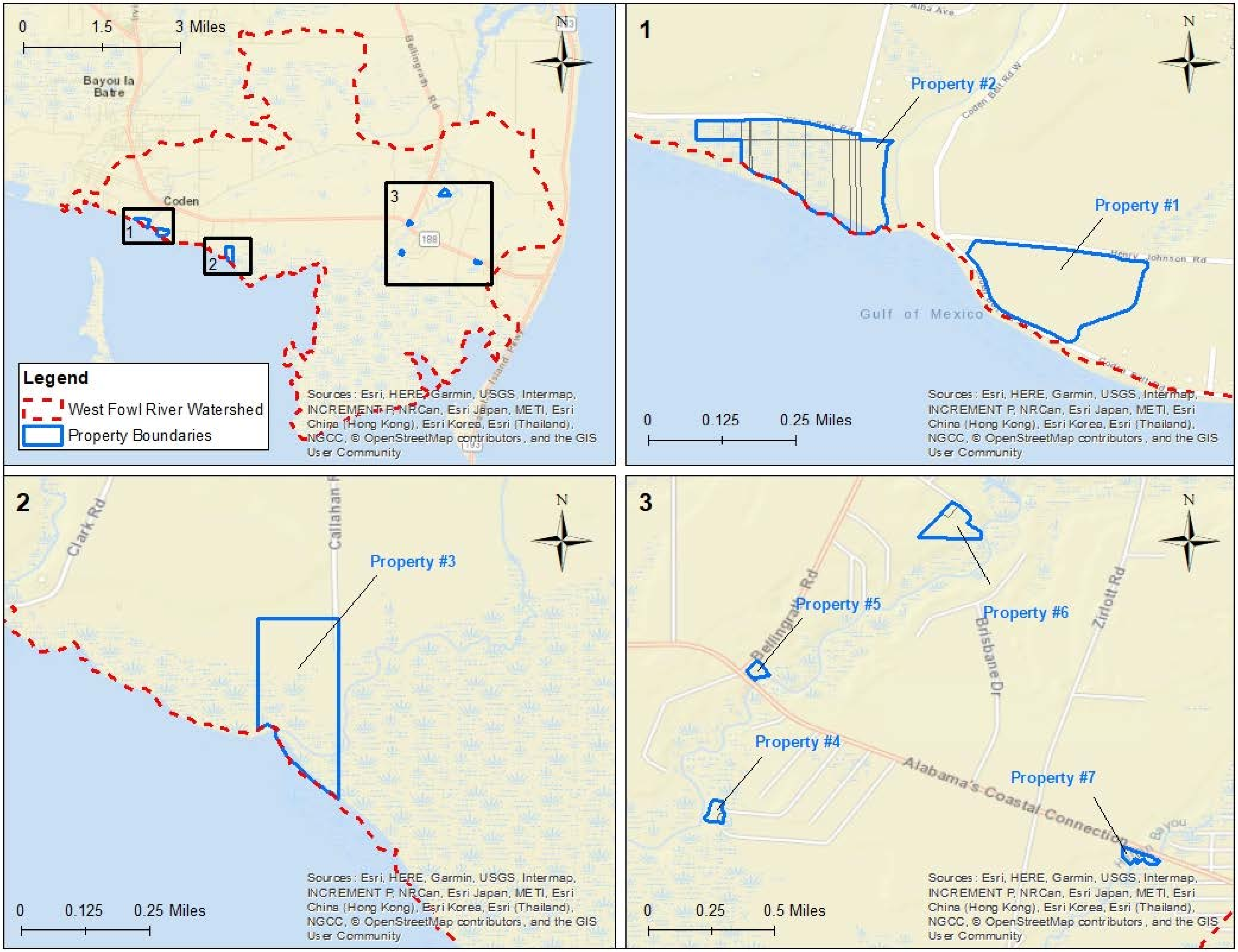


Figure 6.44 Potential locations to improve cultural and environmental enrichment

6.6 Coastlines

Approximately 85% of the Watershed's shorelines that were assessed as part of the Jones & Tidwell (2112) study were classified as natural. Nearly the entire Bayou Coden, Shell Belt, and Coden Belt roads coastlines' have hard armoring in place. In the upper Watershed, the narrows has been identified as a critical location for shoreline restoration due its susceptibility to natural wave action and boat traffic.

6.6.1 Shoreline Restoration and Preservation

There is evidence that shorelines having intact natural habitat (e.g., wetlands, dunes, oyster reefs, beaches, etc.) experience less damage from severe storms and are more resilient than hardened shorelines (NOAA 2015a). However, as discussed in Chapter 4, natural shoreline habitats in the West Fowl River Watershed have experienced losses and degradation. Therefore, management measures should focus on protecting, conserving, preserving, or restoring shorelines and natural shoreline habitats in the Watershed.

In 2016, The Nature Conservancy was awarded funds from the National Fish and Wildlife Foundation's Gulf Environmental Benefit Fund to acquire approximately 100 acres of coastal habitat, restore approximately 28 acres of salt marsh, and create nearly 1.5 miles of nearshore breakwaters along the mouth of Bayou La Batre at Lightning Point (see **Figure 6.45**). This project will restore critical coastline areas to their historic positions and more effectively manage the effects of coastal wave action. Projects that involve the nature based restoration of coastal resources similar to that of the acquisition and restoration of Lightning Point are recommend for the Watershed.

NFWF | Gulf Environmental Benefit Fund

RECIPIENTS
The Nature Conservancy

AWARD AMOUNT
$5,903,100

PARTNERS
Alabama Department of Conservation and Natural Resources

Mobile County

City of Bayou la Batre

Dauphin Island Sea Lab

LOCATION
Bayou la Batre, Alabama

AWARD DATE
November 2016

PROGRESS UPDATE
Five of the eight target parcels have been acquired. Two contracts for restoration and monitoring have been executed, and development of management strategy for Forever Wild parcel is underway. (February 2018)

The Gulf Environmental Benefit Fund, administered by the National Fish and Wildlife Foundation (NFWF), supports projects to remedy harm and eliminate or reduce the risk of harm to Gulf Coast natural resources affected by the 2010 Deepwater Horizon oil spill. To learn more about NFWF, go to **www.nfwf.org.**

ALABAMA

Lightning Point Acquisition and Restoration Project – Phase I

This project will protect and restore a key stretch of coastal shoreline at the mouth of Bayou La Batre River. Specifically, the project includes the acquisition of more than 100 acres of coastal habitat and the engineering and design for restoring approximately 28 acres of marsh and 1.5 miles of intertidal nearshore breakwater. The acquisition targets represent more than 2 miles of nearly contiguous undeveloped waterfront adjacent to existing protected lands owned by the state, Mobile County, and the City of Bayou La Batre.

The restoration element will enhance and restore coastal marsh and employ living shoreline techniques along an eroding shoreline. This work extends an existing living shoreline installed immediately to the west and a future living shoreline funded under Early Restoration that will be installed directly to the east. Funding of the restoration elements is anticipated once engineering and design has been completed.

Rock breakwater along the Alabama Coast: Credit iStock

The acquisition and improvement of target coastal parcels will expand existing protected lands and restoration projects. The proposed breakwater will help stabilize a key stretch of eroding shoreline.

Figure 6.45 National Fish and Wildlife Foundation's Gulf Environmental Benefit Fund, Lightning Point Project. Source: NFWF (2016)

6.6.1.1 Implement Living Shorelines

Vertical bulkheads degrade habitat at their toes and reflect boat wake energy to nearby unprotected shorelines, causing erosion. Much better alternatives involve the use of living shorelines technologies. Living shorelines combine engineered erosion control using living plant material, oyster shells, earthen material or a combination of natural structures with riprap, offshore or headland breakwaters to protect property from erosion (Boyd 2007). Living shorelines are designed to absorb and dissipate energy, rather than reflect it, and also seek to provide habitat for aquatic life.

Stabilization solutions for shorelines range from green (soft) or natural and nature based measures to gray (hard) or structural types, shown in **Figure 6.46** (NOAA 2015). The term "living shoreline" refers to the management of shorelines through natural means such as the placement of structural organic materials and plants native to the local environment, with limited or strategic use of structures. The implementation of a living shoreline method, as opposed to armoring techniques, seek to maintain the sustenance and improve biodiversity of the ecosystem.

Many of the Watershed's shorelines may perform quite well with soft structures. Examples of areas suited for living shorelines are presented in **Figures 6.47** through **6.51.**

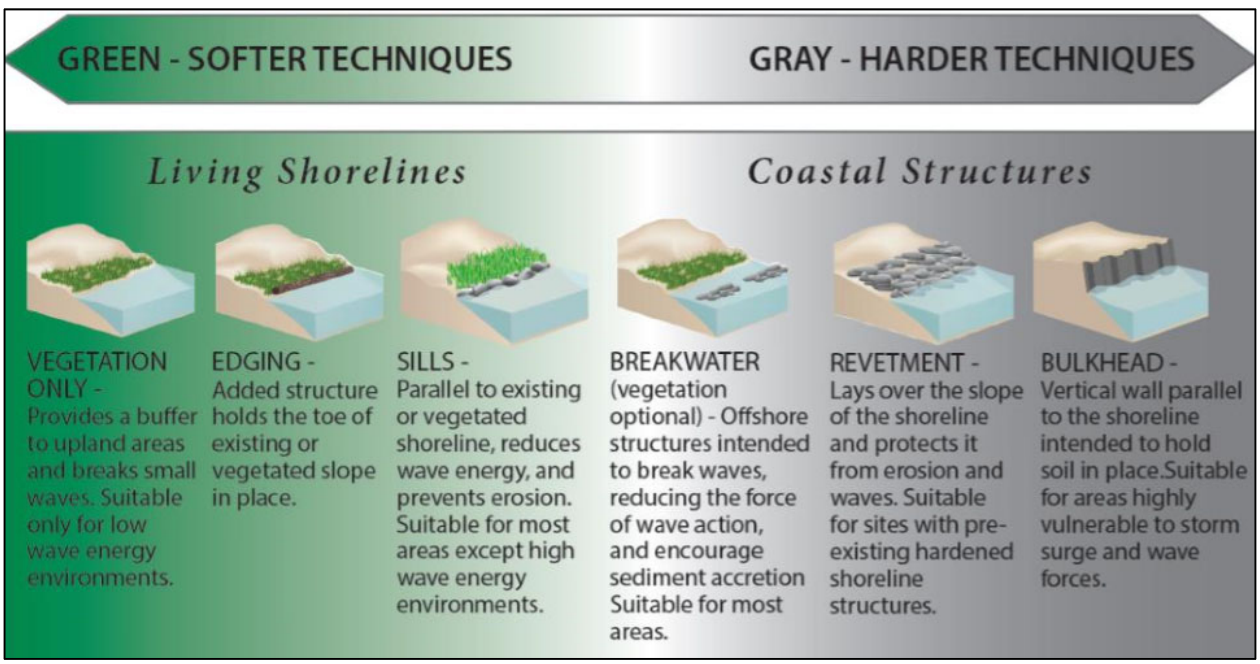


Figure 6.46 Green (soft) to gray (hard) shoreline stabilization techniques (NOAA 2015)

Figure 6.47 General example of an area along the West Fowl River suitable for a living shoreline

Figure 6.48 General example of an area the west Fowl River narrows that is suitable for a living shoreline

Figure 6.49 General example of an area the West Fowl River narrows that is suitable for a living shoreline

Figure 6.50 Example of residential shorelines in the watershed that are suitable for a living shoreline

Figure 6.51 Example of residential shorelines in the watershed that are suitable for a living shoreline

6.6.2 Water Quality Monitoring

Chapter 11 will provide in detail, the guidance, and direction for implementing a water quality monitoring program for the watershed. The monitoring program is designed to assess and document the overall health of the West Fowl River Watershed, while providing a quantitative method that helps to establish trends intended to identify successes and failures of the implemented management program. The monitoring program will be designed to assess the entirety of the study area and effects on the adjacent Portersville Bay in a time and cost efficient manner, while also providing sufficient and concise data, which is necessary to identify possible sources and localities contributing to current and future water quality degradation within the Watershed.

The monitoring program should incorporate the outlined framework identified in the *Mobile Bay Subwatershed Restoration Monitoring Framework* (**Appendix E**) as recommended by the MBNEP's Science Advisory Committee: Monitoring Working Group, 2015. The monitoring program shall also consider coordination and support of Auburn University Shellfish Laboratory's Portersville Bay water quality monitoring efforts to support fisheries restoration and management, and aquaculture activities.

6.6.3 Sea Level Rise

Results of the SLR models described in Section 4 provide some indication of the Watershed's vulnerabilities as they relate to SLR, storm surge, and resiliency. The SLOSH results indicate that nearly the entire Watershed will be impacted by Category 3 storm surge, and possibly the entire Watershed will be impacted by a Category 3 storm surge when incorporating the most conservative SLR projections (IPCC 2013 intermediate level). Essentially all of the built environment within the floodplain is vulnerable to impacts from major storms and localized flooding events.

6.6.3.1 Planning for Sea Level Rise

Development of an adaptation planning strategy provides local governments and vested stakeholders a guide to better determine vulnerable areas and develop strategies to mitigate the effects caused by SLR and flooding. The following summary was adapted from the Florida Department of Economic Opportunity accessed at (http://www.floridajobs.org/docs/defaultsource/2015-community-development/ community planning/crdp/adaptationplanninginflorida.pdf?sfvrsn=2). The adaptation strategy was developed recognizing that SLR will increase coastal vulnerability to a variety of problems, including:

- Increased flooding and drainage problems;
- Destruction of natural resource habitats;
- Higher storm surge, increased evacuation areas and evacuation time frames;
- Increased shoreline erosion;
- Saltwater intrusion; and
- Loss of infrastructure and existing development.

The adaptation strategy prescribes a series of steps that a community may take to become more resilient to the impacts of storm surge, flash floods, stormwater runoff and SLR. The three main strategies a community may use to protect infrastructure and developed areas are:

I. Protection

Protection strategies involve "hard" and "soft" structural defensive measures to mitigate the impacts of rising seas and increased flooding. These include shoreline armoring or beach nourishment. This decreases vulnerability yet allows structures and infrastructure in the area to remain unaltered. Protection strategies may be targeted for areas of a community that are location-dependent and cannot be significantly changed structurally (i.e. downtown centers, areas of historical significance, water-dependent uses, etc.).

II. Accommodation

"The accommodation strategy mitigates the risk of sea level rise through changes in human behavior or infrastructure while maintaining existing uses of coastal areas. For example, it might involve modifying existing infrastructure for adaptive land uses, raising the ground level or improving drainage facilities, encouraging salt resistant crops, restoring sand beaches, and improving flood warning systems" (Lee, 2014).

III. Retreat

Retreat involves the actual removal of existing development, possible relocation to other areas, and the prevention of future development in these high-risk areas. Retreat options usually involve the acquisition of vulnerable land for public ownership, but may also include other strategies such as: transfer of development rights, purchase of development rights, rolling easements, conservation easements, etc. Additional information related to habitat migration and managed retreat is found in **Section 6.7.**

6.6.3.2 Property Acquisition

Most of the Watershed's shoreline is in a natural state. However, approximately 70% of Bayou Coden's shorelines were classified as armored (Jones & Tidwell 2112) and nearly the entire Shell Belt, and Coden Belt roads coastlines' have hard armoring in place. In order to implement shoreline restoration and return Bayou Coden, Shell and Coden Belt Roads waterfront to natural stabilization, the County/ State will need to acquire additional properties within and adjacent to these shorelines. Coordination with the Nature Conservancy in identifying additional properties that may provide opportunities for additional shoreline restoration and preservation is recommended. Many properties previously identified for access and cultural enrichment opportunities, **Section 6.5**, could serve as sites for habitat restoration or preservation activities.

6.7 Resiliency

As described in previous sections, much of West Fowl River Watershed's developed areas also lie within areas most prone to coastal storm surge and flooding. In fact, the majority of the West Fowl River Watershed lies within the FEMA designated flood zones. Models suggest that a significant portion of the Watershed's infrastructure would be impacted by a Category 3 hurricane, which when compounded with SLR, would put critical infrastructure like the Community Center, the Post Office, and Volunteer Fire Station at risk.

6.7.1 Land Use Planning and Zoning

The Watershed's communities are prone to hurricanes and flooding, and these weather events present the highest risk to residents and infrastructure within the Watershed. The County could minimize these risks by implementing building restrictions and development requirements that address flood hazards and focus on protecting residents and infrastructure prior to a natural disaster.

Planning that a) limits land use within flood zones to specific types of infrastructure and b) keeps critical structures and the most vulnerable residents out of the flood zone provides a significant form of risk reduction. In addition, zoning regulations that require infrastructure within the flood zone be designed and built to withstand flooding further minimizes risk to structures during a disaster.

6.7.1.1 Existing Land Use Analysis

The first step in implementing land use designation and zoning regulations is to analyze how existing development and infrastructure is organized and where it is located. Performing this task will allow Mobile County to identify areas within the Watershed that are at highest risk and identify alternatives locations to minimize risk.

6.7.1.3 Implement Floodplain Management

Implementation of restrictions for development within flood zones limits the risk of exposure and ensures that structures are built to minimum standards. This effort could qualify the County for participation in the Community Rating System (CRS), which provides reduced flood insurance rates for policyholders when communities practice floodplain management activities that exceed the minimum NFIP standards. Additionally, FEMA provides several funding opportunities for technical assistance and Hazard Mitigation Assistance to help communities fund projects to reduce flood impacts.

6.7.2 Risk Management

6.7.2.2 Diversification of the Local Economy

As stated in previous sections, the Watershed's economy has been centered around coastal resources, specifically, seafood harvesting and most recently ship building. However, diverse economies, which depend on multiple types of industries, are more stable and resilient. Therefore, diversifying the Watershed's economy to include tourism and ecotourism provides an opportunity to make the overall Watershed more economically resilient while protecting the local culture and history. The management measures provided for the creation of a working waterfront, creation of new parks and recreational activities that protect water quality will be key factors in promoting the development of a tourism/ecotourism sector to support the local economy.

An expanded economy in the southern part of the watershed might include some or all the following elements:

- Ecotourism
    - Charter Fishing
    - Charter Shrimping
    - Educational Tours
    - Working waterfront
    - Excursions to local islands and habitats
    - Elevated Boardwalks for wildlife stations/viewing
    - An Environmental Education Center
    - Biking/hiking/nature trails
    - Birding Sites
    - Eco-explore cruises
    - Canoeing and Kayaking

- Ecotourism Support Elements

- Tourism Research and Marketing Center
- Floating House Communities
- Marinas
- Fisherman's Markets
- Maritime Museum
- Waterfront Dining

6.7.2.3 Participate in the Coastal Resiliency Index Program

The Coastal Resilience Index is a self-assessment tool developed by the Mississippi-Alabama Sea Grant Consortium and NOAA's Coastal Storms Program. The index is a tool to guide discussion about a community' resilience to coastal hazards and weaknesses that need to addressed prior to the next hazard event. It consists of an eight-page guiding document, and includes six sections (critical facilities and infrastructure, transportation issues, community plans and agreements, mitigation measures, business plans, and social systems).

6.7.2.4 Promote a Resilience Action Award for Individual/ Groups

A Resilience Action Award could be developed by the County that acknowledges and promotes those individuals (adults and youth) and businesses within the Watershed that proactively incorporate resiliency and environmental stewardship practices into their design or practices. Creating and promoting such annual awards would create substantial visibility for the need to protect the Waterway and encourage personal and corporate stewardship.

7 The West Fowl River Watershed Management Plan Implementation Program

In **Chapter 6** a number of management measures were provided to address the critical areas and issues over a short and long-term time frame. For successful implementation of each of the management measures, a clearly defined strategic approach is needed to address the threats previously identified as affecting the West Fowl River Watershed. The actions and strategies identified within this chapter are recommended to successfully implement the management measures in this Watershed Management Plan (WMP).

The West Fowl River WMP is centered on these six values and addresses the following:

Water

Identifies actions to reduce point and non-point source pollution and remediate past effects of environmental degradation, thereby reducing outgoing pollutant loads into Portersville Bay, Mississippi Sound, and the Gulf of Mexico.

Coastlines

Assesses shoreline conditions and identifies strategic areas for shoreline stabilization and fishery enhancements.

Access

Characterizes existing opportunities for public access, recreation, and ecotourism and identifies potential sites to expand access to open spaces and waters within the watershed.

Fish

Identifies actions to reduce the incidence and impacts of invasive flora and fauna and improve habitats necessary to support healthy populations of fish and shellfish. Provides a strategy for conserving and restoring coastal habitat types; providing critical ecosystem services; and identified by the MBNEP's Science Advisory Committee (SAC) as most threatened by anthropogenic stressors. These habitat types: freshwater wetlands; streams, rivers and riparian buffers; and intertidal marshes and flats, were classified as most stressed from dredging and filling, fragmentation, and sedimentation, all related to land use change.

Heritage

Characterizes customary uses of biological resources and identifies actions to preserve culture, heritage, and traditional ecological knowledge of the watershed.

Resiliency

Identifies vulnerabilities in the watershed from accelerated sea level rise, storm surge, temperature increases, and precipitation and improves watershed resiliency through adaptation strategies.

7.1 Implementation Strategies

7.1.1 Establish a Watershed Plan Implementation Team (WPIT)

Implementation of the West Fowl River Watershed Management Plan will require leadership and substantial funding. A West Fowl River Watershed Plan Implementation Team (WPIT) must be created to implement the work necessary to prioritize specific projects, develop project budgets, collaborate with all appropriate entities and agencies, and locate the necessary funding. It is recommended that a watershed coordinator position be created to lead the WPIT.

A watershed coordinator staff position should be filled by an individual or organization with fundamental knowledge of the Watershed and the uniqueness of its stakeholders. The primary responsibility of an appointed watershed coordinator would be to shepherd the efforts to promote, encourage, implement, and facilitate the recommended management measures of WMPs in the region. Establishment of a coordinator position would illustrate the community's resolve to serve as committed partners with vested interests in the long-term protection of the Watershed. Additionally, this position would work alongside the MBNEP's Project Implementation Committee (PIC), which would allow for synergy and maximization of a coordinated regional approach to support and enhance existing efforts and implement new recommended measures of all WMPs within coastal Alabama.

Membership of the Implementation Team must illustrate the diversity of entities that guided development of the WMP including local citizens and business interests, Mobile County, engineering firms (as needed), regional planners (SARPC), agricultural interests, seafood interests, boat building interests, Mobile County Public School System, utilities and others. Members of the Implementation Team should be open to interdisciplinary discussions on how to establish and achieve consistent management goals, devise appropriate regulatory requirements, share critical information, and seek program and funding objectives.

The WPIT should also provide an avenue for public engagement and membership, and foster community outreach and education to promote the goals of the WMP. Moving forward, it is critical for the WPIT to focus on the following principles:

- Involve
- Engage
- Educate
- Own

Involve

Momentum has been building over the years to transform the West Fowl River and its watershed into a healthy and vibrant community that supports robust habitat; provides increased public access; serves as an economic engine supporting the seafood and shipbuilding industry and ecotourism; and celebrates and preserves the rich culture and heritage of the area. With the development of this WMP and the activities involved (i.e. public meetings, committee meetings), the timing is right to build upon the involvement of current audiences and invite more to participate in this work. The WPIT must develop a working coalition with local residents and organizations, townships, county, state, and federal agencies, as well as private industry.

Engage

The WPIT should build upon existing as well as create new opportunities for public involvement and membership, host meetings with community groups and local associations to equip them with knowledge and materials to advocate and promote the goals and objectives of this WMP, and provide education and outreach events that promote wise stewardship of the Watershed.

Educate

Successful implementation of the recommended management measures and achievement of the goals and objectives identified in this WMP may not be possible without public education and outreach. Education extends beyond school curriculum opportunities and involvement of academia in research and teaching. It involves educating all stakeholders (i.e. local officials and leaders, private industry, and local citizens) to increase awareness about the present and future threats to the Watershed, and to foster new attitudes, motivations, and stakeholder commitments.

Own

In order to achieve the desired vision for the Watershed, this WMP must become an initiative rooted within the community. The MBNEP has led by initiating and driving the development of the WMP, however, local officials, leaders, and citizens must take ownership of this WMP for the vision of the Watershed to become a reality.

7.1.2 Develop Appropriate Monitoring and Adaptive Management Mechanisms

To achieve maximum effectiveness, the West Fowl River Watershed Management Plan implementation effort should monitor a variety of management measures and indicators, including but not limited to the following:

- acres of wetlands preserved
- acres of wetlands restored
- miles or acres of riparian buffer restored
- acres treated for invasive plant removal
- number of septic tanks inspected and serviced and/or taken out of service

- number of alternative on-site sewage disposal systems installed
- miles of livestock exclusion fencing installed
- number and type of agricultural Best Management Practices (BMPs) implemented,
- miles of waterway restoration
- additional investigations created to identify pollutant.

In addition, a comprehensive watershed water monitoring system should be designed and implemented that will be consistent enough to accurately monitor trends in Watershed conditions and parameters. All monitoring activities should be conducted in accordance with ADEM or Alabama Water Watch (AWW) protocols. A vital element of the Watershed Monitoring Program will be volunteer citizen participation to enable successful implementation and establish a sense of community ownership within the Watershed. Efforts should be made to recruit as many volunteer monitors as possible.

7.1.3 Establish and Implement a Range of Educational Outreach Efforts within the Watershed

Educational programs on priority West Fowl River Watershed issues (wetlands, water quality, stormwater management, sea level rise, etc.) should be developed and targeted toward municipal officials, business interests, homeowners and youth. Outreach and education efforts must target different messages to different audiences on issues relating to implementation of the WMP. The primary goal should be to increase the sensitivity and understanding of the target audiences to the necessity of implementing the management measures outlined in the WMP.

