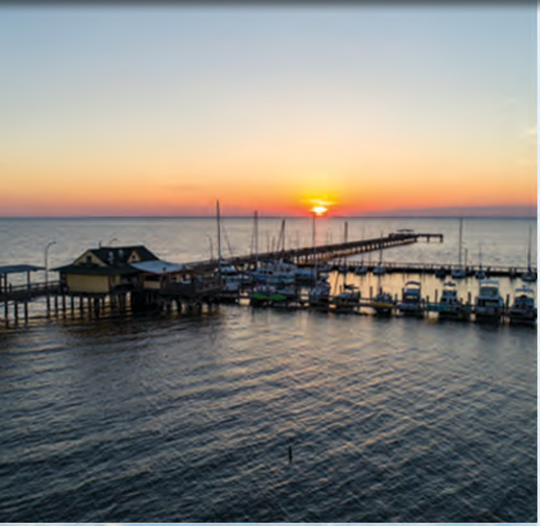
JUNE 2023

MOBILE BAY NATIONAL ESTUARY PROGRAM

EASTERN SHORE WATERSHED MANAGEMENT PLAN



Presented by

thompson ENGINEERING

Final Draft

Eastern Shore

Watershed

Management Plan

MAIN REPORT

June 2023

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Acknowledgements

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Thompson Engineering was selected to organize and lead the work of a Planning Team to prepare the ESWMP. Other members of the Planning Team included; Environmental Science Associates (ESA) who conducted climate vulnerability and water quality assessments, Barry A. Vittor & Associates, Inc. who conducted the ecological evaluations; and M&R Solutions, LLC and Ephriam and Associates who assisted with stakeholder engagement and outreach.

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This Watershed Management Plan and all associated data and related items of information were prepared by the Mobile Bay National Estuary Program under Award No. GNTCP18AL0066 from the Gulf Coast Ecosystem Restoration Council (RESTORE Council). The data, statements, findings, conclusions, and recommendations are those of the authors and do not necessarily reflec any determinations, views, or policies of the RESTORE Council.

Executive Summary

In 2020, the Mobile Bay National Estuary Program (MBNEP) contracted with Thompson Engineering to conduct a comprehensive Watershed Management Plan (WMP) for the Eastern Shore of Mobile Bay in Baldwin County, Alabama. The Thompson Team brought together a group of highly qualified experts to make up the Planning Team. The Planning Team includes representatives from Environmental Science Associates, Barry A. Vittor and Associates, Inc., M&R Solutions, and Ephriam Environmental, LLC. This WMP provides a strategy for conserving and restoring coastal habitats that provide critical ecosystem services and have been identified by stakeholders as critical issues in the Eastern Shore Watershed. The Eastern Shore Watershed Management Plan (ESWMP) is organized into the following chapters:

Chapter 1 Introduction provides an overview of the watershed planning process.

Chapter 2 Community Engagement provides an overview of the public outreach and stakeholder engagement efforts that were conducted as part of the development of the WMP.

Chapter 3 Watershed Characterization describes the Eastern Shore Watershed, providing background on characteristics and current conditions—including topography, hydrology, habitats, demographics, land use, etc.

Chapter 4 Watershed Conditions evaluates the existing conditions within the Watershed and helps to focus management efforts to address the most pressing needs.

Chapter 5 Climate Vulnerability Assessment addresses vulnerabilities associated with climate change and sea level rise and looks at potential adaptation strategies.

Chapter 6 Identification of Critical Issues and Areas 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.

Chapter 7 Management Measures describes the conceptual management measures considered to address the critical issues and areas of this WMP.

Chapter 8 Implementation Strategies provides a list of concrete action items, timelines, and prospective partnerships to help facilitate the implementation of the identified management measures.

Chapter 9 Regulatory Review discusses the regulatory framework of laws, regulations, and ordinances that pertain to stormwater management, coastal zone issues, wetlands, etc. under the jurisdiction of the Federal, State, County, and the Cities of Fairhope and Daphne governmental entities.