7.1.4 Short-Term Strategies

The short-term strategies listed in **Table 7.1** have been identified to facilitate realistic short-term successes that will assist the WPIT in building early momentum within the stakeholder communities. These early successes will provide the WPIT with the building blocks of environmental stewardship by instilling confidence and involvement from the stakeholders, which is necessary to achieve the overall vision of the WMP. These short-term strategies are identified along the lines of the MBNEP Comprehensive Conservation and Management Plan's values with management measures relating to water quality, coastlines, heritage, access, and resiliency. Within each of these management measures, potential action items have been identified as well as prospective partnering with other institutions/ agencies to meet their respective published plans and goals. These include, but are not limited to, the Alabama Department of Conservation and Natural Resources, State Lands Division, Coastal Section; *Alabama Coastal Area Management Program Strategic Plan 2013-2018* (ACAMP), Alabama Gulf Coast Recovery Council project's list (AGCRC), US Fish and Wildlife Service; *Vision for a Healthy Gulf of Mexico Watershed; Next Steps for a Healthy Gulf of Mexico Watershed* (FWS Next Steps) and Mobile Bay National Estuary Program; *Comprehensive Conservation & Management Plan 2013-2018* (CCMP) and Deepwater Horizon Natural Damage Assessment Trustees (DHNRDAT) funded projects.

Table 7.1 Short Term Strategies (0-3 years)

Table 7.1 Short Term Strategies (0-3 years)			
West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action Items	Prospective Partnerships
Resiliency Water Fish Coastlines	Reduce the amount of trash in and entering the River, bayous and tributaries	1. Develop a public educational program to address litter control (CCMP EPI 4) 2. Develop educational and outreach to waterfront property owners and businesses; Fishing vessel owners and operators to properly manage waste (CCMP EPI 3.3) 3. Organize waterways and coastline clean-up events (Two per year) (CCMP TAC-2.1) 4. Champion the enhancement and enforcement of littering and solid waste ordinances (CCMP TAC 5.2 & EPI 3.3) 5. Assist in the development and advocate enforcement of derelict vessel ordinances (CCMP EPI 3.3) 6. Coordinate efforts between City and County officials to establish a Household Hazardous Waste Collection Day Program throughout the watershed (AGCRC #202) (CCMP EPI 3.3) 7. Coordinate an "Adopt a Stream/Area/Mile" program with PALS (CCMP TAC 2.1) 8. Coordinate efforts between City and County officials to establish solid waste / recycling stations through	Alabama PALS; Alabama Coastal Clean Up Inc.; Local businesses; Bayou La Batre Area Chamber of Commerce; Mobile County; GOMA Marine Debris Cross-Team Initiative; NRCS; Alabama Coastal Conservation Corps

Table 7.1 Short Term Strategies (0-3 years)			
West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action Items	Prospective Partnerships
	Reduce the amount of trash in and entering the River, bayous and tributaries	the watershed (CCMP EPI 3.3) 9. Coordinate the installation of in-stream litter catchment devices within areas identified as litter "hotspots" Goal 2 A ii)(CCMP TAC 1.2)	
Resiliency Water	Reduce sediments in stormwater runoff and address nuisance flooding in yards and streets	10. Develop GIS based inventory of stormwater conveyances and outfalls within the City (ACAMP Goal 2 C) 11. Develop a dirt road restoration plan that includes and implements LID designs and options—priority areas: Zirlott Rd along West Fowl River tributary, McGraw Blvd & Lossing Rd along the West Fowl River, Clark Rd & Old Rock Rd in the Bayou Como sub-watershed, Callahan Rd & Bayou Street in the Bayou Sullivan sub-watershed, Henry Johnson Rd & St Michael Street in the Coden Bayou Sub-watershed, Williams St & Johnson Rd in the Heron Bayou sub-watershed (AGCRC Prj 383)(CCMP TAC-6.1)	Mobile County; CIAP; ADCNR; Weeks Bay CTP; ARWA; USFWS; CIAP, AGCRC 2018

Table 7.1 Short Term Strategies (0-3 years)			
West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action Items	Prospective Partnerships
Resiliency; Water	Reduce sediments in stormwater runoff and address nuisance flooding in yards and streets	12. Coordinate with the County to address rural road stormwater runoff. (implement BMPs/LID/ pave dirt roads)(ACAMP Goal 2 A ii)(CCMP TAC 1.2)	Mobile County; CIAP; ADCNR; Weeks Bay CTP; ARWA; USFWS; CIAP, AGCRC 2018
Resiliency; Water; Coastlines	Reduce nutrients and sediments from stormwater runoff	13. Work with local land owners to implement agricultural, and/ or silvicultue/ forestry BMPs (i.e. vegetated buffers or perimeter swales)(ACAMP Goal 5) 14. Partner with large land owners in the upper watershed to implement land management practices (CCMP EPI-1.2) 15. Implement outreach for compliance with NPDES stormwater construction activities (CCMP TAC-2.3)	Mobile County Soil & Conservation District; Alabama Extension Alabama A&M and Auburn Univ.; Auburn Univ. Shellfish Lab; DISL; ARWA;ACES; ADEM; ADCNR; NRCCS-LLPI & WLFW, Farm restoration program; ACNPCP; NWTF; USDA-FS; USFWS
Fish; Resiliency; Water	Remove Sanitary System Leaks, SSO, and illicit discharges into West Fowl River	16. Identify and promote the remove of sanitary system leakage/overflows into groundwater, creeks and tributaries (CCMP EST 1.1 & TAC 3.4) 17. Conduct/ coordinate outreach for compliance with the NPDES activities (MS4, Industrial and Vessel sectors) (CCMP TAC-2.3)	ADEM; ADCNR; ARWA; Mississippi-Alabama Sea Grant Consortium; Bayou La Batre Area Chamber of Commerce; Mobile Baykeepers; Marine Police

Table 7.1 Short Term Strategies (0-3 years)			
West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action Items	Prospective Partnerships
Fish Resiliency Water	Remove Sanitary System Leaks, SSO, and illicit discharges into West Fowl River	18. Preform outreach for compliance with the Marine Sanitation Act 2003-59 (CCMP EPI 3.3) 19. Coordinate water quality sampling volunteers with the MBNEP's program, Coastal Volunteer Environmental Monitoring Initiative (CCMP EST 1.1 & EPI 2.2) 20. Coordinate and support AU Shellfish Lab efforts to create and operate additional water quality monitoring stations in Portersville Bay for MBNEP's My Mobile Bay Environmental Monitoring efforts CCMP EST 1.1 , EPI 2.2)(AGCRC #166) 21. Promote and coordinate additional pathogen source tracking and identification efforts 22. Develop outreach and education program for fishing vessel owners, operators, and crew (CCMP TAC 2.1) 23. Promote the creation and participate in a Comprehensive Coastal Monitoring & Community Engagement Network	ADEM; ADCNR; ARWA; Mississippi-Alabama Sea Grant Consortium; Bayou La Batre Area Chamber of Commerce; Mobile Baykeepers; ALEA Marine Police Div.; MBNEP; DISL; NFWF; Mobile County

Table 7.1 Short Term Strategies (0-3 years)			
West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action Items	Prospective Partnerships
Fish Resiliency Water	Remove Sanitary System Leaks, SSO, and illicit discharges into West Fowl River	(COCO) (AGCRC #166)(CCMP EST 1.1) 24. Conduct/ coordinate outreach to improve the business communities understanding of coastal resources importance to the local community and economy. (CCMP TAC-1)(ACAMP Goal 5) 25. Advocate for the construction collection system upgrades (AGCRC project #261) 26. Promote long-range sanitary sewer planning by the County's Planning and Development Department 27. Develop a plan to relocate critical infrastructure and facilities out of the 100-year floodplain. (ACAMP Goal 4 Aii) (CCMP TAC-4.1) 28. Organize the mapping of all active NDPES MSGP discharges within the watershed 29. Implement outreach for compliance with NPDES stormwater construction activities (CCMP TAC-2.3)	ADEM; ADCNR; ARWA; Mississippi-Alabama Sea Grant Consortium; Bayou La Batre Area Chamber of Commerce; Mobile Baykeepers; ALEA Marine Police Div.; MBNEP; DISL; NFWF; Mobile County

Table 7.1 Short Term Strategies (0-3 years)			
West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action Items	Prospective Partnerships
Coastlines Fish Resiliency	Reduce the occurrence of nuisance and/or exotic species with focus on the bayou	30. Coordinate a field survey of invasive/ exotic flora and fauna (FWS Next Steps) 31. Initiate and develop an invasive/ exotic eradication program (FWS Next Steps)	Alabama Extension Alabama A&M and Auburn Univ.; ADCNR; NRCS- LLPI & WLFW, Farm Restoration program; Alabama Forestry Commission; Alabama Treasure Forest Foundation; USFWS; USDA-FS
Coastlines Fish Resiliency	Promote coastal habitat protection and conservation	32. Identity and prioritize parcel acquisition for areas: a. along the shores of the West Fowl River Bay (Cat Island (18Ac.), Henderson Tract (1665 ac.), Tensaw Land & Timber Tract (2810 ac.), West Fowl River Tract (900 ac.)(CCMP ERP-3.2) (FWS Next Steps) 33. Develop a "Adopt a Watershed/ Stream" program (CCMP TAC 2.3) 34. Promote the restoration and/ or enhancement of Oyster and in-shore reefs (AGCRC#70, 77, 83, 97)(CCMP TAC-6) 35. Acquire flood prone area and turn into public green spaces design for stormwater attenuation (CCMP TAC-5.3)	Mobile County; ADCNR; Weeks Bay CTP; CIAP; NFWF; GOMA HCRT; The Nature Conservancy; Alabama Extension Alabama A&M and Auburn Univ.; ADCNR; NRCS- LLPI & WLFW, Farm Restoration program; Alabama Forestry Commission; Alabama Treasure Forest Foundation; USFWS; USDA-FS; Alabama Wildlife

Table 7.1 Short Term Strategies (0-3 years)			
West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action Items	Prospective Partnerships
Coastlines Fish Resiliency	Promote coastal habitat protection and conservation	36. Identify greenspace and conservation lands within the watershed (ACAMP Goal 4vi)(CCMP ERP-3)(FWS Next Steps) 37. Develop an plan to identify beneficial dredge spoil usage projects to support shoreline sustainability (ACAMP Goal 1 J)(CCMP TAC-6.1)	Federation/Coastal Conservation Association Alabama/Alabama Marine Resources Division; Organized Seafood Association of Alabama (OSAA)
Access Heritage Resiliency	Citizen access	38. Bayou Coden Maintenance Dredge (AGCRC Prj 219)(ACAMP Goal 3 Bi) 39. Champion Waterfront Park upgrades (Lightning Point, Rolston Park)(ACAMP Goal 3 Bi) Bayfront Park (AGCRC#199)(CCMP TAC 3)	Alabama Working Waterfront Coalition. Mississippi-Alabama Sea Grant Consortium; ADCNR; NPRA; USACE; Mobile County
Access Heritage Resiliency	Eco-tourism/ Economic Resiliency	40. Champion the creation of a local Alabama Coastal Bird Stewardship Program(AACBSP)(AGCRC #102)(CCMP EPI 1.3) 41. Assist in the economic diversification (AGCRC Prj # 217)(CCMP TAC 3.1) 42. Coordinate the creation of nature trails with wildlife observation points within local public lands(ACAMP Goal 3 Bi)(CCMP ERP 3) 43. Explore the creation of a multi- user trail along Shell Belt and Coden Belt Roads	NFWF; ADECA. NPRA; Bayou La Batre Chamber of Commerce, the South Mobile County Community Development Corporation and the South Mobile County Tourism Authority (SMCTA); ADCNR; Alabama Rivers Alliance; ADEM,

Table 7.1 Short Term Strategies (0-3 years)			
West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action Items	Prospective Partnerships
Access Heritage Resiliency	Eco-tourism/ Economic Resiliency	(ACAMP Goal 3 Bi)(CCMP ERP 3) 44. Establish a Bluewater tail in conjunction with the Mobile County Blueway Trail (AGCRC prj#228) (ACAMP Goal 3 Bi)(CCMP ERP 3) 45. Coordinate with local recreational department to install habitat and natural resource interpretive signage in new and existing parks to educate visitors(CCMP EPI-1.1) 46. Participate in promoting the Alabama Gulf Seafood Marketing efforts (AGCRC Prj 241)(CCMP EPI-1.3) 47. Participate in the development of the regional Strategic Plan for Coastal Alabama Region (Coastal Alabama Partnership (AGCRC Prj 198)(CCMP TAC-4.3)	NFWF; ADECA. NPRA; Bayou La Batre Chamber of Commerce, the South Mobile County Community Development Corporation and the South Mobile County Tourism Authority (SMCTA); ADCNR; Alabama Rivers Alliance; ADEM, Mobile County
Access Heritage Fish Water	Increase private sector support for protecting bayou water quality/ habitat	48. Conduct Maritime and historic inventory 49. Identify and connect stakeholders for partnerships in celebrating the rich cultural heritage of the bayous and River (CCMP TAC-2.2)	ACAMP; Bayou La Batre Chamber of Commerce, the South Mobile County Community Development Corporation and the South Mobile County Tourism Authority (SMCTA)

Table 7.1 Short Term Strategies (0-3 years)			
West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action Items	Prospective Partnerships
Access Heritage Water	Educational outreach for Create a Cleanwater Future (CCWF)	50. Conduct outreach to private sector (seafood/ shipbuilding industries, large landholders, etc.) (CCMP TAC-1.2) 51. Promote education / outreach program for OSDS BMPs for homeowners	BLB Chamber, Seafood Industry, Shipbuilding Industry, Farmers
Access Heritage	Heritage/ Cultural trails	52. Encourage eco-heritage tourism around the bayou by the creation of walking/ biking/ paddling trails (CCMP ERP-3.3) 53. Create coastal resource protection guidelines for eco-tourism (CCMP TAC 4.3) 54. Encourage the development of the Mississippi Sound Coastal Eco-Tourism and Aquaculture Village (CCMP TAC 3.1)	Alabama Gulf Coast Convention and Visitor Bureau; Bayou La Batre -Coden Historical Foundation; ADCNR' Gulf Permaculture; USDA; GCERC
Access Heritage	Preserve cultural heritage	55. Promote Seafood Industry (AGCRC prj. # 241)(CCMP EPI 1.3) 56. Promote the Shipbuilding Industry (CCMP EPI 1.3) 57. Advocate for an Oysterman Support Dock at the Delta Port Marina (AGCRC #240)	Alabama Gulf Coast Convention and Visitor Bureau; Bayou La Batre -Coden Historical Foundation. Mobile County
Coastlines	Implement living shoreline projects	58. Develop an action plan to increase "natural" shorelines within the bayou to reduce shoreline erosion (ACAMP Goal 1 Aiii)(CCMP EPI 2.5)	Alabama Working Waterfront Coalition. Mississippi-Alabama Sea Grant

Table 7.1 Short Term Strategies (0-3 years)

West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action Items	Prospective Partnerships
Coastlines Fish Resiliency Water	Implement living shoreline projects	59. Education campaign to waterfront property owners about natural shoreline stabilization. (ACAMP Goal 1 Aiii)(CCMP EPI 1) 60. Coordinate efforts to replace harden structures with " natural" shorelines (CCMP ERP-2.1) 61. Promote feasibility study for a living shoreline along Shell Belt and Coden Belt Roads.	Consortium; ADCNR; MBNEP; Alabama Coastal Foundation; NOAA; The Nature Conservancy ; USFWS
Coastlines Water Fish Resiliency	Shoreline sustainability	62. Develop an plan to identify beneficial dredge spoil usage projects to support shoreline sustainability (ACAMP Goal 1 J) 63. Develop public outreach/ education for currently funded shoreline restoration projects at Lightning Point, Shell Belt Road and Coden Belt Road. (CCMP EPI 1) 64. Develop a long-term plan for management and protection of shoreline sites that have been acquired (ACAMP Goal 1 Aiii)(CCMP TAC 4)	ADCNR; Weeks Bay CTP; CIAP; GOMA HCRT; The Nature Conservancy; USFWS
Coastlines Water Fish	County comprehensive planning and development	65. Develop Outreach/ Educational program about the importance of wetland systems(CCMP EPI-1.1) 66. Advocate and participate in the development of a Mobile County Comprehensive Recreation	Mississippi-Alabama Sea Grant Consortium; ADCNR; GOMA; FEMA; Mobile County; ACAMP; Weeks Bay CTP;

Table 7.1 Short Term Strategies (0-3 years)			
West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action Items	Prospective Partnerships
Coastlines Water Fish Resiliency Access Heritage	County comprehensive planning and development	Plan (AGCRC#418)(CCMP TAC-3) 67. Implement programs that will lower homeowner's insurance premiums. (ACAMP Goal 4 AIII) (CCMP TAC 4.3)(ACAMP Goal 4 Aiii) 68. Develop policies to promote relocation of new housing areas to upland areas that are out of the floodplain (ACAMP Goal 4 Aii)(CCMP TAC 4.3) 69. Promote a Resiliency Action Award recognition for local Individuals/ Industry/ Group that encourages/ implements environmentally sound management practices (CCMP TAC 2.2) 70. Adopt/ institute a Wellhead/ groundwater protection plan 71. Participate in the Coastal Resilience Index Program (ACAMP Goal 4 Aiii)(CCMP TAC 4.2) 72. Advocate for local updating of the Building Code and adopt the most current International Building Code (ACAMP Goal 4 iv & v)(CCMP TAC-4.3) 73. Advocate and participate in the development of a comprehensive Ecotourism Plan (AGCRC#273)(CCMP ERP-3.3)	ARWA; CLECP; Mississippi-Alabama Sea Grant Consortium; ADCNR; GOMA; FEMA; ACAMP; Weeks Bay CTP; ARWA; CLECP

Table 7.1 Short Term Strategies (0-3 years)			
West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action Items	Prospective Partnerships
Coastlines Water Resiliency Heritage	Clean & Resilient Marinas Initiative	74. Encourage local marinas to participate in an initiative to explore possible best management implementation(CCMP TAC 3.1)	Mobile County; GOMA; ADCNR; Mississippi-Alabama Sea Grant Consortium

7.1.5 Long-Term Implementation Strategies

The long-term strategies listed in **Table 7.2** have been identified to perpetuate the successes gained from the short-term strategies by continued sustainability of the WPIT's charge to improve the overall quality of the Watershed for its stakeholders. These strategies will focus on the long-term "big picture" projects that will enhance the Watershed's condition. One of these enduring goals is to establish a Watershed Management Authority under the 1991 Alabama State Law, Act No. 91-602, authorizing the establishment of Watershed Management Authorities with the intent of protecting and managing Watersheds by developing and executing plans and programs related to water conservation, water usage, flood control and prevention, wildlife habitat protection, agriculture and timberland protection, erosion control and prevention and floodwater and sediment damages. This authority could be sought in conjunction with WPIT from adjacent Watersheds.

Table 7.2 Long Term Strategies (4-10 years)

Table 7.2 Long Term Strategies (4-10 years)			
West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action items	Prospective Partnerships
Resiliency Water	Reduce the amount of trash in and entering the bayou and tributaries	1. Champion the acquisition of a trash boat to maintain the bayous 2. Organize water ways and coastline clean-up events (Two per year)(CCMP TAC-2.1)	Alabama PALS; Alabama Coastal Clean Up Inc.; City of Bayou La Batre; Bayou La Batre Area Chamber of Commerce; Alabama Coastal Conservation Corps; GOMA
Resiliency Water Fish	Reduce sediments in stormwater runoff and address nuisance flooding in yards and streets	3. Develop a watershed wide study to ID drainage and water quality improvements. (CCMP TAC 1.2) 4. Map existing ROW and drainage easements. ID required easement acquisition to provide future maintenance for the drainage system (ACAMP Goal 2 C)	ADCNR; Weeks Bay CTP; USFWS

Table 7.2 Long Term Strategies (4-10 years)			
West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action items	Prospective Partnerships
Resiliency Water Coastlines	Reduce nutrients and sediments from stormwater runoff	5. Work with local agricultural land owners to implement agricultural BMPs (i.e. vegetated buffers or perimeter swales)(FWS Next Steps)(CCMP EPI 1.2)	Alabama Extension Alabama A&M and Auburn Univ.; ARWA; ACNPCP; NRCS; NWTF; USDA-FS
Fish Resiliency Water	Remove Sanitary System Leaks, SSO, and illicit discharges into West Fowl River	6. Advocate for the construction of sewage pump out stations for working vessels(CCMP TAC 2.1) 7. Organize the mapping of all active NDPES MSGP discharges within the watershed to include abandoned mines. Evaluate runoff controls and ID problem areas 8. Address the location of the wastewater treatment plant surface water discharge pipe. (AGCRC project #255) 9. Explore implementation of Clean Marina Program (ACRC#297) (CCMP TAC 2.3)	Mississippi-Alabama Sea Grant Consortium; ARWA; ADEM
Coastlines Fish Resiliency	Reduce the occurrence of nuisance and/or exotic species with focus on the bayou	10. Initiate and develop educational programs for large landowners in the upper watershed about land management practices (Prescribed burns, Longleaf Pine, etc.) (FWS Next Steps)(CCMP EPI-1.2)	Alabama Extension Alabama A&M and Auburn Univ.; ACAMP; NRSC- LLPI & WLFW, Farm Restoration program; USFWS

Table 7.2 Long Term Strategies (4-10 years)

West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action items	Prospective Partnerships
Coastlines Fish Resiliency	Upper West Fowl River Watershed	11. Implement a program to protect natural shorelines from erosive environments (ACAMP Goal 1 Aiii) 12. Explore restoration of the natural streambed within the Watershed (CCMP ERP-2.1)	ADCNR, MBNEP ,EPA, ADEM; The Nature Conservancy; USFWS
Coastlines Fish Resiliency	Promote coastal habitat protection and conservation	13. Identity and prioritize parcel acquisition for areas: a. along the east and west shore of the bay (CCMP ERP-3.2) 14. Develop an "Adopt a Watershed" program	ADCNR; Weeks Bay CTP; CIAP; GOMA HCRT; The Nature Conservancy
Access Heritage	Create access points	15. Create educational access points that includes an area of shoreline/ habitat restoration (CCMP ERP-3.1) (ACAMP Goal 3 Bi) 16. Establish a Bluewater tail in conjunction with the Mobile County Blueway Trail (AGCRC prj#228) (ACAMP Goal 3 Bi)	Alabama Working Waterfront Coalition. Mississippi-Alabama Sea Grant Consortium; ADCNR

Table 7.2 Long Term Strategies (4-10 years)			
West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action items	Prospective Partnerships
Access Fish Heritage Water	Environmental outreach/ education	17. Create an Environmental Center (AGCRC prj #333)	ADEM, ADCNR; AGCRC, GOMA, ACAMP; The Nature Conservancy; USFWS; NWTF
Access Heritage Water	Working Waterfront	18. Coordinate and increase awareness of working waterfront issues and eco-friendly BMPs. (CCMP TAC 3.5)	Alabama Working Waterfront Coalition; Mississippi-Alabama Sea Grant Consortium; ADCNR; National Working Waterfront Network, US Economic Development Administration; Mobile County
Access Heritage Resiliency Water	Long-Term Watershed Management	19. Explore the creation of a Watershed Management Authority under Alabama Code Title 9 Chapter 10A. May look at combining other watersheds such as Bayou La Batre, and Dauphin Island	City of Bayou La Batre; ADCNR; Weeks Bay CTP; MBNEP

Table 7.2 Long Term Strategies (4-10 years)			
West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action items	Prospective Partnerships
Coastlines Water Resiliency	Outreach/ education	20. Coordinate an educational curriculum and teaching tools that can support local schools in teaching the values and the importance of natural resources (SAVs, Wetlands, Watersheds) (ACAMP Goal 1 Ei)	Alabama Working Waterfront Coalition. Mississippi-Alabama Sea Grant Consortium; ACAMP; GOMA
Coastlines Fish Water Resiliency	Implement living shoreline projects	21. Coordinate efforts to replace harden structures with " natural" shorelines (CCMP ERP-2.1) 22. Promote acquisition of parcels on the east and west side an upper part of the bayou (ACAMP Goal 4 vi)	ADCNR; Weeks Bay CTP; ACAMP; The Nature Conservancy; USFWS; NWTF
Heritage Coastlines Resiliency	Preserve coastal Alabama heritage	23. Explore the creation of an Oyster Farm Enterprise Zone (CCMP TAC-3.1) (ACAMP Goal 3 Bi) 24. Develop a Safe Harbor in the bayou AGCRC prj. #237; CCMP TAC-3.2)	Alabama Working Waterfront Coalition. Mississippi-Alabama Sea Grant Consortium; ADCNR

Table 7.2 Long Term Strategies (4-10 years)			
West Fowl River Watershed Challenge to be Addressed and CCMP Value	Management Measures	Potential Action items	Prospective Partnerships
Coastlines Resiliency Fish Water	Coastal habitat protection	25. Look for opportunities to acquire properties in the floodplain and restore to natural habitat (ACAMP Goal 4 Aii) 26. Create outreach events to educated elected officials, citizens and business and industry leaders of the importance of resiliency strategies for long term sustainability (ACAMP Goal 1 Di, Goal 4 Aii)	ADCNR; Weeks Bay CTP; CELCP; ACAMP; The Nature Conservancy; USFWS

7.1.6 Implementation Milestones

Interim milestones should be established to support detailed scheduling and task tracking. The interim milestones should identify specific goals, and the time frame within which those milestones should be accomplished. Milestones can be loosely organized into short-term (one to three years), mid-term (five years), and long-term (five to ten years) categories.

Short-Term Milestones

- Appoint a watershed coordinator position as the leader of the WPIT
- Get WMP adopted by Mobile County Board of County Commissioners
- Apply for and receive funding for projects identified in **Table 7.3**
- Develop Education and Outreach Programs
- Coordinate with Mobile Baykeeper and Alabama Water Watch to develop a formal Monitoring Program.

Mid-Term Milestones

- Initiate a formal Monitoring Program
- Implement projects identified in **Table 7.3**
- Encourage and implement necessary legislative and regulatory actions
- Continue to identify opportunities and apply for funding

Long-Term Milestones

- Reduce the volume of trash deposited in the West Fowl River Watershed
- Improve watershed drainage systems and stormwater treatment
- Reduce SSO's and unpermitted discharges
- Diversify local economy
- Improve access to coastal resources
- Implement community resiliency actions
- Complete projects prescribed in the WMP
- Continue to identify opportunities and apply for funding.

7.1.7 Implementation Schedule

The implementation schedule for the WMP should be organized and executed by the WPIT under the leadership of the watershed coordinator. The time frames for implementation may be subject to change, depending on the availability of funds, success of management measures, and watershed response. The implementation schedule will serve as an important tool to assess the status of the WMP and to identify where corrective actions are needed to address problems encountered in the implementation of the WMP. As part of the recommended adaptive management approach, a review of the WMP implementation program should be performed every year, with an in-depth assessment every three to five years. This review should consider the results of performance monitoring as discussed in **Chapter 11** to assess the results from implemented action items and whether changes are warranted to the action items, scope, or management measures to achieve the stated goals and objectives of the WMP. Additionally, the WPIT should develop standards for determining implementation success with the input from the stakeholders and the general public. On an annual basis, a Watershed Progress Report should be prepared and made public on the accomplishments, success stories, and overall condition of the Watershed.

7.1.8 Evaluation Framework

The evaluation framework for this WMP, its implementation, and its success can be divided into three primary areas: inputs, outputs, and outcomes. Inputs include human resources of time and technical expertise, organizational structure, management, and stakeholder participation. Outputs include implementation of management measures, public outreach and education, and the monitoring program. Outcomes include increased public awareness, improved watershed conditions, and improved water quality.

An effective evaluation framework allows the WMP and implementation strategy to be modified as necessary to maximize efficiency and achieve stated goals. The evaluation framework for the West Fowl River WMP should focus on answering these questions during the indicated time frames. If the answer to any of these questions is negative, the implementation strategy should be reevaluated and revised.

Short-Term Milestone Period (0-4 Years)

- Has the watershed coordinator established WPIT members along with assigned duties and responsibilities?
- Has WMP been adopted by the Mobile County Board of County Commissioners?

- Has the necessary funding been quantified, sources identified, and received?
- Has the Public Education and Outreach Program been organized and implemented?
- Has the Monitoring Program been established and a qualified entity identified to carry out the program?

Mid-Term Milestone Period (5 Years)

- Has the Monitoring Program been successfully implemented?
- Have any management measures been implemented?
- Did the level of public interest and participation rise to the level of helping to achieve the WMP goals?
- Have any legislative or regulatory actions been implemented or adopted?
- Has additional funding been identified and secured?

Long-Term Milestone Period (5-10 Years)

- Have specific projects and management measures proposed in the WMP been fully implemented and completed?
- Have there been reductions in trash and pollution in the Watershed?
- Have water quality conditions improved?
- Has the local economy diversified and/or expanded?
- Has access to the Watershed been improved?
- Has the County initiated any recommended resiliency actions?

7.1.9 Estimation of Costs

The costs to implement the proposed management measures and to monitor the results will be significant. Cost estimates to implement the WMP over 10 years will be between $20,581,318.00 and $39,072,438.00; estimated costs are listed in **Table 7.3**. The WPIT under leadership of the watershed coordinator will require the assistance of numerous government agencies and private organizations.

Table 7.3 Estimation of costs

Chapter/Section	Activity Description	Quantity	Unit Cost ($)	Total Cost ($)
Water Quality				
6.2.1.2	Develop GIS based inventory of stormwater infrastructure within the watershed	Study only; estimate 4 sq. mi.	$3,000 - $5,000/sq.mi.	$12,000 - $20,000
6.2.1.3	Implement stormwater structural BMPs	Assume 12	$500,000 – $1,000,000	$6,000,000 - $12,000,000
6.2.1.4	Install LID practices	Assume 12	$35,000 – $125,000	$420,000 - $1,500,000
6.2.1.5, 6.2.1.6, 6.2.3.3, 6.2.4.5.2	Field observation/identification of permitted and unpermitted discharges, GIS inventory of discharges, and code enforcement/fines	10 years	$30,000/yr allocation	$300,000
6.2.2	Partner with private land owners to install agricultural BMPs; provide grants/incentives	Assume 50 projects	$5,000 - $20,000/project @ 50% cost share	$250,000 - $1,000,000
6.2.2.2	Conservation Buffer Strips: CB-1	1	$2,500/ac	$27,500
6.2.2.2	Conservation Buffer Strips: CB-2	1	$2,500/ac	$25,000
6.2.2.2	Conservation Buffer Strips: CB-3	1	$2,500/ac	$57,500

Chapter/Section	Activity Description	Quantity	Unit Cost ($)	Total Cost ($)
6.2.2.2	Conservation Buffer Strips: CB-4	1	$2,500/ac	$8,750
6.2.2.2	Conservation Buffer Strips: CB-5	1	$2,500/ac	$6,750
6.2.2.2	Conservation Buffer Strips: CB-6	1	$2,500/ac	$6,750
6.2.3.1	Paving Unpaved Roads including roadside treatment – Zirlott Road; excludes crossing replacement	1	$100/LF labor and materials 8% Engineering 15% General Conditions 8% CEI	$329,000
6.2.3.1	Paving Unpaved Roads including roadside treatment – McGraw Blvd; excludes crossing replacement	1	$100/LF labor and materials 8% Engineering 15% General Conditions 8% CEI	$222,700
6.2.3.1	Paving Unpaved Roads including roadside treatment – Lossing Road; excludes crossing replacement	1	$100/LF labor and materials 8% Engineering 15% General Conditions 8% CEI	$209,600
6.2.3.1	Paving Unpaved Roads including roadside treatment – Clark Road; excludes crossing replacement	1	$100/LF labor and materials 8% Engineering 15% General Conditions 8% CEI	$347,150

Chapter/Section	Activity Description	Quantity	Unit Cost ($)	Total Cost ($)
6.2.3.1	Paving Unpaved Roads including roadside treatment – Old Rock Road; excludes crossing replacement	1	$100/LF labor and materials 8% Engineering 15% General Conditions 8% CEI	$825,300
6.2.3.1	Paving Unpaved Roads including roadside treatment – Callahan Lane excludes crossing replacement	1	$100/LF labor and materials 8% Engineering 15% General Conditions 8% CEI	$322,260
6.2.3.1	Paving Unpaved Roads including roadside treatment – Bayou Street; excludes crossing replacement	1	$100/LF labor and materials 8% Engineering 15% General Conditions 8% CEI	$159,820
6.2.3.1	Paving Unpaved Roads including roadside treatment – Henry Johnson Road; excludes crossing replacement	1	$100/LF labor and materials 8% Engineering 15% General Conditions 8% CEI	$602,600
6.2.3.1	Paving Unpaved Roads including roadside treatment – St. Michael Street; excludes crossing replacement	1	$100/LF labor and materials 8% Engineering 15% General Conditions 8% CEI	$389,070

Chapter/Section	Activity Description	Quantity	Unit Cost ($)	Total Cost ($)
6.2.3.1	Paving Unpaved Roads including roadside treatment – Williams Street; excludes crossing replacement	1	$100/LF labor and materials 8% Engineering 15% General Conditions 8% CEI	$281,650
6.2.3.1	Paving Unpaved Roads including roadside treatment – Johnson Road; excludes crossing replacement	1	$100/LF labor and materials 8% Engineering 15% General Conditions 8% CEI	$512,210
6.2.3.1	Unpaved Road BMP's (aggregate and/or grading)	11 roads for 10 years	$100,000/yr	$1,100,000
6.2.4.2	Install sewage pump out station for working vessels	1	$75,000	$75,000
6.2.4.5, 6.2.4.5.4	Partner with County and private hauler to establish solid waste and recyclcling transfer stations throughout the Watershed (coordinate with education and enforcement measures); assume 25% shared capital cost	4 ea	$100,000 - $150,000	$400,000 - $600,000
6.2.4.5.1	Trash Boat	1 @ operation for 10 years	$50,000	$150,000

Chapter/Section	Activity Description	Quantity	Unit Cost ($)	Total Cost ($)
6.2.5.1, 6.2.5.2, 6.2.5.3	Develop multi-topic education and outreach program; partner with schools, churches and community groups. Pollution prevention topics include litter control, erosion control, proper sewage disposal and pathogen control, fertilizer and pesticide control	10 years	$20,000/yr allocation	$200,000
6.6.2	Water Quality Monitoring and Sampling Program including Enforcement	10 years	$100,000 - $150,000/yr	$1,000,000 - $1,500,000
Fish/Habitat				
6.3.1.1 and 6.3.1.2	Field survey of invasive species, GIS inventory, and eradication program	10 years	$50,000/yr	$500,000
6.3.2	Channel Restoration – assessment, engineering, construction, monitoring, and maintenance - Site 1	352 LF	$400/LF	$140,800
6.3.2	Channel Restoration – assessment, engineering, construction, monitoring, and maintenance - Site 3	473 LF	$400/LF	$189,200
6.3.2	Channel Restoration – assessment, engineering, construction, monitoring, and maintenance - Site 5	881 LF	$400/LF	$352,400

Chapter/Section	Activity Description	Quantity	Unit Cost ($)	Total Cost ($)
6.3.2	Channel Restoration – assessment, engineering, construction, monitoring, and maintenance - Site 6	320 LF	$400/LF	$128,000
6.3.2	Channel Restoration – assessment, engineering, construction, monitoring, and maintenance - Site 8	3800	$400/LF	$1,520,000
6.3.3	Preservation – Upper Bayou Como	37.68 acres	$3,100 - $7,100/acre	$116,808 - $267,528
6.3.3	Preservation – Upper Bayou Coden	23 acres	$3,100 - $7,100/acre	$71,300 - $163,300
6.3.3	Preservation – Lower West Fowl River	328 acres	$3,100 - $7,100/acre	$1,016,800 - $2,328,800
Access and Heritage				
6.4.1	Master Recreational Use Plan	1	$50,000	$50,000
6.5	Property Acquisition – Property #1	App. 23 acres	$19,000 - $90,000/acre	$437,000 - $2,070,000
6.5	Property Acquisition – Property #2	App. 15 acres	$19,000 - $90,000/acre	$285,000 - $1,350,000
6.5	Property Acquisition – Property #3	App. 27.85 acres	$19,000 - $90,000/acre	$528,150 - $2,506,500
6.5	Property Acquisition – Property #4	App. 2.75 acres	$19,000 - $90,000/acre	$52,250 - $2,475,000

Chapter/Section	Activity Description	Quantity	Unit Cost ($)	Total Cost ($)
6.5	Property Acquisition – Property #5	App. 2 acres	$19,000 - $90,000/acre	$38,000- $180,000
6.5	Property Acquisition – Property #6	App. 10.8 acres	$19,000 - $90,000/acre	$205,200 - $972,000
6.5	Property Acquisition – Property #7	App. 5.5 acres	$19,000 - $90,000/acre	$104,500 - $495,000
Resiliency				
6.6.2, 11.3	Water Quality Monitoring of the West Fowl River Watershed	6 stations	$20,000 each set up cost	$120,000
Resiliency				
6.7.1	Land Use Planning and Zoning including Future Land Use Map	1	$70,000	$70,000

7.1.10 Initial Implementation of Management Measures

Implementation of recommended management measures should begin immediately following the approval of the West Fowl River WMP, under the guidance of the watershed coordinator and WPIT. Initial implementation should focus on the most critical issues and the prioritized management measures identified in this WMP.

1. **Develop a long-term water quality monitoring and sampling plan.** Establish a long-term monitoring program to collect water quality data at permanent sample locations to assure consistency over an approximate 10-year time period. The monitoring program will be designed to assess the entirety of the study area and effects on the adjacent Portersville Bay in a time and cost efficient manner, while also providing sufficient and concise data, which is necessary to identify possible sources and localities contributing to current and future water quality degradation within the Watershed. This will allow for better analyses (identification of trends, significant changes to data output, etc.), determine the success of implemented management

measures within the Watershed, and indicate where additional measures are needed. The monitoring program shall also consider coordination and support of Auburn University Shellfish Laboratory's Portersville Bay water quality monitoring efforts to support fisheries restoration and management, and aquaculture activities.

2. **Improve public access to the water** by purchasing properties identified for access and cultural enrichment and pursue funding for recreational amenities.

3. **Stabilize unpaved roads** to reduce the risk of sediment entering waterways.

4. **Restore critical habitats** to provide ecological benefits and improve water quality and flooding (infiltration, flood control, treatment, decrease sedimentation, etc.). Restoration efforts include stream, streambank, and conservation buffer restoration, living shorelines, and invasive species management.

5. **Implement stormwater management improvements to target identified critical issues.** Install structural BMPs for treatment of stormwater runoff and encourage LID projects (bioretention swales and cells, constructed stormwater wetlands, and rainwater harvesting.

6. **Expand and diversify the local economy** with the acquisition of critical parcels and support for expanding the tourism and ecotourism industry.

7. **Secure funding to acquire a Trash Boat.** Trash is an endemic problem throughout the Watershed. It not only negatively affects water quality and aquatic habitats, but also has a negative impact on recreational activity within the Watershed.

8 Regulatory Framework

In conjunction with the development of this Watershed Management Plan (WMP) for the West Fowl River Watershed, a review of existing regulations at the federal, state, and local levels were conducted. The regulatory framework reviewed in this WMP focuses on the Federal, State, Mobile County laws, regulations, and ordinances that pertained to water quality, stormwater management, erosion and sediment control, coastal zone issues, wetlands and other surface waters, and land disturbance activities. Federal, state, and local regulations are periodically reviewed and updated. Normally, permitted activities within the Watershed are regularly updated (typically every five years) and usually require some changes from the previously issued permits to become compliant with any regulatory updates.

8.1 Federal Authorities

8.1.1 Federal Water Pollution Control Act

The Federal Water Pollution Control Act was enacted in 1948, and was significantly reorganized and expanded in 1977. The Clean Water Act (CWA) became the Act's common name with the amendments in 1972. The CWA establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating water quality standards for surface waters. The CWA and its amendments provide the basis for the primary federal regulatory and permitting procedures relating to stormwater management in the West Fowl River Watershed. The most applicable sections of the CWA related to controlling stormwater runoff and erosion and sedimentation within the Watershed are listed below.

- CWA §303 (33 USC §1313) – Water quality standards and TMDL program
- CWA §319 (33 USC §1329) – Non-point source pollution program
- CWA §401 (33 USC §1341) and CWA §401(a) – State Water Quality Certification
- CWA §402 (33 USC §1342) – NPDES permitting program
- CWA §404 (33 USC § 1344) – dredged/fill material discharged to waters of the US

8.1.1.1 CWA § 303(D) (33 USC §1313)

Under Section 303(d) of the 1972 CWA, states, territories, and authorized tribes are required to develop lists of impaired waters. These impaired waters do not meet water quality standards that states, territories, and authorized tribes have set for them, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop total maximum daily loads (TMDLs) for these waters. The TMDLs are used to establish limits for the amount and type of pollutant discharges that the receiving streams can handle without experiencing further degradation. Once a TMDL is established, additional research may be warranted to determine additional measures that can be implemented to meet the required TMDL. TMDLs have been approved for several other pollutants and named surface water systems in the West Fowl River Watershed and are further described in Chapter 3.

8.1.1.2 CWA § 404 (33 USC §1344)

This section establishes a program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands. CWA Section 404 requires a permit before dredged or fill material may be discharged into waters of the United States, unless the activity is exempt from Section 404 regulation (e.g., certain farming and forestry activities). The USACE is the primary permitting authority for impacts to waters of the United States, including wetlands. Permit applications are reviewed and evaluated based on the environmental criteria set forth in the CWA Section 404(b)(1) guidelines and regulations promulgated by the U.S. Environmental Protection Agency (EPA). The permits must also meet State water quality standards and coastal area requirements and must be consistent with each program.

8.1.1.3 CWA § 402 (33 USC §1342)

This section authorizes permitting under the NPDES program with EPA having primary permitting authority. The NPDES program requires dischargers to obtain permits prior to discharging pollutants into waters of the United States. The NPDES program covers point source discharges from industrial facilities; municipal separate storm sewer systems (MS4s); concentrated animal feeding operations (CAFO); publicly-owned treatment works (POTW); combined sewer overflows (CSO) and sanitary sewer overflows (SSO); and construction, non-coal/non-metallic mining and dry processing less than five acres, other land disturbance activities, and areas associated with these activities.

Through delegation from the EPA, ADEM has the authority to administer the NPDES program. Through ADEM Administrative Code Reg. 335-6-6 the Department regulates and permits certain point source discharges. Through ADEM Admin Code Reg. 335-6-6, ADEM regulates discharges from construction, non-coal/non-metallic mining and dry processing less than five acres, other land disturbance activities, and areas associated with these activities. This regulation also imposes requirements for controlling erosion, sedimentation, and other potential sources of pollution from these activities through the use of best management practices. This regulation also outlines requirements for inspections, reporting, and enforcement actions.

The EPA promulgated the *Effluent Limitations Guidelines and Standards for the Construction and Development Point Source Category* in December 2009. The rule requires owners and operators of permitted construction activities to adopt certain requirements including the implementation of erosion and sediment controls, stabilization of soils, management of dewatering activities, implementation of pollution prevention measures, provision and maintenance of a buffer around surface waters, prohibition of certain discharges, and utilization of surface outlets for discharges from basins and impoundments. The 2009 rule also included the establishment of numeric limitations on the allowable level of turbidity in discharges from certain construction sites. In 2014, the EPA made several revisions to the 2009 rule requirements including defining "infeasible" and removing the numeric turbidity effluent limitation and monitoring requirements.

In addition to the activities listed above, ADEM is also the delegated authority from the EPA to regulate discharges from MS4s. ADEM requires municipalities and other large operators of

MS4s, such as the Alabama Department of Transportation (ALDOT), to obtain and comply with terms of an NPDES permit to control the discharges from such systems.

8.1.2 Coastal Zone Management Act (16 USC§1451)

The U.S Congress authorized the Coastal Zone Management Act after it recognized the challenges the coastal areas faced with continuing growth. The Act is administered by the National Oceanic and Atmospheric Administration (NOAA) and encourages coastal states to develop and implement a coastal zone management plan to manage, preserve, protect, develop, and where possible restore or enhance coastal resources.

8.2 State Authorities

8.2.1 Alabama Water Pollution Control Act (Code of Alabama 1975 § 22-22-1)

The Alabama Water Pollution Control Act, like its federal counterpart (CWA), prohibits the discharge of pollutants to waters of the State without a permit and provides the foundation for the State's delegated authority to implement various federal water quality programs, including the §402 NPDES permitting program, §303 water quality standards and Total Maximum Daily Load (TMDL), and §319 Non-Point Source programs. Water quality programs are generally implemented through various sections of ADEM Administrative Code Rs. 335-6 and NPDES permits.

8.2.2 Water Quality Criteria (Code of Alabama 1991 § 335-6-10)

As previously mentioned, CWA §404 permit applications, pursuant to CWA §401(a), State Water Quality Certification, must be submitted to ADEM for review of the proposal's consistency with the State's water quality program. ADEM reviews applications to ensure the proposed discharge of dredged or fill material will not cause or contribute to a violation of State water quality standards as set forth in ADEM Administrative Code Rs. 335-6-10.

8.2.3 Construction Site Stormwater & State MS4 NPDES Program (Code of Alabama 1977 § 335-6-6)

Section 402 of the CWA, NPDES Permitting Program, sets forth the national permitting program for discharges of pollutants to waters of the United States. Alabama is an NPDES delegated state and ADEM is authorized to implement the NPDES permitting program. ADEM administers the program through its Water Quality Program, ADEM Administrative Code Rs. 335-6-6. Facilities discharging pollutants are divided by ADEM into a number of categories based on the type and/or size of the facility (e.g. major industrial, major municipal, minor industrial, mining, etc.) and level of treatment required. Discharge limitations are generally similar within the classifications but may vary where the water quality of the waterbody receiving the discharge is a limiting factor. The larger facilities, such as sewage treatment plants and heavy industrial facilities usually are authorized to discharge under stricter "Individual" NPDES permits. Smaller facilities of a similar nature (*i.e.* concrete plants, construction sites, etc.) are usually grouped under a "General Permit" developed to cover the specific industrial sector. The primary ADEM NPDES permit relevant to this project is ALR1000000 addressing construction stormwater discharges. A copy of the current version of the permit is available on the ADEM website at:

http://adem.alabama.gov/programs/water/waterforms/ALR16CGP.pdf

Construction site operators and/or owners seeking coverage under this general permit must submit a Notice of Intent (NOI) in accordance with the permit requirements. Operators and/or owners of all regulated construction sites must implement and maintain effective erosion and sediment controls in accordance with a Construction Best Management Practices Plan (CBMPP) prepared and certified by a Qualified Credentialed Professional (QCP). For priority construction sites, which include any sites that discharge to (1) a waterbody listed on the most recently EPA approved 303(d) list of impaired waters for turbidity, siltation, or sedimentation; (2) any waterbody for which a TMDL has been finalized or approved by EPA for turbidity, siltation, or sedimentation; (3) any waterbody assigned the Outstanding Alabama Water use classification in accordance with ADEM Admin. Code Reg. 335-6-10-.09; and (4) any waterbody assigned a special designation in accordance with ADEM Admin. Code Reg. 335-6-10-.10, the CBMPP must be submitted to ADEM for review along with the NOI. A Qualified Credentialed Inspector (QCI) or QCP must conduct regular inspections of regulated construction activities to ensure effective erosion and sediment controls are being maintained.

This program also includes the NPDES Municipal Separate Storm Sewer System (MS4) permitting covering large municipalities and urban areas with more than 50,000 people. The MS4 permitting program sets requirements for the covered entity to develop and implement a local stormwater management program to reduce the contamination of stormwater runoff and prohibit illicit discharges. The general requirements of MS4 permits are to develop, implement, and enforce a Storm Water Management Program Plan (SWMPP) that addresses the following minimum control measures:

- Public Education and Outreach on Stormwater Impacts
- Public Involvement and Participation
- Illicit Discharge Detection and Elimination
- Construction Site Stormwater Runoff Control
- Post-construction Stormwater Management
- Pollution Prevention/Good Housekeeping for Municipal Operations

The MS4 permits also may set forth requirements for actual stormwater or stream monitoring or assessment where stormwater discharges are to a 303(d)-listed stream or to a stream with an approved TMDL, and encourages the implementation of Low Impact Development/Green Infrastructure (LID/GI) practices. The MS4 permits also require that an annual report of activities and accomplishments related to the six control measures be submitted to ADEM. With few exceptions, the local jurisdictions with the more stringent stormwater management requirements are those with MS4 permit coverage.

8.2.4 CWA § 303 (D) (33 USC §1313)

ADEM is required by the EPA to designate waters for which technology-based limits alone do not ensure attainment of applicable water quality standards. This list is to be submitted to the EPA on the 1st of April for each even-numbered year. Impairments include things such as nutrients, pesticides, pathogens, metals, organic enrichment, and siltation, among other things, and can be caused by point sources or non-point sources. The impaired waters must then be sampled and a TMDL amount or limit must be calculated.

8.2.5 Alabama Coastal Zone Management Act (Code of Alabama 1975 § 9-7-10)

The Alabama Coastal Zone Management Act establishes the statutory basis for the Alabama Coastal Area Management Program and was first enacted in 1976 with the stated purpose "to promote, improve and safeguard the lands and waters located in the coastal areas of this state through a comprehensive and cooperative program designed to preserve, enhance and develop such valuable resources for the present and future well-being and general welfare of the citizens of this state." Currently, the coastal program's implementation is split between ADEM (regulatory portions) and the Alabama Department of Conservation and Natural Resources (planning and administration portions) and only applies to lands and waters seaward of the continuous 10-foot contour. Within the coastal area, a separate coastal management permit or coastal consistency certification is required pursuant to ADEM Administrative Code Rs. 335-8. This requirement applies to projects impacting wetlands (dredge or fill), developments greater than five acres, shoreline stabilization, docks and piers, construction on beaches and dunes, and other similar activities impacting coastal resources.

Alabama Coastal Area Management Program Strategic Plan 2013-2018 (ACAMP), Alabama Code § 9-7-1 et seq., requires approval by ADEM for most construction and development activities within the coastal area through regulations established in ADEM Admin. Code Reg. 335-8. The inland boundary of the coastal area in Alabama is the continuous 10-foot contour where the land surface elevation reaches 10 feet above sea level. The coastal area includes all land lying seaward of the 10-foot contour. ACAMP is a joint effort of the Alabama Department of Conservation and Natural Resources -State Lands Division (ADCNRSLD) and the ADEM Coastal Program. The ADCNRSLD is responsible for planning and policy development, while the ADEM is responsible for permitting, monitoring, and enforcement activities. A significant portion of ADEM's permitting, monitoring, and enforcement activities in the coastal area are related to determining federal consistency for projects and activities that require federal permits, such as Section 404 permits issued by the USACE.

8.2.6 Alabama Watershed Management Authority Act (Code of Alabama 1991 § 91-602)

The State of Alabama passed Legislature Act No. 91-602 that provides for the creation of a watershed management authority having the statutory authority to develop and execute plans and programs related to water conservation, water usage, flood control and prevention, wildlife habitat protection, agriculture and timberland protection, erosion control and prevention and floodwater and sediment damages with the intent of protecting and managing Watersheds.

This body is non-regulatory; however, the law provides numerous powers and authorities to the Board of Directors of a watershed management authority, including the power to:

- Acquire lands or rights-of-way by purchase, gift, grant, bequest, or through condemnation proceedings;
- Construct, improve, operate, and maintain such structures and projects as may be necessary for the exercise of any authorized function of the Authority;
- Borrow money as is necessary for the performance of its functions;
- Make and execute contracts and other instruments necessary to the exercise of its powers;
- Act as agent for the State of Alabama or any of its agencies, the United States or any of its agencies, or any county or municipality in connection with the acquisition, construction, operation, or administration of any project within the boundaries of the Authority;
- Issue, negotiate, and sell bonds upon approval of the State Finance Director; and Accept money, services, or materials from national, state, or local governments.

8.3 Mobile County Authorities

The county government's statutory authority is somewhat more limited. The county requirements are implemented countywide in areas not subject to a municipality's planning jurisdiction. *Code of Alabama 1975* §11-19-1 through 24 provides general authority for counties to adopt zoning ordinances in flood prone areas.

Mobile County also cites *Code of Alabama 1975* §11-24-1. *et. seq.* as the authority for its subdivision regulations. Although Mobile County states in its stormwater management plan that it does not have authority to require or enforce the use of BMPs during construction, with the exception of implementing local zoning districts.

8.3.1 Mobile County Flood Damage Prevention Ordinance (March 2010)

The Mobile County Flood Damage Prevention Ordinance applies to all areas of special flood hazard within the jurisdiction of Mobile County. Although the primary focus of the Ordinance is to regulate activities within designated flood hazard zones, the Ordinance does include regulations that also help protect water quality. The Ordinance includes measures to control the alteration of natural floodplains, stream channels, and natural protective barriers that are involved in the accommodation of floodwaters. The protection of these areas is important to the overall water quality of the West Fowl River Watershed.

8.3.2 Mobile County Subdivision Regulations (Amended April 2005)

The Mobile County subdivision regulations are administered by the Mobile County Commission. These regulations apply to every subdivision of land in all unincorporated areas of Mobile County that do not lie within the planning jurisdiction of any municipal planning commission. The primary purpose of the regulations is to establish procedures and guidelines for the development of subdivision or proposed additions to existing subdivisions related to minimum size of lots; the planning and construction of streets, roads, and drainage features; and the installation of water and sewer facilities. Portions of the Regulation, Sections 4, 7, and 8, include provisions related to water quality. Section 4.12 of the regulation requires the design of subdivisions to implement measures to protect streams and other water bodies. This section also requires a written statement that all applicable federal and state permits have been required prior to the approval of construction plans. In Section 7.5, it requires that good engineering practices, judgement, and criteria be employed to control stormwater runoff, and water detention shall be employed where required by such good engineering practices, judgement, and criteria. This section also requires that best management practices be used during construction. Stormwater detention requirements are outlined in Section 8.1 of the *Mobile County Subdivision Regulations* for any watershed that contains a public drinking water source. The detention requirements include a maximum release rate equivalent to the 10-year storm pre-development rate, and a minimum detention capacity for the volume of a 50-year post development storm.

8.3.3 Mobile County MS4 Phase II Permit (September 2016)

The Phase II MS4 General Permit was issued September 6, 2016. Coverage under this permit was granted to the Mobile County Commission and became effective October 1, 2016 (Permit #ALR040043) and expires September 30, 2021. The MS4 permit for Mobile County requires:

- Identify major sources of stormwater pollution (mapping and tracking)
- Reduce pollutants in runoff from industrial, commercial and residential areas
- Control stormwater discharges from new development and redevelopment areas
- Implement a water quality monitoring program

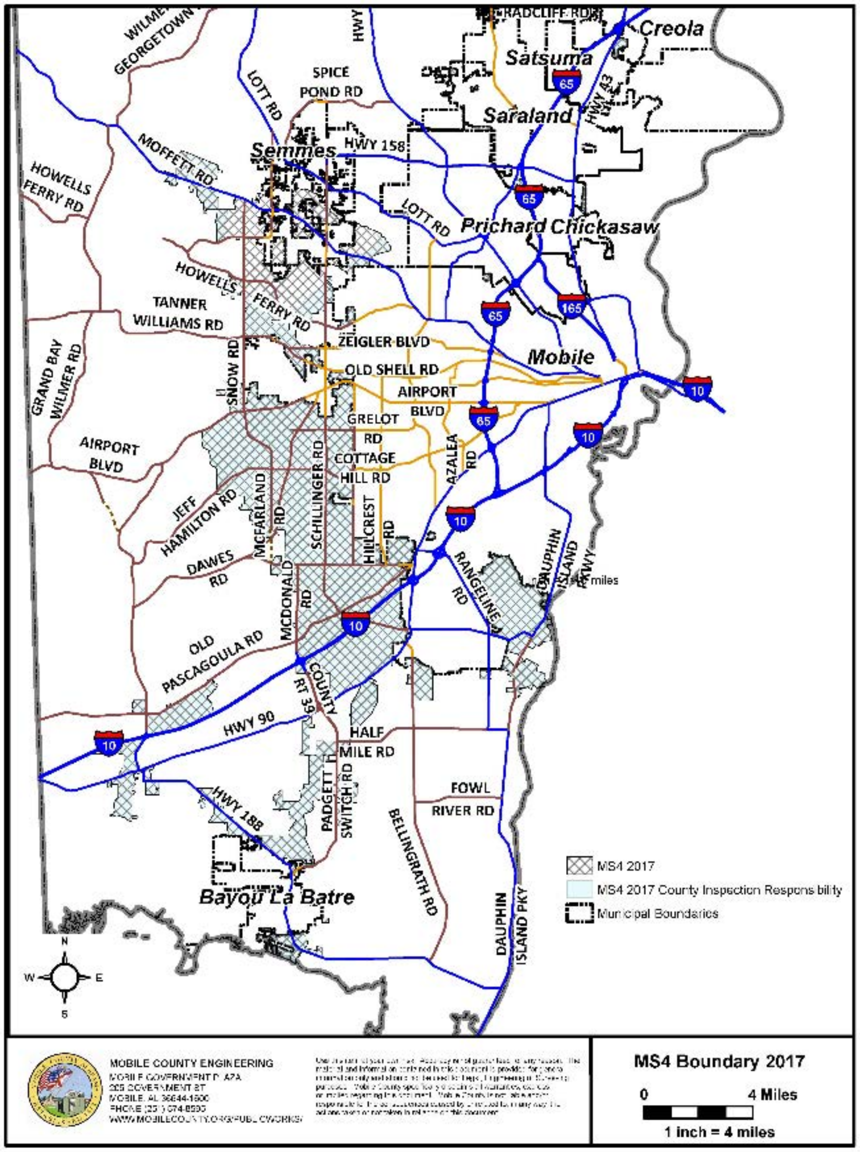


Figure 8.1 Mobile County MS4 Boundary Source: Mobile County MS4 SWMPP 2017)

The implementation of these requirement has the intent to reduce the discharge of pollutants to and from the MS4 to the maximum extent practical, thus protecting water quality. The MS4 permit is coordinated and managed by the mobile County Environmental Services Department.

8.3.4 Mobile County Stormwater Management Program Plan (October 2013)

The Mobile County Commission prepared the Mobile County Stormwater Management Program Plan (SWMPP) as part of the requirements of the County's NPDES MS4 Permit. The plan was created to protect water quality by reducing, to the maximum extent practicable, the discharge of pollutants in stormwater. The SWMPP provides regulatory purview for areas located within twenty-two 12—digit Hydrologic Unit Code (HUC 12) including an area approximately 800 acres within the West Fowl River Watershed.

8.4 Local Authorities

8.4.1 Jurisdiction Regulations and Ordinances

Information originally gathered and provided by the Mississippi-Alabama Sea Grant Legal Program indicates that Alabama is a “Dillon’s Rule” state. According to uslegal.com, under Dillon's Rule, a municipal government has authority to act only when:

> (1) the power is granted in the express words of the statute, private act, or charter creating the municipal corporation;
>
> (2) the power is necessarily or fairly implied in, or incident to the powers expressly granted; or
>
> (3) the power is one that is neither expressly granted nor fairly implied from the express grants of power, but is otherwise implied as essential to the declared objects and purposes of the corporation.

The local cities and towns, as municipal corporations under Alabama law, have the authority to implement zoning, regulate new development, and manage stormwater. The legal basis for this authority can be found in the *Code of Alabama 1975*:

- §11-40-1: Defines municipal corporations/municipalities as cities and towns
- §11-40-6: Municipalities with 2,000 or more residents constitute cities, and those with less than 2,000 residents constitute towns
- §11-45-1: Gives power to municipal corporations to create ordinances generally
- §11-52-2: Gives municipalities authority generally for creation of a municipal plan and planning commission
- §11-52-6: Defines powers of municipal planning commissions generally
- §11-52-7: Gives specific zoning authority for municipal planning commissions
- §11-52-70: Gives municipal corporations authority to divide municipality into commercial, industrial, and residential zones

Some municipalities exercise their authority to issue permits within their police jurisdiction or “extraterritorial jurisdiction” (ETJ) while others confine permitting to the city limits. Currently the City of Bayou La Batre has not implemented this jurisdiction.

8.4.2 Additional local regulations

In addition to the regulatory drivers noted above, subdivision restrictive covenants can also play an important role in stormwater management. Usually, within a residential subdivision, property owners’ associations are incorporated, and for most, there exist various subdivision restrictions that have been recorded and are imposed to regulate the activities within the subdivision. By nature, these restrictions look inward without consideration of neighboring property and, until recently, most do not address stormwater management.

8.5 Regulatory Overlap

Understandably, there is overlap among federal, state, and local requirements and the West Fowl River Watershed Management Plan (2018) provides an excellent example, using the permitting of a proposal to fill jurisdictional wetlands, which would require:

- A proper CWA §404 permit – either an individual permit with review by all agencies and the public, or a Nationwide Permit (NWP);
- Appropriate ADEM §401 water quality certification;
- Consideration of CWA §303(d) impacts (for listed stream segments);
- ADEM coastal program consistency determination (if in the coastal area);
- A CWA §402 NPDES construction stormwater permit (if greater than one acre will be disturbed);
- City and/or county land disturbance permits;
- City and/or county development permits and plat approvals; and
- City and/or county building permits.

This overlap is unavoidable; however, the degree of regulatory overlap has been lessened by delegation of certain programmatic or regulatory authority by EPA to ADEM and for certain coastal program requirements from ADEM to the local authorities.

Table 8.1 Current regulations within the West Fowl River Watershed

Table 8.1 : Current regulations within the West Fowl River Watershed		
	ADEM	Mobile County
Construction Phase Stormwater Management	Yes	Yes
Design Standards	Yes	Yes
Design Storm Event	Yes	N/A
Site Size	Yes	N/A
Inspection Requirement	Yes	N/A
Stabilization Times	Yes	N/A
BMP Maintenance/ Repair Schedule	Yes	N/A
Non-Compliance Reporting	Yes	N/A

Table 8.1 : Current regulations within the West Fowl River Watershed		
	ADEM	Mobile County
Turbidity Monitoring	No	N/A
Buffer Requirement	Yes	N/A
Post-Construction Phase Stormwater Management	No	Yes
Stormwater Quality	N/A	No
Stormwater Quantity	N/A	Yes
Design Storm	N/A	Yes
Site Size	N/A	Yes
Inspection Requirements	N/A	Yes
Maintenance Requirements	N/A	Yes
Reporting	N/A	Yes
Calculation Method	N/A	N/A
Protection for Waters of the U.S. (Wetlands and other surface waters)		
Permit Requirement	Yes in coastal Areas	ADEM/USACE
Setback Requirement	No	No
Buffer Requirement	No	Yes
Coastal Area Protections	Yes	No

8.6 Regulatory Deficiencies

8.6.1 Regulatory Gaps

States often rely on federal regulatory requirements, and in turn local governments rely on state requirements, to provide a measure of consistency and some level of "minimum standards." The federal and state environmental and stormwater requirements are necessarily designed to be applied at a national or statewide level and, while appropriate at their respective levels, may not be meaningful or provide the level of protection needed for a particular local resource and should be considered only as "minimum standards". The federal and state requirements are also more difficult to modify because of their broader application and implications, which becomes a problem when regulations do not address critical issues or have become antiquated. A prime example of a lack of federal or state standards is with regard to post-construction stormwater management. If it were not for the Federal Emergency Management Agency (FEMA) flood requirements, which only address volume, there would be no consideration of post-construction stormwater runoff. Neither EPA nor ADEM have any promulgated standards to set a consistent baseline for stormwater quality or treatment, so this endeavor falls solely to local units of government. Outdated regulations are often less effective than they could be, because they do not consider advancements in science, technology, or resource protection alternatives. ADEM's coastal program regulations relating to resource protection (ADEM Administrative Code Rs. 335-8-2) have not been updated in over 20 years. Recent studies funded by Baldwin County (HydroEngineering Solutions, 2010) found that consideration should be given to the timing of stormwater releases as well as discharge rates.

Local governments often assume that the maze of federal and state permitting requirements will be sufficient to protect the natural function of these systems. Unfortunately, this is rarely the case.

- The State of Alabama currently has no codified buffer or setback requirements (other than the setback requirements in the construction general permit).
- There are no federal of State requirements for post-construction stormwater management.
- Federal and state permits are routinely issued that allow wetlands to be impacted either directly or indirectly and, although mitigation for stream and wetland impacts may be required by the permit, mitigation often takes place outside of the watershed in which the impacts actually occur.

Therefore, local governments must fill the gaps in order to protect these vital resources from both direct and indirect impacts associated with development.

In a 2018 report, S*outh Alabama Stormwater Regulatory Review,* for the Mobile Bay National Estuary Program, it identified that 23 of 27 local jurisdictions (~85%) have their own construction-phase BMP requirements, but within Mobile County, the rate is only ~67%. Most of the jurisdictions that do not have specific requirements refer to the ADEM requirements. Post construction stormwater management requirements follow the same trend, primarily due to FEMA flood control requirements. However only 10 local jurisdictions (~37%) address post-construction stormwater quality. Coastal resource protection requirements are only evident in ~44% of the local jurisdictions, although all jurisdictions mention the State and/or federal permitting requirements. LID and shoreline protection requirements are only evident in about 30% and 15%, respectively (although shoreline protection is less critical in more inland communities without traditionally navigable waterways). Ten of the 27 jurisdictions are currently covered under the NPDES MS4 program permit.

8.6.2 Regulatory Inconsistencies

Regulatory inconsistencies between federal, state, and local units of government are inevitable and can contribute to ineffective watershed management, serve as impediments to restoration efforts, and cause confusion in the regulated community. Addressing regulatory inconsistency was a high priority item identified by both the development community and local government representatives during the public planning workshop held as part of the Weeks Bay Watershed Management Planning process. Development entities frequently gravitate to, or seek incorporation into, jurisdictions with "less regulation". However, the long-term costs to the broader community and its citizens will be realized as flooding increases; flood zones expand, increasing insurance rates; and waterbodies become polluted, prompting additional regulatory oversight, expensive restoration projects, and increased stormwater treatment costs; and stormwater conveyance, maintenance, and dredging costs manifest and increase.

Regulatory inconsistencies have even precipitated legal action between jurisdictions (Baldwin County *v* Bay Minette, *et. al.*, 854 So. 2d 42[Ala. 2003]) whereby the County was attempting to prevent municipalities from issuing permits outside of their respective city limits because of potential differences in regulatory standards between the County and the various municipalities. The fact that creeks and rivers do not respect political boundaries, and what happens relative to stormwater runoff in an upstream community has impacts on all communities downstream, highlights the need for consistent stormwater management policies and practices. By example, stormwater runoff from the southeast corner of Semmes, Alabama, enters a watercourse tributary to Eight-Mile Creek, and flows through Mobile County, the City of Mobile, the City of Prichard, the City of Chickasaw, joins Chickasaw Creek and borders the City of Saraland, and flows back into the City of Mobile. Conversely, stormwater runoff from various portions of the City of Mobile affects about a dozen different major (HUC 12) watersheds.

In that 2018 report, S*outh Alabama Stormwater Regulatory Review,* the most notable inconsistencies between-jurisdictions are the requirements for stabilization timeframes, which is the most critical element in erosion control. Other obvious inconsistencies are in design standards and storms; site size to which the requirements apply; and buffers and setbacks. The following list has been paraphrased from the *Weeks Bay Watershed Management Plan* (2017) and provides a good example of where (and why) regulatory consistency is of most benefit:

- Design standards for construction-phase BMP implementation. The current recommendations by EPA, the *Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas (2014),* and the ADEM stormwater general permit all reference the two-year 24-hour frequency event. This is generally the physical limitation of most all of the temporary construction phase BMPs currently available, and designing for a larger event is impracticable. Having requirements for construction phase BMP plan preparation and BMP design and selection that are compatible with the ADEM guidance and requirements also reduces the potential for applicants having to prepare multiple plans under differing guidelines.
- Stabilization Time. Erosion and sedimentation issues are directly related to the "extent and duration" of the area exposed, *i.e.,* how much denuded area is exposed to rainfall and how long it is exposed before being stabilized. ADEM's construction stormwater general permit requires that areas that have been disturbed and will not have activity for 13 days or more be temporarily stabilized immediately (emphasis added). Based on guidance from EPA, the ALDOT limits exposure to 17.5 acres, unless waived by the project engineer, to help control the extent of an area exposed.
- Maintenance. The effectiveness of construction-phase BMPs is directly related to maintenance of the individual control measures. The ADEM permits allow five days (from the date of discovery) to repair, maintain, or replace ineffective BMPs. Three

municipalities within the two counties use a 48-hour repair or maintenance timeframe, which is consistent with recommendations in the D'Olive Creek WMP (2010) and other areas of the state.

- Post-construction design standards. The effectiveness of post-construction stormwater management is directly related to adequate design and installation and routine inspection and maintenance. There are no federal or State requirements, so having consistent local requirements that meet both flood mitigation goals and watershed protection goals are critical.
- Long term maintenance of post-construction stormwater facilities. Developing a consistent set of maintenance and repair requirements for permanent stormwater management facilities will ensure that watershed protection goals can be sustained. This could also facilitate the compilation of an inventory of systems that can be used to systematically inspect and prioritize the repair, maintenance, or retrofitting of systems throughout the two-county area.

To add to the above list, having a consistent site size, where the construction-phase and post-construction-phase requirements apply, consistent design criteria (storm size/frequency, calculation methods, etc.) and consistent setbacks/buffers and LID requirements would be helpful to those working in multiple jurisdictions. Having a degree of consistency on erosion and sediment control plan submission, what credentials are necessary to prepare plans and perform inspections, as well as consistent nomenclature relative to stormwater management, would also be beneficial. Resolving the majority of the inconsistencies identified in the matrix to achieve common watershed protection goals would be beneficial to both local governments and the development community (developers, builders, consultants, etc.) and will foster wise stewardship of the resources within the watersheds.

8.7 Regulatory Enforcement

The West Fowl River Watershed falls within authority of one local governmental entity, Mobile County. For Mobile County, the Inspection Services Department administers compliance with plan review components of subdivision regulations and commercial site plan requirements. It also administers compliance with building construction, permitting, inspections, and enforcement of construction regulations, flood damage prevention ordinance, and Land Disturbance Permitting. The county's SWMPP states "Failure to maintain storm water controls results in an escalating enforcement strategy including verbal and/or written warnings, failed inspections, Stop Work Orders, and fees if work continues without remedying deficient items. ADEM is notified once it is determined that the County's enforcement methods are considered unsuccessful. ADEM is also notified if a qualifying inspected construction site does not have an NPDES permit." Local government is instrumental in providing additional support to the federal and state agencies with enforcement rights to identify and regulate water quality concerns within the watershed.

9 Financing

Often the most challenging and intricate phase of a watershed management plan is financing the implementation program. In these post-watershed management activities, funding must be secured to carry out the recommendations in **Chapter 6 and 7** in order to fulfill the goals and objectives outlined in **Chapter 5**. Because watershed management goals and objectives can vary widely, especially across different geographic and economic regions, sources of funding for watershed projects can also vary widely. The following section describes the suggested framework for financing watershed projects in the West Fowl River Watershed followed by specific descriptions of the most viable funding sources.

9.1 Framework

In previous sections, we have addressed the challenges facing the West Fowl River Watershed, identified the goals and objectives for restoring the Watershed, and explored the range of management measures and implementation strategies for consideration in restoring the West Fowl River Watershed. This section discusses the proposed framework for financing projects discussed in **Chapters 6 and 7**. The basic project financing framework consists of the following steps:

1. Identify project need and goal(s)
2. Develop scope and budget to meet project goal(s)
3. Identify individual project schedules (in total months) with a breakdown of activities that can be used for easy phasing of project. For example:

Activity	Date
Phase I – Planning	Months 1 - 3
Phase II – Engineering, Design, Permitting, and Bidding	Months 4 - 16
Phase III – Construction	Months 17-19
Phase IV – Construction Inspections	Month 20
Phase V – Monitoring	Months 21-24

4. Identify all potential funding sources for each phase of the project using key words and phrases from the project scope.
5. Analyze the funding sources for each project to create individual project schedules which align with funding schedules:
6. Project schedules are very important as they can allow for flexibility in sensitive timing of funding sources.
7. Project schedules should include:
    - Funding source(s) application open date
    - Funding source(s) award notification date
    - Funding source(s) effective start date

8. Use the information above to create proposed project start and end dates by phase. Different funding sources can be used to leverage one another in order to fund the full project budget. See **Figure 9.1**.

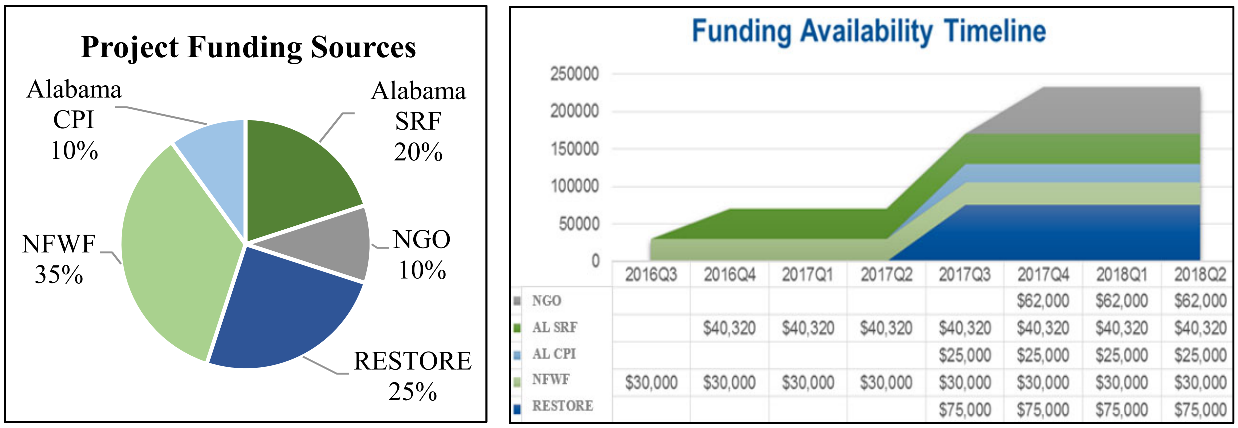


Figure 9.1 Example of leveraging project funding sources

9.1.1 Funding Analyses

Step 4 in the financing framework is to analyze the funding sources for each project to create individual projects schedules. Developing project funding schedules will allow project planning milestones to be easily tracked. Most importantly, they identify time frames for which funding should be pursued and secured. Most funding sources discussed in this WMP are recurring annually; however, are only open to apply for a limited timeframe each year. Reviewing current and archived funding opportunity announcements will provide information on the application open date, application deadline, award notification date, and effective start date.

9.2 Funding Sources – Public and Private

Restoration and management priorities were identified in **Chapter 6** to include water quality, fish/ habitat, access, heritage, coastlines, resiliency. These management priorities have identified various strategies and goals for each management priority, which will have the greatest potential to provide significant early benefits to reaching the WMP goals and objectives. Step 4 of the framework is to identify potential funding sources for each project. The public and private funding sources, as identified in Appendix E, are described in detail as prospective funding matches for management priorities identified in **Chapter 6**.

9.2.1 NRDA

On April 20, 2010, the offshore oil drilling platform, Deepwater Horizon (DWH), exploded in the Gulf of Mexico near Louisiana releasing approximately 134 million gallons of crude oil and four million pounds of natural and methane gas into Gulf waters before it was capped on July 15, 2010. The Oil Pollution Act authorizes certain state and federal agencies to evaluate the impacts of the DWH oil spill. This legal process, known as Natural Resource Damage Assessment (NRDA), determines the type and amount of restoration needed to compensate the public for damages caused by the oil spill. In April 2011, BP committed to $1 billion in early restoration projects in an agreement with the NRDA trustees. To date there are five phases of early restoration planning. Figure 9.2 shows the NRDA restoration funding allocated for each restoration goal identified for Alabama.

No projects within the Watershed were selected for Phases I through III Early Restoration funding. However, in late 2015, the Shell Belt and Coden Belt Roads Living Shoreline project was selected for Phase IV Early Restoration funding for a total estimated cost of $8.05M. This project will employ shoreline restoration techniques to increase benthic productivity and enhance the growth of planted native marsh vegetation. Specifically, shoreline breakwaters will be constructed to dampen wave energy and protect newly planted emergent vegetation while also providing habitat and increasing benthic secondary productivity. Over time, the breakwaters are expected to develop into reefs that support benthic secondary productivity, including, but not limited to, bivalve mollusks, annelid worms, shrimp, and crabs. Marsh vegetation is expected to become established further enhancing both primary and secondary productivity adjacent to the breakwaters. In 2017, the Trustees determined the project was not feasible as planned, and returned the unspent funds to the Alabama Trustee Implementation Group fund to be used for other projects restoring wetlands, coastal and nearshore habitats.

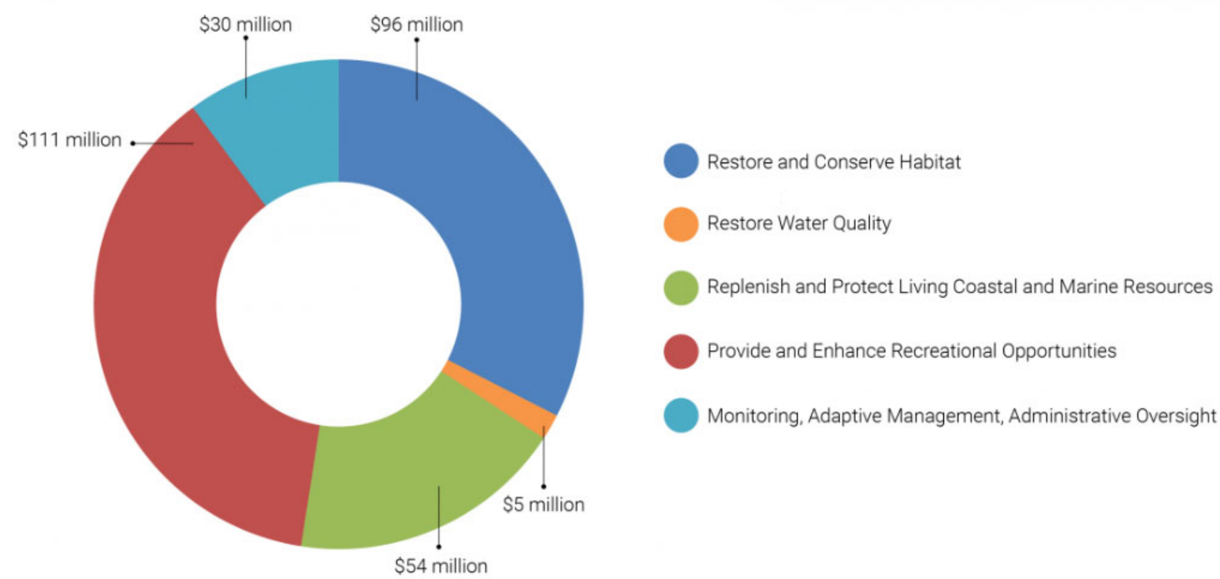


Figure 9.2 Allocation of NRDA restoration funds in Alabama for each restoration goal

On July 2, 2015 an agreement in principle was announced in which BP Exploration & Production Inc. (BP) will pay $8.1 billion in natural resource damages, including the $1 billion BP previously committed to pay for early restoration projects.

9.2.2 GEBF

The National Fish and Wildlife Foundation's (NFWF) Gulf Environmental Benefit Fund (GEBF) was established in early 2013 as a result of two plea agreements resolving the criminal cases against BP and Transocean after the 2010 Deepwater Horizon oil spill. The agreements direct a total of $2.544 billion to NFWF over a five-year period. The funds are to be used to support projects that remedy harm to natural resources where there has been injury to, or destruction of, loss of, or loss of use of those resources resulting from the oil spill. Projects are expected to occur within reasonable proximity to where the impacts occurred, as appropriate. Under the allocation formula and other provisions contained in the plea agreements, $356 million of the total amount to be deposited into the Gulf Environmental Benefit Fund will be for project expenditures in the state of Alabama (funded over a five-year period).

In 2016, GEBF awarded The Nature Conservancy $5,903,100 for the Lightning Point Acquisition and Restoration Project (Phase I). This project will protect and restore a key stretch of coastal shoreline at the mouth of the Bayou La Batre. Specifically, the project includes the acquisition of more than 100 acres of coastal habitat and the engineering and design for restoring approximately 28 acres of marsh and 1.5 miles of intertidal nearshore breakwater. The acquisition targets represent more than 2 miles of nearly contiguous undeveloped waterfront adjacent to existing protected lands owned by the state, Mobile County, and the City of Bayou La Batre.

Other regional cooperative projects funded by GEBF that benefit the Mississippi Sound Complex include:

- Enhanced Fisheries Monitoring in Alabama's Marine Waters (Phase I – III) - $1,800,000
- Fowl River Watershed Restoration: Coastal Spits and Wetlands Project (Phase I) - $1,127,000
- Dauphin Island Conservation Acquisition - $3,568,600
- Alabama Coastal Bird Stewardship Program -$1,462,000
- Grand Bay Acquisition - $1,777,500
- Alabama Artificial Reef and Habitat Enhancement - $12,525,400
- Alabama Barrier island Restoration Assessment - $4,277,600
- Alabama Marine Mammal Conservation and Recovery Program - $1,281,600
- Restoration and Enhancement of Oyster Reefs in Alabama - $3,750,000
- Fowl River Watershed Restoration - $3,244,150
- Dauphin Island Bird Habitat Acquisition and Enhancement Program - $4,525,000
- Little Dauphin Island Restoration Assessment - $1,481,500

9.2.3 RESTORE

The federal RESTORE Act was signed into law on July 6th, 2012, as part of the Moving Ahead for Progress in the 21st Century Act (Public Law 112-141). The legislation established a mechanism for providing funding to the Gulf region to restore ecosystems and rebuild local economies damaged by the Deepwater Horizon oil spill. The RESTORE Act established in the Treasury of the United States the Gulf Coast Restoration Trust Fund (Trust Fund) consisting of 80% of an amount equal to any administrative and civil penalties paid after the date of the RESTORE Act by the responsible parties in connection with the Deepwater Horizon oil spill to the United States pursuant to a court order, negotiated settlement, or other instrument in accordance with section 311 of the Federal Water Pollution Control Act (FWPCA, 33 U.S.C. 1321).

As shown in **Figure 9.3**, the RESTORE Act divides the funds into five separate allocations and sets the parameters for how the funds are to be spent in each:

- 35% of the funds are divided equally among the five Gulf Coast states for ecological and economic restoration. Eligible activities include: restoration and protection of natural resources; mitigation of damage to natural resources; work force development and job creation; improvements to state parks; infrastructure projects, including ports; coastal flood protection; and promotion of tourism and Gulf seafood

- 30% of the funds will be administered for restoration and protection according to the Comprehensive Plan developed by the Gulf Coast Ecosystem Restoration Council

- 30% of the funds are dedicated to the Gulf Coast states based on a formula. This formula will be based on the number of miles of shoreline that experienced oiling, the distance from the Deepwater Horizon mobile drilling unit at the time of the explosion, and the average population as of the 2010 Census. Each state is required to have a Council-approved plan in place for use of these funds

- Two and a half percent of the funds are dedicated to the Gulf Coast Ecosystem Restoration Science, Observation, Monitoring and Technology Program, which will be established by NOAA for marine and estuarine research, ecosystem monitoring and ocean observation, data collection and stock assessments, and cooperative research.

- Two and a half percent of the funds are dedicated to the Centers of Excellence Research Grants Program. The funding is distributed through the states to nongovernmental entities to establish Centers of Excellence that will focus on the following disciplines: coastal and deltaic sustainability; restoration and protection; fisheries and wildlife ecosystem research and monitoring; offshore energy development; sustainable and resilient growth; and comprehensive observation, monitoring, and mapping in the Gulf.

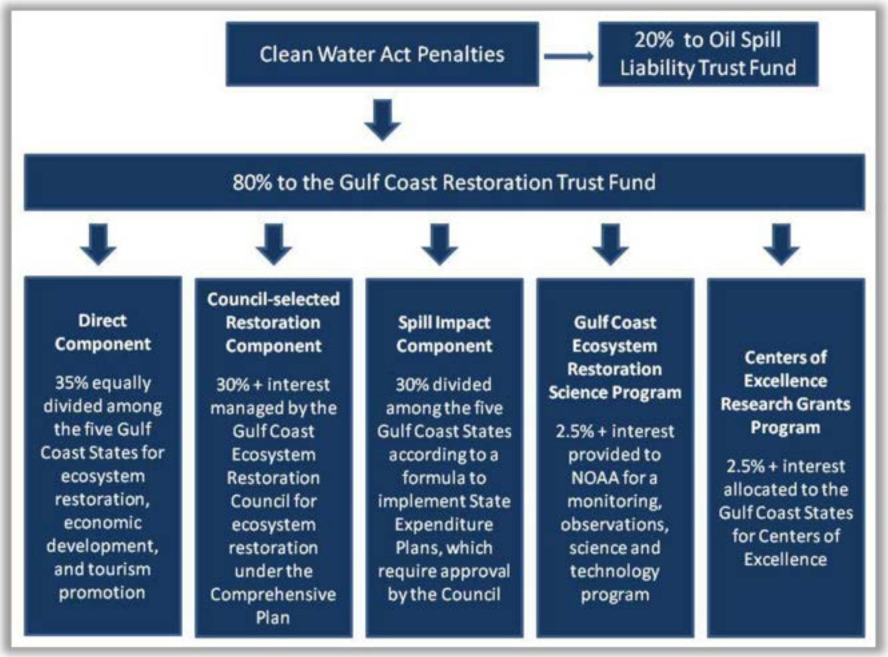


Figure 9.3 RESTORE Act allocation structure

9.2.4 Gulf of Mexico Energy Security Act of 2006 (GOMESA)

On December 20, 2006, the President signed into law the Gulf of Mexico Energy Security Act of 2006 (Pub. Law 109-432). The Act significantly enhances outer continental shelf (OCS) oil and gas leasing activities and revenue sharing in the Gulf of Mexico

(GOM). The Act shares leasing revenues with Gulf oil and gas-producing states and the Land & Water Conservation Fund for coastal restoration projects; bans oil and gas leasing within 125 miles of the Florida coastline in the Eastern Planning Area, and a portion of the Central Planning Area, until 2022; and, allows companies to exchange certain existing leases in moratorium areas for bonus and royalty credits to be used on other GOM leases.

The Act created revenue-sharing provisions for the four Gulf oil- and gas- producing states of Alabama, Louisiana, Mississippi, and Texas, and their coastal political subdivisions (CPSs). GOMESA funds are to be used for coastal conservation, restoration, and hurricane protection. There are two phases of GOMESA revenue sharing:

- **Phase I:** Beginning in Fiscal Year 2007 (FY07), 37.5% of all qualified OCS revenues, including bonus bids, rentals, and production royalties, were shared among the four states and their coastal political subdivisions from those new leases issued in the 181 Area in the Eastern planning area (also known as the 224 Sale Area) and the 181 South Area. Additionally, 12.5% of revenues are allocated to the Land and Water Conservation Fund (LWCF).
- **Phase II:** The second phase of GOMESA revenue sharing begins in Fiscal Year 2017 (FY17). It expands the definition of qualified OCS revenues to include receipts from GOM

leases issued either after December 20, 2006, in the 181 Call Area, or, in 2002–2007, GOM Planning Areas subject to withdrawal or moratoria restrictions. A revenue-sharing cap of $500 million per year for the four Gulf oil- and gas-producing states, their CPSs, and the LWCF applies from Fiscal Years 2016 through 2055. The $500 million cap does not apply to qualified revenues generated in those areas associated with Phase I of the GOMESA program. The Bureau will address the second phase of GOMESA revenue sharing in a subsequent rulemaking.

9.2.5 Non-Governmental Organizations and Other Private Funding

Numerous private foundations and non-governmental organizations (NGOs) are either headquartered or operate within or around the Watershed. These organizations include a wide range of environmental, academic, social, educational, religious, medical, and philanthropic institutions focused on achieving continued improvement in the quality of life for the residents of the Watershed. While not all of these organizations have either the focus or capacity of watershed recovery in their missions, we believe that many of these organizations would actively participate and contribute if simply given the opportunity. The following is a list of foundations and organizations that could participate and contribute in achieving the many goals and objectives identified in this WMP:

- Alabama Coastal Foundation
- Bishop State Community College
- Coalition of Alabama Students for the Environment
- Discovering Alabama
- Hands on Mobile
- J.L. Bedsole Foundation
- Keep Mobile Beautiful
- Mobile Baykeeper
- Mobile Bay Sierra Club
- Mobile United
- National Audubon Society
- The Nature Conservancy
- Partners for Environmental Progress
- Restoration Keepers
- University of South Alabama
- Kodak American Greenways Program
- RBC Bank Blue Water
- South Mobile County Community Development Corporation
- Surdna Foundation

9.2.6 Funding of Management Measures

The extensive and varied group of flexible financing-support structures identified in this WMP illustrates that there are readily available mechanisms to help support the West Fowl River WMP implementation at whatever implementation schedule the supporting governance and community are prepared and committed to undertake to conserve this invaluable resource. In anticipation that this WMP will be adopted for implementation, an initial assessment of which of these entities might offer the best initial underwriting assistance for the identified management measures. The results of that assessment are provided as a "jump- start" blueprint in **Table 9.1**.

Table 9.1 Recommended funding sources for Priority Management Measures, Short-Term Strategies (0-3 years)

Priority Management Measures	Recommended Support Targets / Authorities		
	Federal / State Grants (65%)	Local Cost Share (15%)	Private Partnership Support (20%)
Reduce trash in and entering waterways	EPA NOAA USDA(GOMI) ADEM RESTORE	General Fund Commitments (County & Municipal) Municipal Bonds Clean Water SRF Stormwater Utility Fee Program Implementation (w/TMC Set-aside) AL RESTORE ADCNR ADECA	Private Contributions and Grants Portfolio Development and Management NFWF
Reduces sediments and nutrients from runoff	ACOE NOAA FEMA (HMGP) ADEM ACAMP RESTORE		
Remove illicit discharges	EPA ADEM		
Reduce nuisance and/ or exotic species	NOAA USFWS EPA ACOE NRCS USDA RESTORE		
Blueway & Greenway trails	ALDOT HUD/ CDBG USDA RESTORE NOAA ACAMP DOI GOMA		
Tourism	ACAMP SMCTA	General Fund Commitments (County & Municipal) Municipal Bonds Clean Water SRF	Private Contributions and Grants Portfolio Development and Management NFWF
Education and outreach	ADEM ACAMP GOMA AGCRC		
Heritage	AGCCVB GOMA		

Priority Management Measures	Recommended Support Targets / Authorities		
	Federal / State Grants (65%)	Local Cost Share (15%)	Private Partnership Support (20%)
Shoreline protection and Restoration	RETORE EPA NOAA USFWS ACOE GOMA	Stormwater Utility Fee Program Implementation (w/TMC Set-aside) AL RESTORE ADCNR ADECA	
Coastal Resiliency	EPA NOAA RESOTRE GOMA ACAMP		

In summary, there are significant financial support options available to help support and ensure the West Fowl River WMP's success in conserving and revitalizing this resource. Establishment of a WMTF would clearly demonstrate to the grant markets the communities' active resolve to serve as vested and committed partners in the West Fowl River watershed improvement and protection process. This endeavor would significantly enhance the WPIT's attractiveness and position as it pursues available federal, state, local, and private grant assistance needed for implementation. By having, a well-supported watershed coordinator and WIPT, coupled with an aggressive, deliberate implementation of the initial Short-Term Strategies over the next three years, will help secure a long-term local commitment. These efforts will also establish the knowledge and experience needed to apply for the full range of funding sources needed for complete and successful implementation of this WMP.

10 Community Participation and Stakeholder Engagement

10.1 Introduction, Purpose and Goals

This section of the West Foul River Watershed Study describes the efforts undertaken to create a robust community outreach effort that would inform and engage a substantial cross-section of citizens. The ultimate goal was to provide education concerning the watershed and obtain their informed suggestions concerning preservation and management practices.

The challenges associated with engaging citizens in a watershed study are always complex due to socioeconomic disparities, variations in educational levels related to environmental issues and solutions and individuals desires to participate in public exercises. Dewberry recognized all of these factors and designed a public awareness and outreach program that emphasized the value of each person's ideas and suggestions, engendered trust, and encouraged participation. Throughout the course of the project, efforts were made to address questions and inquiries with solid information in order to maintain stakeholder interest and participation.

In addition to Stakeholder/ Advisory Committee group sessions and one-on-one meetings the Dewberry team provided watershed materials and presentations at a number of community events and gatherings including bingo nights at the Alabama Port Volunteer Fire Department and church gatherings.

Specific objectives established for the Community Outreach, Culture, and Heritage portion of the WFR watershed study included the following:

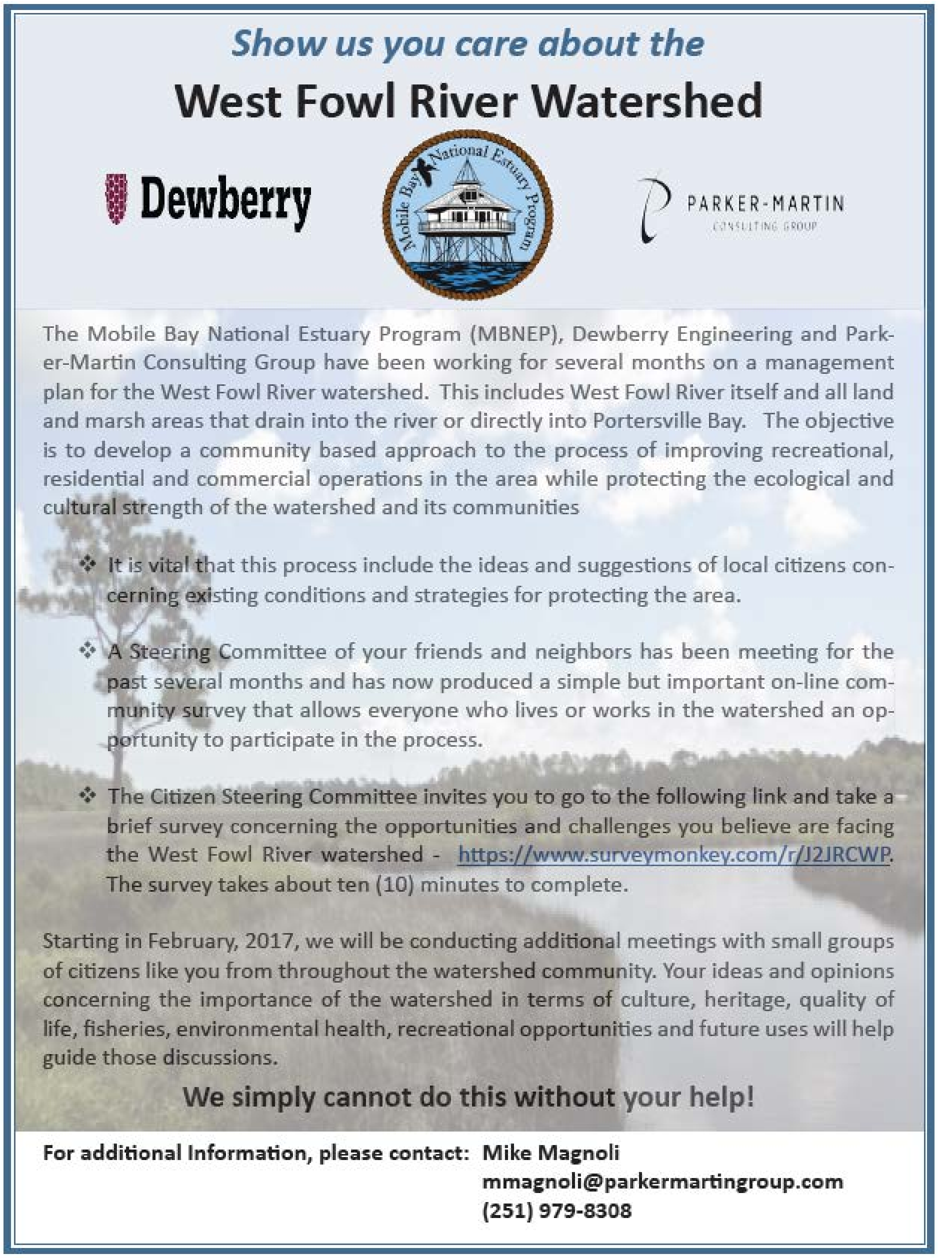
- Objective #1. Provide stakeholders with a thorough understanding of the concept of watershed management planning
- Objective #2. Explain the rationale and importance of a comprehensive West Fowl River watershed management plan
- Objective #3. Provide stakeholders with a voice concerning protection of the area's ecology and its ability to deal with future resilience issues
- Objective #4. Illustrate for stakeholders the importance and value of their pragmatic ideas and suggestions for protecting and preserving the watershed
- Objective #5. Build public ownership of the watershed to support potential future projects and actions

10.2 Audiences

The following subsets of stakeholders were identified, and specific outreach programs were designed for each stakeholder subset.

- **General Public:**
    - Those whose live in the watershed full time
    - Those whose own second homes in the watershed
- **Commercial and Business Community:**
    - Seafood Related Businesses (Harvesters/ Growers, Processors, Commercial Boat Owners, Retailers, Workers)
    - Boat/Shipbuilding Businesses
    - Other Businesses (Predominantly small retail)
- **Traditional Farmers:**
    - Cattle farmers
    - Second income farmers
- **Elected Officials:**
    - County officials
    - Municipal officials (no incorporated municipalities within the watershed)

Figure 10.1 Steering Committee watershed tour


Show us you care about the

West Fowl River Watershed

The Mobile Bay National Estuary Program (MBNEP), Dewberry Engineering and Parker-Martin Consulting Group have been working for several months on a management plan for the West Fowl River watershed. This includes West Fowl River itself and all land and marsh areas that drain into the river or directly into Portersville Bay. The objective is to develop a community based approach to the process of improving recreational, residential and commercial operations in the area while protecting the ecological and cultural strength of the watershed and its communities

- It is vital that this process include the ideas and suggestions of local citizens concerning existing conditions and strategies for protecting the area.
- A Steering Committee of your friends and neighbors has been meeting for the past several months and has now produced a simple but important on-line community survey that allows everyone who lives or works in the watershed an opportunity to participate in the process.
- The Citizen Steering Committee invites you to go to the following link and take a brief survey concerning the opportunities and challenges you believe are facing the West Fowl River watershed - https://www.surveymonkey.com/r/J2JRCWP. The survey takes about ten (10) minutes to complete.

Starting in February, 2017, we will be conducting additional meetings with small groups of citizens like you from throughout the watershed community. Your ideas and opinions concerning the importance of the watershed in terms of culture, heritage, quality of life, fisheries, environmental health, recreational opportunities and future uses will help guide those discussions.

We simply cannot do this without your help!

For additional Information, please contact: Mike Magnoli
mmagnoli@parkermartingroup.com
(251) 979-8308

Figure 10.2 Outreach Flyer

10.2.1 General Public

Substantial effort was made to involve the general public in all meetings that were held throughout the watershed.

- Public notices and announcements were posted on the Alabama Port Volunteer Fire Department roadside sign.
- Handouts were prepared and distributed through two retail stores in the watershed and at community gatherings at the Alabama Port Volunteer Fire Department and at the Coastal Response Center.

- Steering Committee members were encouraged to recruit other citizens as their guests for all watershed meetings
- Five local churches were contacted, information was provided to church leadership and congregants, and Survey Instruments were distributed to members to obtain their insights.
- The outreach team met one-on-one with citizens within the watershed to review the objectives of the study and obtain their feed-back and provide them with surveys instruments.

10.2.2 Business Community

The West Fowl River Watershed is home to a variety of business that are primarily water related such as shipbuilding in Bayou Coden as well as boat repair and various seafood harvesting and processing companies along the West Fowl River waterway and its tributaries. The Steering Committee had broad representation from each of these sectors.

Attempts to secure participation by Panenergy, Exxon-Mobile, and Williams natural gas companies were not successful.

10.2.3 Traditional Farming Community

Numerous efforts were made to reach the traditional farmers in the watershed. However, these are mostly small farmers for whom farming is a supplement to a salaried and more dependable than income. Input from this group of stakeholders was excellent in substance but was limited to one-on-one sessions.

10.2.4 Elected Officials

There are no incorporated municipalities within the West Fowl River Watershed, but Mobile County was very well represented at all public meetings and was invaluable in helping obtain support information.

10.2.5 Steering Committee

A West Fowl River Watershed Steering Committee was created, and it quickly became the engine behind the watershed study. Great care was given to selecting Steering Committee members from all major community subsets as well as from key resource agencies. Factors considered when identifying potential Steering Committee members included the following:

- Community leadership roles
- Centers of influence.
- Representatives of important population centers
- Ability to assist with the design of survey instruments that would be used to gauge stakeholder knowledge
- Ability to assist with citizen communications
- Ability to interpret study results and provide feedback
- Ability to identify and secure key community facilities for outreach meetings

- Ability to assist in planning and executing educational programs with the general public

The Steering Committee met several times during the course of the study and helped disseminate information and educational resources to their respective communities.

Table 10.1 West Fowl River Watershed Steering Committee Members

Committee Member	Organization
Douglas Ankersen	Oyster Farmer
Dorothy J. Beech	Homeowner
Chris Blankenship	Alabama Department of Conservation and Natural Resources (ADCNR)
Lori Bosarge	Homeowner and President, South Bay Community Alliance
Dr. Louis W. Buckalew	Homeowner
Patrick Burns	Chief, Alabama Port Vol. Fire Department
Michelle Clark	Oyster Farmer
Glenn Coffee	Homeowner and Environmental Activist
Chris Collier	Homeowner and Business Owner
Troy and Rebecca Cornelius	Oyster Farmer
Lorrie Dovin	Homeowner
Elizabeth Downing	Resident
Judy Haner	The Nature Conservancy
Connie Hamilton	Homeowner
Patric Harper	US Fish and Wildlife Service, Grand Bay Coastal Resources Center

Committee Member	Organization
Philip Hinesley	Alabama Department of Conservation and Natural Resources (ADCNR)
Johnny Johnson	Resident and Commercial Oyster Farmer
Regina Kollegger	Property Owner
Col. Roosevelt Lewis	Homeowner
Justin S. McDonald	USACE Mobile District
Shannon McGlynn	Alabama Department of Environmental Management (ADEM)
Christian Miller	MBNEP
Eliska Morgan	Alabama Gulf Coast Recovery Council
Cameron Morris	Dewberry
James Morris	Oyster Farmer and Crab Fisherman
David Rice	Master Boat Builders, Inc.
Dale Rivers	Resident
Tina Sanchez	Mobile County
Randy Shaneyfelt	Alabama Department of Environmental Management (ADEM)
Gregory Spies	Resident and Land Surveyor
Roberta Swann	MBNEP
Cheryl Ulrich	Dewberry

Committee Member	Organization
Dr. Bill Walton	Auburn University Shellfish Lab
Chris Warn	Environmental Science Associates
Col. Travis M. Wheeler	Resident
Dale Williams	Williams Fabrication
Estelle Wilson	Dewberry
Rosa Zirlott	Oyster Farmer
Victor Zirlott	Resident and Seafood Processor

Figure 10.3 West Fowl River Steering Committee Meeting Kick-Off

10.3 Messaging

All stakeholder meetings, whether group sessions or one-on-one discussions, were designed to introduce the importance and process of watershed planning, describe the specific elements of the watershed study, and encourage stakeholder participation.

Communications emphasized the critical nature of individual responsibility in protecting the quality and heritage of the West Fowl River Watershed and provided opportunity for feedback and inquiry.

10.3.1 Content

All messaging, whether delivered by audiovisual means, printed materials, public discussion or private discourse, was tied to the objectives stated in Section 10.1 above. Examples are provided below.

Objective #1. Provide stakeholders with a thorough understanding of the concept of watershed management planning

- Definition of watersheds
- Benefits of watershed planning (identifying strengths, weaknesses, opportunities and threats)
- The process of watershed planning with an emphasis on ultimate development of a West Fowl River Watershed Management Plan
- The critical role of community stakeholders in watershed studies with emphasis on their roles in the West Fowl River Watershed.

Objective #2. Explain the rationale and importance of a comprehensive West Fowl River watershed management plan

- The health and stability of the Mississippi Sound "complex," including the Grand Bay Swamp watershed, Bayou La Batre watershed, West Fowl River watershed and DI watershed, must be seen as more than just a sum of the individual parts
- The realization that what happens in one watershed directly impacts all of the Mississippi Sound watersheds.
- The Mobile Bay National Estuary Program is expediting coastal watershed management plans for the area because the findings and results of these studies will drive important future projects and funding decisions that could impact the ecology, future land use, protection and resilience of each watershed.
- Proper and functional watershed planning represents a complex network of activities between all groups of stakeholders.

Objective #3. Provide stakeholders with a voice concerning protection of the area's ecology and its ability to deal with future resilience issues

- Stakeholders have a vested interest in maintaining the ecology, beauty and diversity of the watershed for future generations

- It is important for Stakeholders to understand the specific techniques for protecting the West Fowl River watershed
- Controlling storm water runoff and even utilizing it as much as possible can create additional habitats within the watershed
- Stakeholders and other should anticipate changes in the ecology and structure of Dauphin Island in the futures and understand how those changes will impact the West Fowl River Watershed.
- Proper watershed planning must provide a basis for balancing environmental concerns with recreational demands, commercial interests and the interests of homeowners/residents

Objective #4. Illustrate for stakeholders the importance and value of their pragmatic ideas and suggestions for protecting and preserving the watershed

- Stakeholder input in other watersheds, including the Bayou La Batre Watershed, has influenced major decisions.
- Stakeholders often provide creative solutions to long-term habitat challenges that may have been overlooked by traditional scientific or political methods
- Stakeholder input will be critical to creating the public-private partnerships necessary for solving challenges within the watershed

Objective #5. Build public ownership of the watershed to support potential future projects and actions

- A comprehensive and balanced management plan for the West Fowl River Watershed will require informed and committed citizens.
- West Fowl River watershed stakeholders must actively pursue well designed management practices and participate directly in their implementation.

10.3.2 Format

Meeting formats were designed to maximize stakeholder input while providing access to scientific findings of the research teams. Agendas were prepared and distributed; information was shared with the audience; open discussion was encouraged; questions were addressed; and stakeholder surveys were completed and collected. Most public meetings lasted 1 to 1-1/2 hours. Every effort was made to engage the audiences and encourage feedback.

10.3.3 Public Announcements

Public participation in watershed meetings was encouraged using a variety of methods including:

- Large commercial signs posted at strategic intersections in the area
- Electronic notices
- Phone calls

10.3.4 Materials

A variety of materials were prepared for use during the various meetings and with stakeholder groups and individual stakeholders, including but not limited to:

- West Fowl River Watershed Project Description
- West Fowl River Watershed Maps (illustrating drainage, development and contours)
- Frequently Asked Questions Handout
- West Fowl River Watershed Stakeholder Survey Instruments (hard copies and on-line)
- List of West Fowl River Watershed Stakeholder Outreach and Engagement Steering Committee Members
- "We Are Listening" Handouts
- West Fowl River Watershed PowerPoint
- Agendas (for each public meeting)
- Sign-In Sheets (for small and large group meetings)
- Meeting Record Sheets (for one-on-one meetings)
- Maps of regional watersheds showing inter-relatedness
- Pictures of the area for publications and for PowerPoints
- West Fowl River Study Project Description Sheet
- Various other handouts as needed

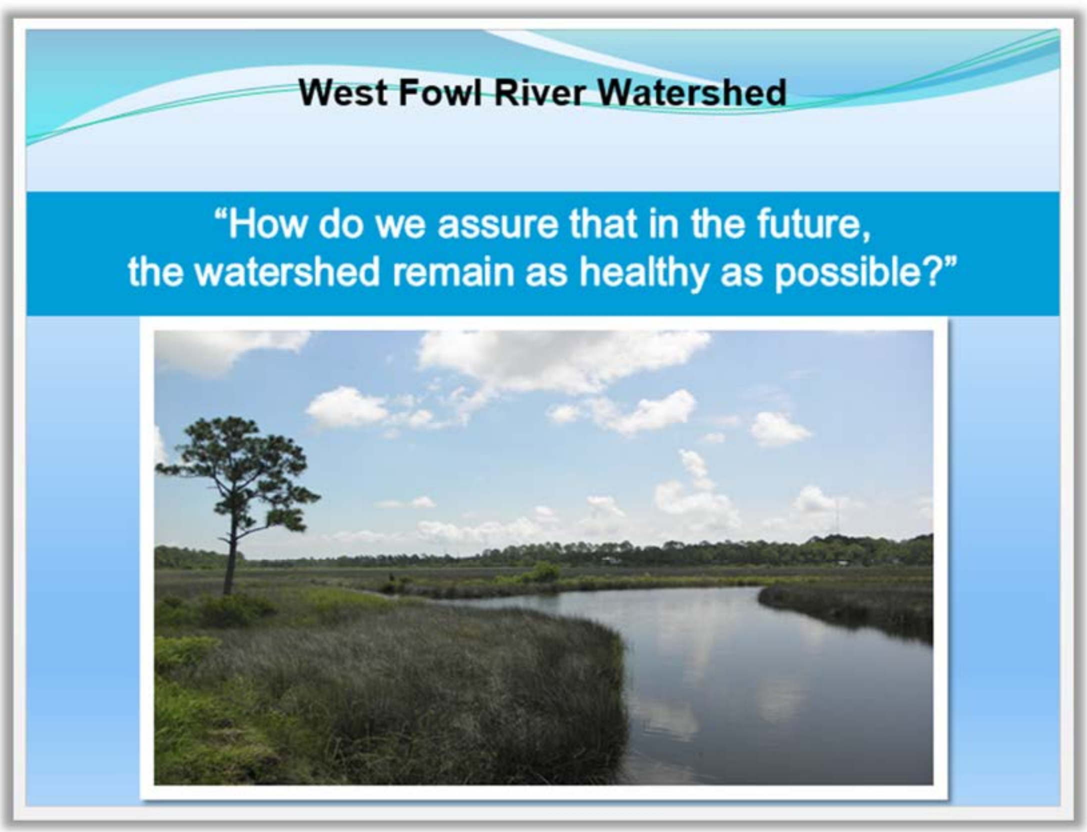


Figure 10.4 Outreach presentation material

10.4 Public Engagement Opportunities

A variety of different outreach methods were employed to engage the diverse subsets of stakeholders. Schedules of these outreach opportunities are provided below.

10.4.1 Community Stakeholder Workshop Programs

Numerous community outreach meetings were held to engage the public in the watershed planning process. **Table 10.2** provides a detailed list of those meetings.

Table 10.2 Community Stakeholder Workshop Programs

Date	Meeting Type	Location	People in Attendance	Highlights
August 4, 2016	Watershed Research Team Field Orientation	Various location throughout the watershed	11	Boat trip from Portersville Bay to upper West Fowl River. Van/ Car trip to key locations within the watershed.
August 4, 2016	WFR Steering Committee Kick-Off	Coden Response Center	25	Steering Committee and Resource Team members were introduced and an overview of the watershed study process was provided to assure that everyone understood the scope of the project and the methodology to be employed.
October 20, 2016	Steering Committee Meeting	Volunteer Fire Station in Alabama Port	26	The goal of the meeting was to review the initial watershed priority of issues and present plans for moving forward with the watershed characterization phase of the project.
April 20, 2017	Steering Committee Meeting	Volunteer Fire Station in Alabama Port	24	A detailed review all research efforts by the watershed study team was provided with special emphasis on issues related to water flow and biological issues within the West Fowl River waterway and Portersville Bay.

Date	Meeting Type	Location	People in Attendance	Highlights
May 16, 2018	West Fowl River Outreach Meeting	Catalina Seafood Restaurant in Bayou La Batre	40	Hosted by the Mobile County Conservation District. Informational meeting to facilitate cooperation among those who are in a position to advocate for practices and policies that will reduce further damage to the watershed and improve its water quality.

10.4.2 One-on-One Informational Sessions

A total of forty-nine (49) one-on-one sessions were conducted with watershed stakeholders who represented the following subsets:

- General Citizenry
- Asian Communities (Vietnamese, Cambodia, Laotian)
- Stakeholder Agency Representatives
- Watershed Business Owners/Operators
- Local church leaders
- Community Activists
- Healthcare Professionals and Advocates
- Owners of seafood operations
- Educators

10.4.3 Other Engagement and Informational Opportunities

Throughout the watershed study, numerous informal opportunities were employed to inform community stakeholders about the watershed study and especially the importance of individual responsibility to the health of the waterway.

Table 10.3 Additional Public Outreach Activities

Date	Activity
September 2016 – December 2017	Members of the community outreach team met one-on-one with residents of the watershed, owners of seafood companies, owners of small retail stores, representatives of public education and healthcare facilities to obtain their concerns and suggestions relative to the West Fowl River Watershed

Date	Activity
October 2016	During the month, a summary of Steering Committee Stakeholder Survey Responses was shared with the Steering Committee and other stakeholders, along with explanations and interpretations.
October 4, 2016	Conducted an orientation boat tour of West Fowl River and several of its tributaries for members of the Steering Committee and local citizens.
February 2017 – April 2017	The leadership of five churches in the watershed were contacted and arrangements made to deliver information concerning the watershed study and surveys for distribution to members of the church. In two cases, the team made presentations to the church members at the request of leadership. All results were collated and incorporated into the larger database of responses. The churches included: ♦ Coden Bible Church ♦ St. Mary's by the Sea ♦ St. Michael's Church ♦ Zirlott Road United Methodist ♦ Sweet Bethel Missionary Baptist Church
April 2017	The Outreach Team prepared Lucite counter displays and distributed them to three retail stores in the watershed. Printed materials were designed to announce the importance of public participation in the watershed study and invite readers to complete Stakeholder Surveys to provide their ideas and concerns relative to the watershed. The materials were entitled **"Show Us You Care About the WEST FOWL RIVER WATERSHED."** 190 flyers were distributed.
February 11, 2017	Participated in a boat tour of West Fowl River hosted by local citizens to identify primary sources of shoreline erosion from boat wave action and to research sites for future public access points.
April 2017 – July 2017	Distributed information by email and U.S. mail to three hundred sixty-nine stakeholder concerning activities and events related to the West Fowl River Watershed study and inviting them to Stakeholder/Steering Committee meeting. All were encouraged to provide their opinions and ideas by logging onto the Mobile Bay National Estuary Program website and complete a Stakeholder Survey.

Figure 10.5 Small Group Community hosted by the Mobile County Conservation District.

10.4.4 School Programs

The Outreach Team contacted teachers at Alba School and Bryant High School concerning the West Fowl River Watershed study and invited them and their students to attend specific community outreach meetings. The team also provided teachers with support materials and information concerning watershed studies in general for use in their classrooms.

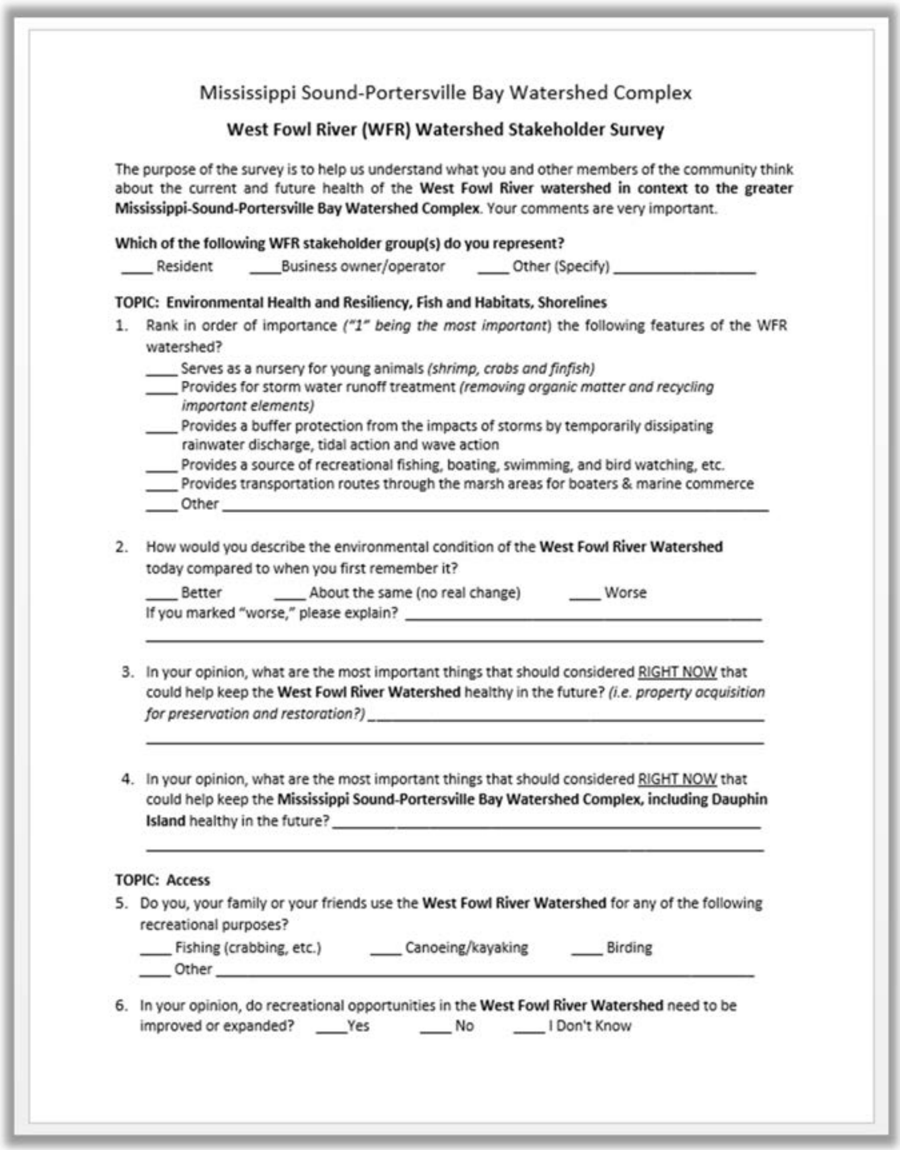
10.4.5 General Communications

In addition to one-on-one and group meetings, the Outreach Team engaged stakeholders via a regular schedule of correspondence including announcements, invitations to meetings, follow up reports from meetings, and information of special interest related to the watershed. Information was delivered electronically (email) when possible and by U.S. mail when necessary.

The South Mobile County Community Development Corporation provided an initial email and U.S.P.S. contact lists of interested residents in the West Fowl River Watershed and the list was expanded as meetings were held and additional stakeholders are identified.

10.5 Summary of Stakeholder Responses

Community participation was encouraged at public Steering Committee meetings, small group meetings (i.e. church and local non-profit meetings) and through more intimate one-on-one discussion sessions. In each of these cases, stakeholders were encouraged to complete questionnaires to identify their views and suggestions relative to the watershed. The local public was also invited and encouraged to access the Mobile Bay National Estuary Program website to participate in a survey related their interest and concerns relative to the West Fowl River Watershed.



Mississippi Sound-Portersville Bay Watershed Complex

West Fowl River (WFR) Watershed Stakeholder Survey

The purpose of the survey is to help us understand what you and other members of the community think about the current and future health of the **West Fowl River watershed in context to the greater Mississippi-Sound-Portersville Bay Watershed Complex**. Your comments are very important.

Which of the following WFR stakeholder group(s) do you represent?

____ Resident ____Business owner/operator ____ Other (Specify) ________________

TOPIC: Environmental Health and Resiliency, Fish and Habitats, Shorelines

1. Rank in order of importance (*"1" being the most important*) the following features of the WFR watershed?
   ____ Serves as a nursery for young animals *(shrimp, crabs and finfish)*
   ____ Provides for storm water runoff treatment *(removing organic matter and recycling important elements)*
   ____ Provides a buffer protection from the impacts of storms by temporarily dissipating rainwater discharge, tidal action and wave action
   ____ Provides a source of recreational fishing, boating, swimming, and bird watching, etc.
   ____ Provides transportation routes through the marsh areas for boaters & marine commerce
   ____ Other ____

2. How would you describe the environmental condition of the **West Fowl River Watershed** today compared to when you first remember it?
   ____ Better ____ About the same (no real change) ____ Worse
   If you marked "worse," please explain? ________________________________

3. In your opinion, what are the most important things that should considered RIGHT NOW that could help keep the **West Fowl River Watershed** healthy in the future? *(i.e. property acquisition for preservation and restoration?)* ________________________________

4. In your opinion, what are the most important things that should considered RIGHT NOW that could help keep the **Mississippi Sound-Portersville Bay Watershed Complex, including Dauphin Island** healthy in the future? ________________________________

TOPIC: Access

5. Do you, your family or your friends use the **West Fowl River Watershed** for any of the following recreational purposes?
   ____ Fishing (crabbing, etc.) ____ Canoeing/kayaking ____ Birding
   ____ Other ____

6. In your opinion, do recreational opportunities in the **West Fowl River Watershed** need to be improved or expanded? ____Yes ____ No ____ I Don't Know

Figure 10.6 Community Stakeholder Meeting, WFR Watershed Stakeholder Survey

All survey responses obtained, whether obtained in large group sessions or one-on-one, were collated and analyzed. The results reflect a substantial depth of understanding among stakeholders concerning the value and importance of the watershed and its intrinsic value to protecting the greater regional environment. Respondents also realized that the watershed was a vital nursery for fish and shellfish, and a great resource for helping the general public relate the beauty and diversity of this natural coastal habitat.

10.5.1 West Fowl River Watershed Stakeholder Survey Results

Provided below are the responses of one-hundred and thirty-six stakeholders who completed the West Fowl River Watershed Stakeholder Survey. (NOTE: It should be noted that not every stakeholder chose to respond to every question.)

- ❖ **Personal Descriptors**
  - Resident - 113
  - Property owner but not a resident - 10
  - Business owner/operator - 13

- ❖ **In your opinion, are the different ecosystems that exist in the West Fowl River Watershed (marshes, dunes, pine stands, beaches, etc.) important to the ecological health, commercial vitality, and community resiliency of the area?**
  - Yes - 121
  - No - 0
  - Don’t Know - 15

  If “yes”, please explain
  - Everything living is important for the longevity of the West Fowl River watershed; very fragile; very beautiful.
  - Marshes affect a lot of seafood; oysters live in the edges; beaches and dunes act as barriers.
  - Ecological stability affects jobs, quality of life, and health. Cleanliness of the living ecosystem is key to everything.
  - All affect each other.
  - We depend on a healthy watershed to make a living.
  - They provide a buffer for the mainland against tropical storms & hurricanes; serve as a buffer protecting shallow water habitats and serve as a source of energy to power biological functions.

- ❖ **Do you feel that these same ecosystems in the West Fowl River Watershed are also important to the ecological health, commercial vitality, and community resiliency of the entire Mississippi Sound-Portersville Bay Watershed Complex?**
  - Yes – 110
  - No - 0
  - Don’t Know - 26

If "yes," please explain

- They provide a buffer for the mainland against tropical storms & hurricanes; serve as a buffer protecting shallow water habitats and source of energy.
- Water pollution/silt doesn't stop at the end of our watershed.
- They are all related. What happens to one impacts the other in a chain reaction.
- Everything that happens in one watershed eventually effects the other.
- Serves as nursery to marine life that is commercially harvested in Mississippi Sound.

❖ **Rank in order of importance *("1" being the most important*) the following features of Alabama's coastal marsh areas as found in the Mississippi Sound-Portersville Bay Watershed Complex, including the West Fowl River Watershed.**

RESPONSE	Rank of Importance 1	2	3	4	5
• Serves as a nursery for young marine life	81	32	6	6	0
• Provides for storm water runoff treatment	0	45	16	12	0
• Provides buffer protection from impact of storms	60	24	24	13	0
• Provides source of recreational fishing, boating	30	34	36	3	3
• Provides transportation routes through marsh areas	0	11	40	12	33
• Source for ecotourism	33	10	19	9	31

❖ **How would you describe the environmental condition of the Mississippi Sound-Portersville Bay Watershed Complex, including the West Fowl River area, today compared to when you first remember it?**

- Better - 16
- About the same - 48
- Worse - 59

If "worse," please explain

- Seafood production has diminished significantly
- The sediment has increased substantially over the last 25 years. Significant erosion and a change in the water quality is obvious
- Marked decrease in bottom feeding marine life – oysters, crabs, etc. over the past 20 years.
- No more oyster beds, not as many shrimp or crabs.

❖ **In your opinion, do recreational opportunities in the Mississippi Sound-Portersville Bay Watershed Complex, including the West Fowl River area, need to be improved or expanded?**

- Yes - 58
- No - 29
- Don't Know - 45

If yes, please explain:

- Ecotourism is important to the economy of the area
- More free boat access is needed

- **What are the cultural, historic, or environmental sites or resources in the West Fowl River Watershed that deserve special protection? *(i.e. certain churches, cemeteries, dunes, shorelines, woodlands etc.)***
  - Waterways, bayous, wetland areas, marshes and wetlands left untouched. Man cannot do a better job. Forever Wild monies should be used to buy the more important or potentially threatened wetlands - 103
  - Wildlife - 91
  - Shorelines, erosion of banks in all areas – 26
  - Live oaks - 24
  - Heritage of seafood, fishermen and their families (possibly construct a museum) - 14
  - Indian shell mounds - 13
  - Railway and historical train tracks 3

- **In your opinion, what are the greatest threats to environmental management, planning and restoration of the West Fowl River Watershed and the combined Mississippi Sound-Portersville Bay Complex? (*i.e. community awareness of problems, managing development, conservation incentives, etc.)***

  - **West Fowl River Watershed: (listed highest to lowest)**
    - Lack of community support. Those that don't care and those that don't want to make any change to make it better.
    - Education and awareness.
    - Lack of appreciation by the state of the vulnerability of mainland coast
    - Lack of environmental planning
    - Pollution management
    - Funding (or lack of funding)
    - Discharges from Fowl River through the "narrows"
    - Overpopulation. Future commercial and residential developments
    - Septic tanks
    - Sea level rise
    - Wave action eroding shorelines. Sediment and runoff

  - **Combined Mississippi Sound-Portersville Bay Watershed Complex: (listed in numerical order highest to lowest)**
    - Awareness
    - Lack of funding
    - Lack of environmental planning
    - Man-made problems (i.e. ship channel dredging)
    - Continual erosion of Dauphin Island.
    - Overpopulation
    - Sewer discharge in shallow areas.
    - Erosion of marsh.
    - Sedimentation in shallow water areas.

- **In your opinion, what are the most important things we should consider doing RIGHT NOW that could help keep the Mississippi Sound-Portersville Bay Watershed Complex, including the West Fowl River Watershed, healthy in the future? *(i.e. property acquisition for preservation and restoration, etc.)***
  - Open the bottleneck (dredge) from Heron Bayou into Heron Bay; Open the bottlenecks in streams and bayous
  - Fix erosion of Dauphin Island (if Dauphin Island continues to erode, all other resources will be damaged or destroyed in the complex)
  - Conserve all wetlands
  - Expand sewer systems to include all residents
  - Pave all dirt roads
  - Create community organizations to work with county and state management agencies
  - Acquiring property
  - Do not allowing any more oil, gas lines to be developed
  - Better control water runoff
  - Control industrial pollution. Monitor commercial plant discharges in the watershed
  - Find out what changes have affected the availability of crabs, oysters and shrimp
  - Monitor salinity levels

- **Please provide any other comments, concerns, or suggestions you feel would benefit the gathering of information relative to the West Fowl River Watershed study.**
  - Make property owners responsible for the squatters in certain portions of the watershed who dump garbage and raw sewage into the waterways
  - Clean up the litter and garbage in certain areas
  - Dredge the oyster reefs as an attempt to rejuvenate them. Get the state to develop more oyster reefs.
  - Clarify roles of contractors, stakeholders, U.S./ State/ Local Government agencies who operate in the watershed
  - Consider land use planning and regulation changes to better control development.
  - Create additional recreational areas including campgrounds in pine lands similar to Meaher Park on the causeway
  - Consider connection of West Fowl River to Fowl River at the narrows to see if this creates a water quality problem
  - Continue to educate residents so they can be proactive in protecting the watershed and the ecosystem
  - Every step needs to be taken to protect the West Fowl River Watershed - the last of Alabama's most pristine wetlands.

10.5.2 Summary of West Fowl River Watershed Stakeholder Primary Concerns

Extrapolation of the data collected from West Fowl River Watershed Stakeholders, whether written or spoken is summarized in the following nine (9) concerns.

- The expanding residential population in the watershed will have negative potential environmental impacts unless appropriate construction and environmental protections are put in place

- The lack of respect for the natural environment by many residents paired with a lack of community support for the implementation of protection mechanisms
- A lack of on-going environmental education programs to enlighten the public (stakeholders) concerning the importance of the West Fowl River Watershed and encourage personal commitment to its protection
- A perceived lack of enforcement by political agencies for such issues as septic tank controls, runoff, erosion prevention and dumping
- A perceived lack of understanding by state agencies as to what is negatively impacting crabbing, oystering and fishing in the West Fowl River Watershed and what corrective actions should be implemented
- The need to expand access to the waterways but with appropriate environmental controls in place
- A perceived lack of funding and/or commitment to on-going research of the West Fowl River Watershed and the implementation of protective strategies
- A perceived lack of environmental planning in the West Fowl River Watershed on the part of any group or agency
- A perceived lack of understanding or concern by the state and the county for the problems faced by traditional and off-bottom oyster growers/harvesters

There is a pervasive realization among the stakeholders of the West Fowl River Watershed for state, federal or non-profit leadership to identify, evaluate and address threats to the ecological and economic components of the watershed. Residential and commercial stakeholders repeatedly expressed a willingness to commit themselves to preserving and protecting the watershed if appropriate partners will take the lead provide a reasonable plan for managing the watershed for the benefit of all.

10.6 Outreach Recommendations

10.6.1 Introduction and Purpose

This WMP provides additional outreach recommendations to be considered during implementation of the plan. Successful implementation of the WMP will be achieved through a partnership between the MBNEP, members of the West Fowl River Steering Committee, and the public. Consistent input from public stakeholders during the planning process identified ideas for addressing the environmental challenges facing the Watershed. Through public meetings, messaging, and other events, local residents have become invested in the restoration of the Watershed. With input from the MBNEP, the WMP Team presents the following Public Outreach Plan to establish a healthy dialogue between stakeholders in the Watershed and create and encourage investment in the restoration of this valuable natural resource.

10.6.2 Goals

The goals of the Public Outreach Plan are to:

- Inform, educate, and engage key stakeholders in an effort to increase public awareness of the benefits provided by the Watershed.

- Develop the public's sense of ownership of the Watershed, along with an understanding of the value of watershed resources to the community.
- Provide avenues for the public to contribute to the watershed restoration and preservation process, such as offering their visions for the watershed that involve aesthetic enhancement, recreational access, and improved water quality.
- Reduce the volume of trash in watershed through a cultural shift – where the community increasingly values the watershed as a natural resource that deserves protection and actively prevents trash from entering the river and its tributaries.
- Explore additional techniques and opportunities for public involvement.

10.6.3 General Messaging

To achieve the goals outlined in **Section 10.6.2**, the following statements were developed to use as cohesive messages for all types of stakeholders. For instance, project handouts or talking points include the project vision statement, the definition of success, or the tag line. The benefit of this approach is delivery of a consistent message to the public. The information below will equip the WMP Team, MBNEP, and members of the Steering Committee with common messages for dissemination.

- **Vision**: *To transform the river and its watershed into a healthy and vibrant community amenity that supports a robust habitat; provides increased public access; serves as an economic engine supporting the seafood and shipbuilding industries and ecotourism; and celebrates and preserves the rich culture and heritage of the area.*

- **Success**: The definition of success would be a transformed river and watershed that preserves habitat and open space, has improved water quality, provides more recreational opportunities, and is more resilient to storms and sea level rise.

Challenges to the West Fowl River Restoration and Preservation

- Negative effects of stormwater runoff – including abundance of trash
- Negative impacts to water quality, particularly from pathogens
- Abundance of invasive species
- Limited public access
- Property acquisition needs
- Lack of an independent organization to lead and manage restoration efforts

Beneficial Impacts from Restoration and Preservation of the West Fowl River

- Monetary:
    - Increased residential and commercial property values
    - Restoration of a cultural destination that celebrates a unique history, attracts visitors, and increases economic opportunities
    - Improved habitats for sustainable fisheries to support local economy

- Health:
  - Improved water quality with less trash
  - Improved fish and wildlife health, resulting in improved community health and increased civic pride
  - Greenway and blueway trails for recreation
  - More open space and access for recreation
- Security:
  - Less exposure and risk to storm events and sea level rise
  - County services and emergency services in more secure areas
  - A more resilient community!

10.6.4 Partnering Together During Implementation

Engagement is an essential component of ongoing restoration and preservation activities and should not end after the publication of the WMP. This planning effort represents an opportunity for intertwining environmental protection with community development. Moving forward, the West Fowl River Watershed restoration and preservation engagement should center on the following principles:

- Involve
- Engage
- Educate
- Own

Involve

As a result of the efforts developing the WMP (i.e., public meetings, outreach efforts, etc.), momentum has built for restoration and preservation of the West Fowl River watershed. The existing Steering Committee structure provides an array of local leaders who have been actively involved throughout this planning process, and their continued involvement will be extremely beneficial in implementing this WMP. New organizations and businesses should also be identified and recruited to share in the Watershed restoration activities.

Engage

The WMP provides ideas and opportunities for stakeholders to become more actively engaged in restoration efforts and allows stakeholders to see where they might fit in with restoration. The WMP Team has strived to get stakeholders engaged in the planning process, and that momentum should be maintained so there is continued excitement for what the Watershed offers and can become.

Educate

Education is critical to continue building the current momentum towards Watershed restoration. Education extends beyond school curriculum opportunities; it involves educating all stakeholders (i.e., local officials, private industry, grassroots organizations, and citizens) to increase awareness about Watershed challenges and solutions and foster new attitudes, motivations, and stakeholder commitments.

Evaluating outreach efforts, particularly education, provides a feedback mechanism for continuous improvement. As part of any future education endeavors, building in an evaluation component from the beginning will ensure some feedback on the impact of the outreach program.

Own

To achieve success, Watershed restoration and preservation must become an initiative rooted within the community. The MBNEP has led by initiating and driving the development of the West Fowl River WMP, engaging a wide variety of stakeholders, and working to make the community vision of the watershed a reality. The MBNEP must pass the West Fowl River Watershed restoration and preservation "torch" to an independent organization solely focused on this effort.

10.6.4.1 Target Audiences During WMP Implementation

The MBNEP and the WMP Team have targeted specific community stakeholders to become leaders in the West Fowl River restoration and preservation. This section identifies these target audiences, describes how WMP implementation will address different values important to each, and identifies appropriate initiatives for each target audience to lead.

The targeted primary audience includes those stakeholders who have the ability to make changes, whether through regulation or policy, participation in restoration activities, management of stormwater runoff, or communication of the West Fowl River Watershed restoration message. This audience includes:

- Local government officials (e.g., Mobile County Commissioners and other regional administrators)
- Private industry
- Academia
- Local resource managers (e.g., utilities, BLB Utility Board, etc.)
- Media (newspaper, radio, TV, and online)
- Community leaders

10.6.4.2 Targeted Audiences - Messaging & Tailored Implementation Initiatives

This section includes particular messages to communicate to important audiences within the Watershed and suggested initiatives to encourage action by these targeted audiences:

- **Local Government Officials** - Local elected officials and their staffs are responsible for establishing priorities for local programs, developing policy, and setting annual budgets. These roles can influence the scale and direction of the West Fowl River

Watershed restoration and preservation. The targeted value message for this stakeholder group is:

The WMP will provide local government officials with a vision to unify the communities in the West Fowl River Watershed around a concept – restoring and preserving the West Fowl River Watershed will revitalize the local community and provide access to a historical and productive waterway. The WMP also provides the necessary information to guide wise decisions related to recreational access and economic development, while ensuring protection of environmental resources.

Local County Officials can*:*

- Review and adopt the West Fowl River Watershed Management Plan (Mobile County Board of County Commissioners).
- Make implementation of WMP recommendations priorities for county planning.
- Ensure stricter enforcement of regulations related to littering and policing of frontage areas.
- Implement short-term and log-term strategies as suggested in Section 7.
- Facilitate the review and approval of permits associated with the proposed WMP BMPs in a timely manner.
- Consider the establishment of an overlay district within the Watershed area to channel a portion of taxes generated by local industry to Watershed restoration.
- Work with state and federal agencies to align projects and priorities.
- Explore a local disposable bag fee. This would entail passing legislation requiring all businesses selling food and/or alcohol to charge customers five cents for each disposable plastic bag. The businesses would retain one cent per bag and the remaining four cents would be put in a fund for the West Fowl River restoration and maintenance, implementation of watershed education programs, trash collection, and retention projects, and distribution of reusable bags. Several cities have implemented this policy (e.g., Washington, DC's Anacostia River Cleanup and Protection Act initiative - "Skip a Bag, Save the Creek"). The initiative would incentivize the use of reusable bags and aid in litter removal and education.
- Investigate opportunities to foster watershed community pride.
- Examine funding watershed signage:
  - Historical and cultural signage – post signs documenting specific moments in history and the role the River played (i.e., Historic activities, biographies of local historical figures, or other uses).
  - "Positive" ownership signs – positively connect residents with the West Fowl River watershed (e.g., "Keep Our Bayous and River Clean" or "Create a Clean Water Future") rather than "Don't Litter."
  - Visual ways to explain the benefits of the River and share the biological richness of the Watershed with people.
- Host events (e.g., 5k races, public health fairs) at locations in the Watershed to celebrate the venue while promoting fitness, health, and community among area residents.

- **Private Industry –** Success is more likely with a broad range of financial supporters. Thinking innovatively and demonstrating support from an active and diverse group of private stakeholders will attract and match sources of federal, state, and local funding.

Major institutions along the River should be motivated to support its restoration because:

- All businesses near the River will benefit from its restoration and preservation.
- Business owners, employees, and citizens will enjoy improved surroundings that will create a better living environment and increase satisfaction and pride in their community.
- Businesses can enhance their public image by demonstrating support for restoring a local resource.

The targeted value message for this stakeholder group is:

The WMP recommends engagement opportunities for private industry in the implementation of projects to support their surrounding community, local workforce, and economy, while promoting their company image and goodwill.

Private industry can:

- Seize opportunities to become involved in recommended action items (see **Section 7**) near their businesses. For example, property owners along Shell Belt and Coden Belt Roads can work with the County to beautify the roadway near their properties and encourage the development of a multi-user trail. Parts of commercial property that are not used for operations can be landscaped with native habitat to help soften commercial areas with landscaping pockets. This benefits not only habitat and water quality, but attracts ecotourism to bolster the economy.
- Fund components of other recommended BMPs throughout the Watershed.
- Highlight sponsorship information on signs or plaques.
- Donate materials for trail development (e.g., local nurseries, landscapers, boat launches, and landscape architects donating materials and planting native plants along the trail).
- Provide construction services and equipment for project implementation.
- Build partnerships with the MBNEP and non-government organizations to become more engaged and learn about other ways they can participate in Watershed restoration.

- **Academia** – Local schools and regional institutions of higher education provide opportunities to inform students about issues in their own backyards. Teachers and instructors can introduce their students to WMP concepts (e.g., dynamics and impacts of littering, stormwater management benefits, and water quality impairments). The targeted value message for this stakeholder group is:

The WMP presents extensive scientific and technical data about the current status of the West Fowl River Watershed and measures to improve conditions that can be utilized as educational *tools for all levels of curriculum. The WMP also identifies data gaps that can provide opportunities for academic fieldwork that benefits local resources.*

Academic institutions can:

- Develop multiple curriculums for grades K-12 and beyond.
- Create grade school field trip opportunities to the River and its tributaries.
- Identify research and implementation opportunities, including fieldwork and data collection with relevant departments at local colleges and universities. Include restoration initiatives in their curricula when possible.

➢ **Area Resource Managers** – Area resource managers provide services to the Mobile County residents, including water supply and wastewater treatment. These managers can assist in guiding water quantity and quality management within the Watershed. The targeted value message for this stakeholder group is:

The WMP recommends actions that can be taken to improve water quantity and quality for the West Fowl River Watershed, such as reducing stormwater pollutants, eliminating sanitary sewer overflows, reducing the amount of trash in waterways, and increasing the public's understanding of human impacts on water resources.

Local resource managers can:

- Continue efforts to eliminate illicit wastewater connections and sanitary sewer overflows into groundwater, creeks, and tributaries within the Watershed.
- Maintain their involvement in Watershed restoration efforts.

➢ **Media** – Newspapers, television news programs, online news sources, and radio stations are significant sources of information for the public. The targeted value message for this stakeholder group is:

The WMP provides the background to a story of possibility for the communities in the West Fowl River Watershed and a vision supported by the public to revitalize the area and provide access for all residents to a beautiful natural resource within Southern Mobile County.

Local media can:

- Publish stories that highlight the WMP and its recommended actions.
- Create a news series describing developments of the West Fowl River Watershed restoration and preservation post-WMP.
- Advertise any cleanup or anti-littering events and/or campaigns.
- Highlight involvement of local leaders in the West Fowl River Watershed restoration and preservation.

Community Leaders (neighborhood associations, community action groups, faith-based organizations, residents, etc.) – Community leaders play a vital role in improving

Watershed conditions through actions such as litter reduction campaigns, sharing restoration ideas, and demanding that elected officials prioritize Watershed restoration. The targeted value message for this stakeholder group is:

The WMP represents a community-based approach to protect water quality, habitat, and living resources of the West Fowl River watershed with the goals of improving recreational opportunities, beautifying the area, and highlighting historical and cultural aspects of the watershed.

Community leaders can:

- Host/co-host cleanup events.
- Work to create and launch neighborhood anti-littering campaigns.
- Promote the river as a neighborhood location for recreational activities (e.g., walks/runs for charity, kayak/canoe clean-up events).
- Educate residents on the benefits of restoration to their properties.
- Demand that elected officials prioritize Watershed restoration and preservation.

10.6.4.3 Future Leadership Structure – West Fowl River Watershed Partnership

The MBNEP and the WMP Team have already identified and involved many key community leaders in this project; therefore, the concept is not to identify additional leaders to engage, but rather, how to structure the existing group moving forward. While the MBNEP has led the effort to initiate the restoration of the Watershed, future efforts and project implementation must be rooted within the community.

The mission of the MBNEP is to promote wise stewardship of water quality and living resources of the Mobile Bay area. The West Fowl River Watershed is a part of this area. In order to support its mission and its role in the community, the MBNEP chooses to promote watershed planning, hence the development of this WMP. The MBNEP recognizes the critical importance of restoring the Watershed, but an independent leadership organization is needed to coordinate WMP implementation in close collaboration with the MBNEP.

Suggestions for West Fowl River Watershed Partnership initiatives:

- Develop a vision, mission, bylaws, and leadership structure based on current Watershed restoration involvement.
- Work with local governmental officials and regulators to implement the recommended WMP projects.
- Provide opportunities for public involvement (i.e. cleanup events) and membership.
- Organize and coordinate the training of volunteer Estuary Coordinators on a wide variety of environmental topics (e.g., water quality monitoring and data collection training) and utilize their skills for various watershed efforts.
- Host meetings with community groups and other neighborhood associations to equip them with knowledge and materials for creating anti-littering campaigns and for

hosting their own cleanup events. The MBNEP should advertise itself as a resource for planning purposes and materials.

- Collaborate with citizen groups like Alabama Water Watch, to promote stewardship efforts in restoring the Watershed. This citizen volunteer water quality-monitoring program addresses water quality issues for both urban and rural watersheds throughout Alabama through citizen-based action enabling people to gather their own environmental data to address local issues.
- Promote the Watershed as a location for recreational activities (e.g., walks/runs for charity, kayak/canoe cleanup events).
- Hold recurring meetings with area media professionals (e.g., The Mobile Press-Register, Lagniappe, other publications, and local television news programs) to educate them about watershed management; provide information on events, pictures, and other descriptive materials; and update them on new developments and opportunities for public engagement.
- Generate media releases once a month on Watershed activity.

11 Monitoring Program

The monitoring program is designed to assess and document the overall health of the West Fowl River Watershed, while providing a quantitative method that helps to establish trends intended to identify successes and failures of the implemented management program. The monitoring program is designed to assess the entirety of the study area in a time and cost efficient manner, while also providing sufficient and concise data, which is necessary to identify possible sources and localities contributing to current and future water quality degradation within the Watershed.

The monitoring program should incorporate the outlined framework identified in the *Mobile Bay Subwatershed Restoration Monitoring Framework* (**Appendix E**) as recommended by the MBNEP's Science Advisory Committee: Monitoring Working Group, 2015. This document identifies sampling protocols for sedimentation and flow, water quality, habitats and biological communities. It also makes recommendations on desired outcomes, efficiencies, and data utilization and storage.

11.1 Monitoring

Following approval of the Watershed Management Plan, the WPIT, under direction of the watershed coordinator, should implement a monitoring program that should be performed by qualified professionals in accordance with the *Mobile Bay Subwatershed Restoration Monitoring Framework,* and state and federal Standard Operation Procedures (SOPs). The monitoring events will include quantitative measures and collection for chemical analysis of analytes (**Section 11.1.0**) contributing to the identified and to unidentified water quality issues. Monitoring events should be conducted during similar time periods and environmental conditions each quarter to promote consistency of collected data. Permanent monitoring stations should be established and identified (**Section 11.3**) to further assure consistency over the life of the monitoring and management program. Furthermore, the monitoring program shall also consider coordination and support of Auburn University Shellfish Laboratory's water quality monitoring efforts to support fisheries restoration and management, and aquaculture activities. This coordination and support should result in additional monitoring stations that would be incorporated into the Mobile Bay National Estuary Program My Mobile Bay website, http://www.mymobilebay.com/, network of environmental monitoring stations.

A biological assessment should be conducted concurrently (**Section 11.2.1**) with the water quality monitoring program to further assess the overall health of the West Fowl River Watershed. The biological assessment component should provide an additional tool in identifying the successes and failures of the management program.

A shoreline assessment within the watershed monitoring program study area should be conducted to observe and document the successes and failures of the living shoreline restoration programs designed to reduce coastal erosion and increase coastal marsh communities.

Data collected during the monitoring program will be compiled, analyzed, and presented to all local, state, and federal agencies involved in the management program. The Annual Report will include a discussion, analysis and presentation of all data gathered in conjunction with the quarterly monitoring program. All data and reports will be provided annually to all involved agencies as paper and electronic copies. An interactive Geographic Information Systems (GIS) dataset should be compiled and developed to facilitate electronic mapping and data query.

11.2 Watershed Conditions and Analytical Parameters

The conditions of the Watershed can be assessed through the quarterly monitoring program. Quarterly monitoring will involve the collection and analysis of the following water quality parameters: Sediment loading and turbidity (**Section 11.2.2**), total nitrogen (**Section 11.2.3**), dissolved inorganic nitrogen (**Section 10.2.4**), total phosphorus (**Section 11.2.5**), dissolved inorganic phosphorus (**Section 11.2.6**), chlorophyll-a (**Section 11.2.7**), bacteria (**Section 11.2.9**), total organic carbon (**Section 11.2.11**), and metals (**Section 11.2.12**). Additionally, standard field parameters (**Section 11.2.1**) will be measured at each monitoring station, including dissolved oxygen, pH, conductivity, and temperature. At locations where there is sufficient water depth, data collection of dissolved oxygen, salinity and temperature should occur at varying water levels to produce a depth profile of existing conditions (**Section 11.2.8**). Observation of coastal shoreline conditions should also be conducted during monitoring (**Section 11.2.13**) and include comparative photographs and aerial photointerpretation of Digital Orthographic Quarter Quadrangles (DOQQs) as available to assess erosion and sedimentation.

11.2.1 Standard Field Parameters

Standard field parameters are basic *in situ* measurements of parameters that should be conducted concurrently with sampling of all other laboratory analytical parameters described in **Section 11.2**. These parameters should, at a minimum, include measurements of temperature, dissolved oxygen, pH, specific conductance, salinity, and turbidity.

11.2.2 Sediment Loading and Turbidity

Sedimentation is a natural part of aquatic ecosystems, but the quantity and composition of the sediment can have a variety of effects on the integrity of the ecosystem. Excessive suspended sediment can create turbid plumes of discolored water, as well as significant deposition in downgradient locations from the source. The suspended sediment can have a variety of biological effects on fish, invertebrates, and aquatic vegetation. Anthropogenic sources of sediment and turbidity include agriculture, livestock, channels, eroded embankments, logging, construction, landslides, prescribed burning and overburden spoil cells. Locations of potential sources should be identified and proper management activities should be initiated to prevent excessive sedimentation in aquatic ecosystems. Quarterly monitoring should provide a means to identify contributing sources.

11.2.3 Total Nitrogen

Total nitrogen includes important compounds and elements for living organisms. Nutrients are considered elements that are essential to plant growth. Many anthropogenic and natural processes can produce various forms of nitrogen compounds. These processes can contribute to excess concentrations of nitrogen compounds in waterbodies and waterways. Excess amounts of nitrogen compounds can lead to depleted dissolved oxygen levels, which may have varying degrees of stress on the impacted ecosystem. Total nitrogen is the sum of total Kjeldahl nitrogen and nitrate-nitrite. Total nitrogen can be calculated by measuring organic nitrogen, free-ammonia, and nitrate-nitrite individually, and adding the components together. Quarterly monitoring should provide a means to identify contributing sources.

11.2.4 Dissolved Inorganic Nitrogen

Nutrients are considered elements that are essential to plant growth. Nitrogen is considered a limiting nutrient in aquatic ecosystems. Dissolved inorganic nitrogen is commonly reported as the sum of nitrite, nitrate and ammonia. Nitrite, nitrate and ammonia can have adverse effects on water quality and in certain concentrations, can be toxic to aquatic organisms. Primary production can be affected by the access presence of dissolved inorganic nitrogen and can drive the accumulation of algal and plant biomass. An anthropogenic source of nitrogen includes water treatment effluents, industrial effluents, municipalities, agriculture, pasture and rangeland, septic systems and residential lots. Locations of potential sources should be identified and proper management activities should be initiated to prevent the introduction of excess dissolved inorganic nitrogen into aquatic ecosystems. Quarterly monitoring should provide a means to identify contributing sources.

11.2.5 Total Phosphorus

Like nitrogen, phosphorus is considered a limiting nutrient in aquatic ecosystems. Many anthropogenic and natural processes can produce various forms of phosphorus compounds. These processes can contribute to excess concentrations of phosphorus compounds in waterbodies and waterways. Excess amounts of phosphorus compounds can lead to depleted dissolved oxygen levels, which may have varying degrees of stress on the impacted ecosystem. Total phosphorus is calculated using a series of laboratory techniques. Quarterly monitoring should provide a means to identify contributing sources.

11.2.6 Dissolved Inorganic Phosphorus

Nutrients are considered elements that are essential to plant growth. Phosphorus is considered a limiting nutrient in aquatic ecosystems. Dissolved Inorganic Phosphorus is a form of phosphorus that is necessary for plant growth. Sources of inorganic phosphorus include soil, rocks, fertilizers, and disturbed lands. Anthropogenic sources are primarily agricultural. Locations of potential sources should be identified and proper management activities should be initiated to prevent the introduction of excess DIP into aquatic ecosystems. Quarterly monitoring should provide a means to identify contributing sources.

11.2.7 Chlorophyll-a

Chlorophyll-a is a plant pigment produced by algae. Chlorophyll-a is an indirect measure of the ability for vegetation to utilize available nutrients. Quantitative analysis for the presence of Chlorophyll-a is a common method for quantifying algal biomass. Tracking the concertation of chlorophyll-a within the Watershed should provide insight into whether management techniques are adequately limiting the amount of nutrients entering the Watershed. Quarterly monitoring should provide a means to identify contributing sources.

11.2.8 Dissolved Oxygen, Salinity, and Temperature Profiling

Dissolved oxygen, salinity, and temperature are considered standard field parameters and have already been discussed in **Section 11.2.1**. In situ measurements of these parameters should be conducted at specific depth intervals at select monitoring locations concurrently with all other quarterly monitoring activities. Conducting depth interval monitoring will provide a water quality profile and allow for analysis of stratification layers within aquatic ecosystems in the West Fowl River Watershed. Water quality profiling will provide an additional tool for further evaluation of the health of the entire Watershed.

11.2.9 Bacteria

Bacteria are naturally present in healthy aquatic ecosystems and are a crucial contributor to the nitrogen cycle that is vital to the life of organisms. The type of bacteria species and concentration of bacteria present in an aquatic ecosystem vary and are dependent on limiting factors, such as nutrient concentration. Anthropogenic sources of bacteria can include birds, cattle and various other wildlife that are utilizing resources within the watershed area of a particular aquatic ecosystem. Excessive levels of bacteria can indicate elevated nutrient concentrations while diminished bacteria levels can indicate an unhealthy ecosystem. Locations of potential sources should be identified and proper management activities should be initiated to prevent the introduction of unhealthy bacteria species and excessive or diminished bacteria concentration into aquatic ecosystems. Quarterly monitoring should provide a means to identify contributing sources.

11.2.10 Biological Assessments

Biological assessments assist in evaluating the health of aquatic ecosystems by observing stressors that may contribute to short term and long term effects that cannot be assessed strictly by water quality monitoring. Biological assessments should be conducted using state or federally approved standards for assessing aquatic organisms, such as the EPA approved Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish. Biological assessments should be conducted at the water quality sampling locations (**Figure 11.3**) established by the Alabama Department of Environmental Management (ADEM). The biological assessment will be a critical component in determining whether the goals of the WMP are being successfully met through the management activities established in the WMP.

11.2.11 Total Organic Carbon

Organic carbon consists of compounds that are naturally present in typical aquatic ecosystems. Sources of organic carbon originate from natural organic matter and from anthropogenic sources. Organic carbon originating from anthropogenic sources can create conditions where concentrations can be present at levels exceeding typical background values. Sources of organic carbons include petroleum based chemicals and pesticides. Elevated organic carbon may promote excessive algae growth and reduced dissolved oxygen concentrations. Locations of potential sources should be identified and proper management activities should be initiated to prevent the introduction of excess organic carbon into aquatic ecosystems. Quarterly monitoring of total organic carbon should provide a means to identify contributing sources.

11.2.12 Metals

Metals in the environment can derive from both natural and anthropogenic sources. Some metals are common and can be essential nutrients to aquatic organisms. While some metals are necessary for survival, all metals have the ability to be toxic at particular concentrations. Metals present in toxic concentrations can have adverse effects on the survival, reproduction, and behavior of aquatic organisms. Metals commonly present in water bodies that may cause adverse effects include arsenic, cadmium, chromium, lead, inorganic mercury, nickel, selenium and zinc. Anthropogenic sources of metals can include mines, firing ranges, waste treatment facility outfalls, various industrial activities, urban runoff, landfills, and junkyards. Locations of potential sources should be identified and proper management activities should be initiated to prevent the introduction of unnatural sources of metal into aquatic ecosystems. Quarterly monitoring should provide a means to identify contributing sources.

11.2.13 Coastline Assessment

Coastline habitats serve as nursery habitat for coastal finfish and shellfish (such as speckled seatrout, redfish, Atlantic croaker, shrimp, and blue crabs). Proposed restoration programs discussed in **Chapter 6** are designed to restore the growth of coastal marsh by employing living shoreline techniques that utilize natural and/or artificial breakwater material to dampen wave energy to protect shorelines, while also providing habitat and increasing benthic secondary productivity. Construction activities for the proposed ecosystem restoration will involve living shoreline projects that include placement of intertidal breakwater materials. Assessment of these programs should be included within the monitoring program to assure that management techniques are achieving their intended goals and objectives. Additional erosional areas of shoreline should be observed and documented for future consideration in restoration programs. Assessments can be conducted by establishing permeant photo stations. Photographs should be taken periodically in the same orientation as those taken during previous monitoring events. Historical, current, and future DOQQ imagery can also be used to analyze erosional and depositional areas along the shoreline.

11.3 Sample Collections Locations

The monitoring program is designed to assess the entirety of the West Fowl River Watershed in an efficient manner and therefore, sampling locations were strategically identified and selected to provide a detailed analysis of the integrity of the entire Watershed. Two (2) monitoring stations were established by Alabama Department of Environmental Management (ADEM) and will continue to be monitored as part of the monitoring program. Six (6) additional monitoring stations have been established as part of the volunteer monitoring program discussed in **Section 11.5**. All 8 monitoring locations are presented in **Table 11.1** and include the Sample ID and the Geographic Position (Latitude/Longitude) of each sampling location.

Table 11.1 Sample Collection Locations

Geographic Position		
Sample ID	**Latitude**	**Longitude**
ADEM Station WFRM-2	30.37625	-88.15639
ADEM Station FRBM-1	30.35590	-88.19650
Volunteer Station #1	30.394091	-88.14995
Volunteer Station #2	30.38909	-88.13641
Volunteer Station #3	30.360864	-88.14313
Volunteer Station #4	30.382648	-88.23767
Volunteer Station #5	30.378000	-88.21017
Volunteer Station #6	30.378363	-88.18878

A location map depicting the location of the sample collection locations are included as **Figure 11.1** ADEM Monitoring Stations and **Figure 11.2** Volunteer Monitoring Stations.

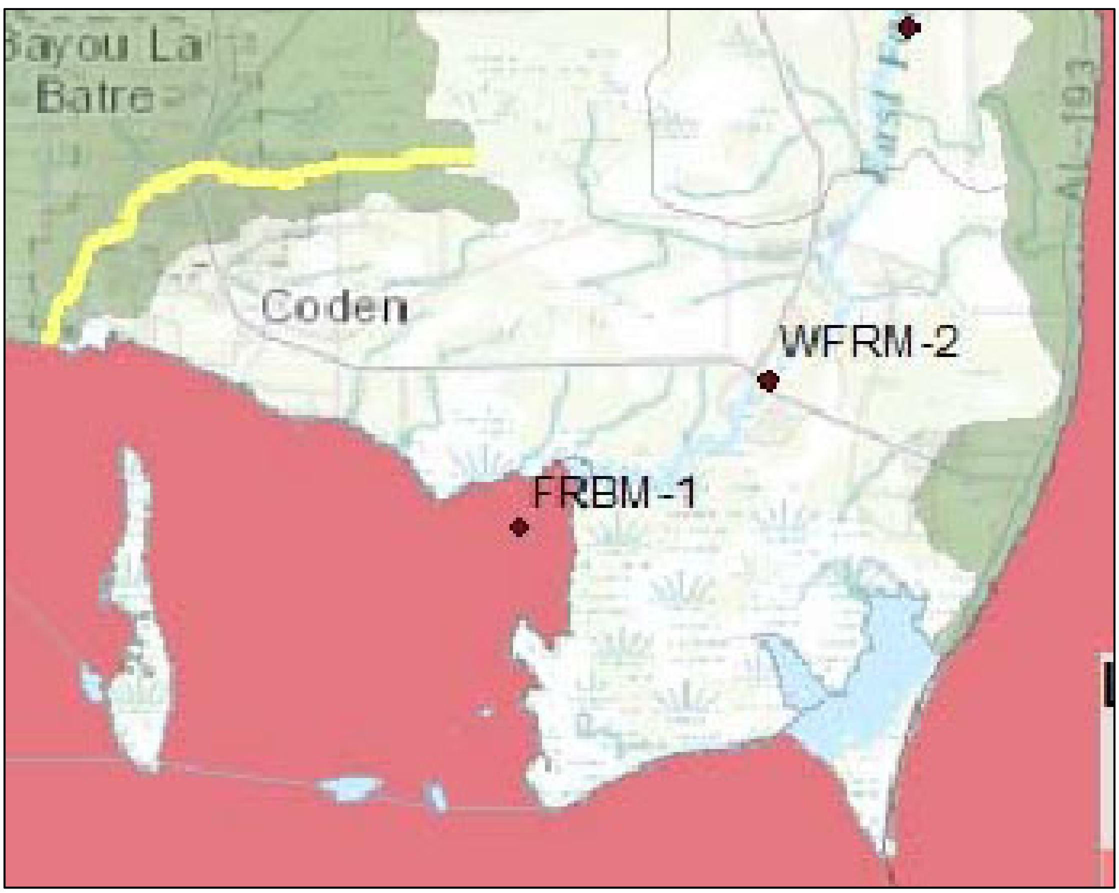


Figure 11.1 ADEM Monitoring Stations (source 2013 CWMP: Fowl River Sub-Estuary Report)

Figure 11.2 Volunteer Monitoring Stations

11.4 Implementation Schedule

The implementation schedule for the WMP should be prepared and maintained by the WPIT. The schedule should provide a detailed breakdown of the scope of work addressing every major and minor component of the watershed-monitoring program. The schedule should provide a clear timeline for completion of each program measurement. The schedule should include projected initiation and completion dates for each measure, and the personnel responsible for delivery of the task. Direction and timeline for submittal of data should be included. The implementation schedule should be reviewed annually and adjusted as necessary. The schedule will serve as an important resource in assessing the status and success of the monitoring program.

11.5 Stakeholder Volunteer Monitoring Program

Two important components of WMP implementation are monitoring and citizen engagement. Monitoring is recommended to continue to document the condition of the Watershed and track the success or failure of implemented planning strategies. Stakeholder participation is important as engaged citizens can assist and support WMP implementation. One way to combine these two important components is to create a volunteer monitoring program. The goal(s) of the monitoring program should be defined based on potential or known threats to water quality identified in this WMP. Benefits of a volunteer monitoring plan include:

- Empowering stakeholders to use monitoring data for education, restoration and protection and advocacy.
- Fun and meaningful volunteerism that fosters stewardship and a sense of community ownership within the Watershed.
- A well-planned monitoring program may uncover previously unknown water quality problems and help answer important questions to shape solutions.

In order for citizen data to be credible and respected, it needs to be accepted by federal and state agencies. Fortunately, Alabama has a statewide volunteer water quality organization with an Environmental Protection Agency approved Quality Assurance Plan: Alabama Water Watch. The WPIT should create or partner with an existing watershed organization to form a volunteer monitoring program. To ease the process of establishing a volunteer monitoring program, Mobile Bay National Estuary Program staff has created a "how-to" guide for coastal Alabama. Volunteer members should reference **Section 11.3** to obtain the geographic locations of the volunteer monitoring locations.

11.6 Adaptive Management

The monitoring program is designed to assess and document the overall health of the West Fowl River Watershed. The program is designed to assess the entirety of the Watershed area in a time and cost efficient manner, while also providing sufficient and concise data, which is necessary to identify possible sources and localities contributing to current and future water quality degradation within the Watershed. The approved monitoring program may encounter instances where data analysis is not correlating with physical observations and biological assessments of the Watershed. In such a case, the monitoring program should be reevaluated and adaptive management implemented to assess if and where data-gaps may be occurring. Additionally, reevaluation of the management plan and management techniques may be necessary to achieve the goals established in the WMP and monitoring program.

11.6.1 Introduction and Purpose

Watersheds are dynamic ecological and physical systems that are impacted by natural and anthropogenic events. Effectively managing them involves making decisions based on multiple, frequently-competing objectives that may be constrained by regulations, implementation capabilities, available resources, and uncertain responses to management actions.
Adaptive management is a systematic approach to improving management decisions by gathering information and learning from outcomes to guide future management decisions. This approach focuses on partnerships of stakeholders who together learn how to create and maintain sustainable resource systems.

11.6.2 The Role of Stakeholders

Stakeholder engagement and input are essential to success in virtually every stage of the adaptive management process; methods to encourage this continued involvement are detailed in Section 8. These stakeholders include the previously identified Steering, Engagement and Technical Committees, as well as interested members of the public, who should continue to serve in collaborative and advisory roles during implementation. The adaptive management process proposed for the West Fowl River Watershed promotes stakeholder and project implementation team collaboration by:

- Bolstering the level of stakeholder knowledge and science in the watershed,
- Setting programmatic goals and resource management objectives,
- Guiding the selection and development of the management actions that will be incorporated in individual projects,
- Tracking the implementation of management actions in the watershed,
- Guiding the development of adjustments to the implemented management actions to improve watershed outcomes,
- Assisting in the management and supervision of long-term O&M activities, and
- Garnering stakeholder support for the goals, strategies and objectives throughout the implementation process if adaptive management strategies are to work in practice.

Adaptive management requires the commitment of time and resources and the active engagement of stakeholders working to produce balanced, resilient and sustainable outcomes in the watershed. All phases of the adaptive management process must be open and transparent to stakeholders.

11.6.3 Adaptive Management Process

To implement the adaptive management process for the West Fowl River Watershed certain elements must be put in place, and then used in a cycle arriving at decisions by repeating rounds of discovery analyses to achieve the most desired result (See **Figure 11.3**). This section discusses each step in this process and the key activities to be undertaken.

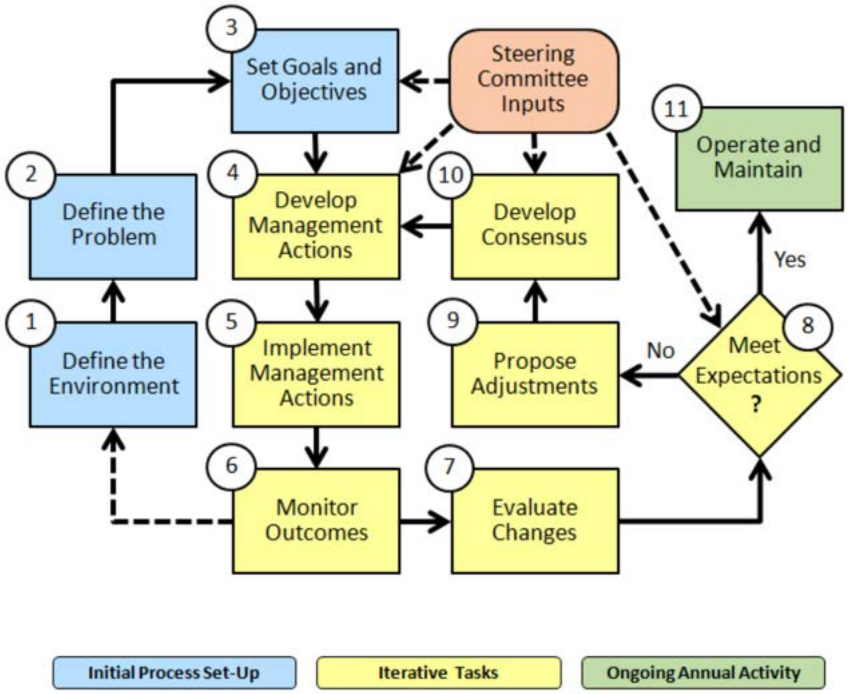


Figure 11.3 The adaptive management process being proposed by the Dewberry Team consists of 11 steps with linked interactions.

11.6.3.1 Step 1: Define the Environment

The multiple aspects of a natural system include its physical, environmental, regulatory, community, financial, cultural and political environments. These environments can be represented as temporal and spatial datasets that are frequently organized in GIS data platforms to facilitate data use and reduce analytical costs. Taken collectively, they provide the basis for identifying and solving problems and developing management solutions. Existing watershed data collected for the development of this WMP includes a GIS database (see Appendix A and Sections 2 and 3 of this document).

Key activities in the initial implementation cycle include:

- Acquire available and relevant information to provide a sound basis for managing the watershed, and
- Identify any data adjustments needed to effectively use the acquired data.

Key activities in successive iteration cycles include:

- Continuously update the environment with new data, and
- Maintain data to ensure that acquired data is readily accessible.

11.6.3.2 Step 2: Define the Problem

This plan identifies the problems and associated consequences in the watershed and prioritizes the problems to be addressed in management actions (see **Section 6**). Implementation of this plan will require initiation of measures, projects and further studies. In each case, a more in-depth evaluation of the specific problems being addressed will be necessary.

Key activities in the initial implementation cycle include:

- Collaborate with stakeholders to develop a consensus regarding the significance of the identified problems; identify additional problems that should be addressed and decide which problems can be potentially eliminated from consideration, and
- Identify additional data gaps that adversely impact the knowledge basis for the management effort.

Key activities in successive iteration cycles include:

- Revise the problem definition(s) as appropriate based on new data resulting from implemented management activities.

11.6.3.3 Step 3: Set Goals and Objectives

Adaptive management requires clear and agreed-upon goals and objectives that are specific, measurable, achievable, results oriented and time-fixed. These goals and objectives will be used to inform and guide decision-making for taking actions, developing assumptions, formulating expected outcomes, modifying implemented actions, ensuring overall value being received and success.

Objectives should not be “broad-brush” statements. Adaptive management itself is not designed to resolve conflicts about objectives. If the objectives are not clear and measurable, the adaptive framework is undermined.

Key activities in the initial implementation cycle include:

- Define goals and objectives in detail, using clear language, so that they are useful as guides for decision making and evaluation;
- Confirm that regulatory requirements, standards and design criteria are being addressed in the new restoration projects;
- Recognize that multiple objectives often exist and work to balance stakeholder interests in the selection of strategies and actions;
- Identify and prioritize critical uncertainties;
- Define the collective vision of stakeholders for the watershed after the identified problems have been addressed;
- Incorporate the social, economic and/or ecological values of stakeholders in the framing of objectives;
- Reach agreement on the definition of and criteria for a successful restoration;
- Ensure that objectives are measurable with appropriate field data, achievable, results-oriented and applicable over the timeframe of the project; and
- Modify goals, objectives and desired endpoints based on input from the stakeholders.

Key activities in successive iteration cycles include:

- Review the initial stakeholder vision to better reflect the insights derived from the implemented management practices,
- Adjust and/or further refine goals and objectives where necessary based on new data and information derived from the monitoring of outcomes, and
- Consider the current criteria being used to identify successful restoration outcomes and make adjustments where required.

11.6.3.4 Step 4: Develop Management Actions

Decision-making in adaptive management involves the selection of appropriate actions for each point in time guided by evolving knowledge and science. Managers have the responsibility of identifying the set of potential management actions from which strategies and implementation plans are developed. If these actions fail to produce intended results, adaptive management will be unable to produce informative strategies. It is often beneficial to consider and include alternatives that will produce different system responses that can be measured and evaluated.

There are many ways to design the process for selecting alternatives. Formal methods can be used to select options that best account for current and future consequences. Stakeholders and managers can sometimes rely on less-structured approaches or common sense to identify acceptable strategies. Decision making should be driven by the objectives and informed by resource status and process uncertainties.

Key activities in the implementation cycle of initial resource management strategies include:

- Determine alternative restoration strategies and approaches that meet goals and objectives.
- Develop appropriate performance measures.
- Bring stakeholders together during the development of management strategies, and encourage long-term collaboration.
- Compare and rank projected outcomes for management alternatives in selection of actions.
- Predict expected outcomes based on the current state of knowledge.

Key activities in successive iteration cycles for project alternatives include:

- Define alternative strategies for new projects based on initial project outcomes measured relative to goals and objectives.
- Continue to bring stakeholders together during the development of management strategies and decision making practices.
- Review predicted performance characteristics from prior iteration, and revise as appropriate.

11.6.3.5 Step 5: Implement Management Actions

When all relevant factors have been considered and a strategy developed to consensus, one or more alternatives can be implemented. Each management activity needs to be defined in terms of what will be done, when it will be done, capital investment needed, anticipated annual operation and management costs, and predicted outcomes/benefits.

Key activities in the initial implementation cycle include:

- Develop consensus with stakeholders early on, regarding who will be responsible for the different aspects of implementing the selected management activities.
- Secure funding for initial construction and annual operating activities.

- Solicit proposals for implementing the selected management actions, select contractors, and award contracts.
- Adjust project plans as needed.

Key activities in successive iteration cycles, in addition to the work required in the initial iteration, include:

- Confirm that regulatory requirements, standards and design criteria are being addressed in the new restoration projects.
- Update the WMP to reflect successes and conclusion of the initial projects, and add any new implementation plans.
- Adjust project plans as needed.

11.6.3.6 Step 6: Monitor Outcomes

Adaptive management is not possible without effective monitoring. Monitoring assesses watershed responses to management actions to inform better decisions and increase likelihood of success. By tracking implementation of management measures, monitoring programs enable project evaluation in adaptive management. Outcomes of management programs need to be measured for two distinct purposes:

- To establish performance points (baseline conditions) that can be used to measure progress and establish trends.
- To trigger change in management direction if performance does not meet objectives.

Monitoring provides the data from which to test alternatives and measure progress towards accomplishing objectives. Improved decision making justifies the cost of monitoring and assessment in adaptive management.

Key activities in the initial implementation cycle include:

- Develop and implement monitoring plans to assess progress toward goals and objectives.
- Align monitoring activities with any current stakeholder monitoring programs to the maximum extent possible.
- Establish current baseline reference conditions in the watershed to compare to responses after project implementation.

Key activities in successive iteration cycles include:

- Continue targeted monitoring activities from the prior iterative cycle with approved adjustments.
- Review and modify the implemented monitoring plans as necessary.

11.6.3.7 Step 7: Evaluate Changes

Evaluation of system changes improves understanding of resource dynamics. Assessing desired outcomes against actual outcomes can be used to evaluate the effectiveness of decisions and to measure success in attaining objectives. Ideally, the response to previous management actions can be assessed before a decision about the next management action is made. For example, the response of water quality to implementation of water quality BMPs in one year can be assessed in time to inform the selection of the next cycle of BMPs.

Key activities in the initial implementation cycle include:

- Review monitoring data and compare expected outcomes against actual outcomes.
- Evaluate progress of improvements related to the implemented management actions.
- Identify approaches for reducing uncertainty and improving choices of management activities through time.
- Develop processes for evaluating alternative management approaches.

Key activities in successive iteration cycles include:

- Continue assessment activities from the prior iterative cycle with approved adjustments.
- Identify which management practices had unrealistic or unobtainable initial performance predictions.
- Evaluate the BMP priorities in future management projects going forward.

11.6.3.8 Step 8: Determine if Meeting Expectations

Adaptive management allows managers to determine systematically whether implemented projects are succeeding or failing to achieve objectives. Consequently, it is important to determine how the actual outcomes measured in the field compare to predicted outcomes. Metrics and the criteria for success in meeting implemented resource management objectives are commonly established by one of two methods:

- Compliance with regulatory criteria and standards
- Consensus of the stakeholders participating in and/or funding the process.

  If performance meets or exceeds expectations:

    - Determine the management practice to be a success.
    - Document the final configuration of components and practices for use in upcoming opportunities.
    - Transition the practice status from "adjustment and testing" to "operating and maintaining."

  If performance fails to meet expectations:

    - Make adjustments based on assessments and best available data.
    - Continue monitoring performance/outcomes.
    - Re-evaluate changes in performance/outcomes.

Key activities in the initial implementation cycle include:

- Determine if data is sufficient to decide whether success was achieved.

- If inadequate information exists, examine the data and estimate how much more is needed to decide if success can be achieved.
- If adequate information exists, share the information with the Steering Committee, schedule a meeting, and collectively decide whether success has been achieved.

11.6.3.9 Step 9: Propose Adjustments

Management decisions can be revisited and adjusted over time. Decision making needs to be fact-based; otherwise, understanding of systems' behaviors cannot advance and learning cannot be applied to other opportunities.

At each decision point during implementation, actions can be adjusted. Appropriate actions are likely to change through time, as understanding evolves and the resource system responds to environmental conditions and management actions. It is the influence of reduced uncertainty on decision making that makes the decision process adaptive.

Key activities in the initial implementation cycle include:

- Use the monitoring results to identify which aspect(s) of the action is causing it to not meet its objective(s).
- Determine which aspect(s) of the action can be adjusted to best improve its performance during the next iterative cycle.
- Recommend one or more potential adjustments expected to improve the future performance of the action.
- Develop consensus for the recommended adjustments and proceed with implementing those adjustments.

Key work activities in successive iteration cycles include:

- Evaluate the cost effectiveness of the action in terms of the cost per unit of benefit (e.g., $/pound of annual pollutant removal, $/acre of new public creek access, etc.) based on the use of monitoring data.
- Adjust management actions over time as resource conditions change and understanding of the processes driving the system's responses increases.

11.6.3.10 Step 10: Develop Consensus

Although technical information and scientific understanding are required to assess tradeoffs and levels of risk associated with different management actions, the selection of an appropriate strategy requires building consensus. Stakeholder support of the programmatic goals and objectives helps to ensure that a management strategy works in practice. Consensus on goals and objectives at the beginning of an adaptive management project sets the stage for iterative, adaptive management cycles. However, consensus should continue through the life of the project.

Consensus is sustained by ongoing collaboration, through which any potential conflicts can be resolved. Consensus is promoted by collaboration and relationship building.

Key activities in the initial implementation cycle include:

- Develop a document that carefully defines the proposed changes in the management practice, and provide it to the Steering Committee so that all decision makers will be working from the same information.
- Conduct a collaborative workshop to develop consensus on the adjustments and timing of management activities based on resource status and ongoing information gathering.

Key activities in successive iteration cycles include:

- Strengthen working relationships with stakeholders to facilitate the best outcomes for the West Fowl River Watershed and receiving water bodies.
- Continue to encourage stakeholders to commit time and energy to adaptively manage the resource.

11.6.3.11 Step 11: Operate and Maintain

The last step in successful adaptive management processes is the conversion from the experimental "what if we..." phase to the sustained operations phase. In some cases, particularly where water quality treatment infrastructure has continued operations, maintenance activities are required to maintain permitting compliance.

Key activities include:

- Continue operating the management practice under the "success" conditions.
- Provide ongoing maintenance as required to sustain performance levels.
- Continue to measure and document performance.
- Look for ways to reduce annual O&M costs (e.g., labor, electricity, fuels, chemicals).
- Update the cost per unit benefit estimates.

11.7 Indications of Programmatic Success in Adaptive Management Process

Although "success" means different things to different people, indications of programmatic success in using the adaptive management process are likely to include:

- Stakeholders are actively involved and committed to the process.
- Progress is made toward achieving resource management objectives.
- Results from monitoring and assessment are used to adjust and improve management decisions.
- Implementation is consistent with applicable laws.

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