Chapter 10 Financing Alternatives presents a financial strategy, including available sources of funding (e.g., grants, partnerships) for projects, and examines innovative mechanisms and alternatives for leveraging funding sources.

Chapter 11 Monitoring outlines a monitoring program to evaluate the success of the management measures over the 5-year planning period.

Chapter 12 References lists all sources cited in this document.

The Watershed

The Eastern Shore Watershed, located in southwest Baldwin County, Alabama, along the eastern shore of Mobile Bay, encompasses approximately 22,400 acres (35 square miles). The Watershed includes the Fly Creek USGS 12-digit Hydrologic Unit Code (HUC 031602050205) and the southern portion of the Tensaw River–Apalachee River Hydrologic Unit Code (HUC 031602040505). The official USGS Fly Creek HUC 12 was modified and re-delineated on its northern end to add an area of approximately 639 acres (0.99 square miles) of the Tensaw River-Apalachee River HUC12, making the Watershed study area approximately 18 miles long and 3.5 miles wide. The Watershed comprises the following seven subwatersheds: the Jordan Brook/Yancey Branch, the Rock Creek/Unnamed Tributary (UT)1-UT3, Fly Creek/UT4, Fairhope Core/UT5-UT6, Point Clear, Bailey Creek/UT7-UT11, and UT12.

The Eastern Shore of Mobile Bay was historically known for its lushly vegetated nearshore areas and subtropical weather. As early as the 1800s, families along the Gulf Coast would vacation in Point Clear, believing the daily breeze from Mobile Bay warded off yellow fever. Summers are normally dominated by high pressure and southerly winds that frequently result in afternoon thunderstorms with temperatures generally ranging from 80° to 90° F, with 100° F not uncommon. Winters are generally mild, with frequent cold fronts and showers originating from the northwest.

In the late 19th century and early 20th century, the region continued to attract a more diverse population – from Italian immigrants who sought refuge in Daphne, to midwestern free-thinkers who developed Fairhope, and former slaves who built a new life in the region (Eastern Shore Magazine 2021). People have continued to be drawn to the region as businesses, natural environment, and art collide to provide a unique quality of life. As a result, during the last two decades, Baldwin County has become the seventh fastest growing metropolitan area in the country with a 27.2% population increase from 2010, and a 65% increase since 2000. With that rapid growth has come many issues related to quality of life, increasing water demand, loss of natural areas, and watershed degradation. One result of this degradation is a loss of submerged aquatic vegetation (SAV) in Mobile Bay. In 1957, extensive SAV grew along the eastern shore of Mobile Bay between Daphne and Point Clear (Baldwin, 1957). By the late 1960s, SAV along the Eastern Shore was much reduced and almost completely gone by the 1970s (Borom, 1975). By 2019, only 212 acres of SAV remained offshore and along the Mobile Bay shoreline. This is a result of the tributaries along the eastern shore of Mobile Bay becoming increasingly stressed due to development pressures. Of particular note, the highly incised Fly Creek, which is at the center of the watershed, exhibits significant wetland impacts as well as erosion and head cutting along its main stem and tributaries, and studies have shown significant sediment and nutrient loads going to the Bay from the creek.

With the rapid growth and increased vulnerability to climate hazards, these conditions will continue to deteriorate, and the quality of life that residents and visitors have come to appreciate will suffer. This WMP addresses these critical issues and attempts to make recommendations for positive changes.

Critical Issues and Areas

Critical areas and issues affecting the health of the Watershed were identified through input from the Steering Committee, public workshops, field reconnaissance, analysis of historical aerial photography and maps, and analysis of other historical and current data. Critical issues and areas identified for the Eastern Shore Watershed are (not in order of priority):

1. **Development pressures** – the rapid growth experienced on the Eastern Shore has been identified as a major concern from citizens and stakeholders and encompasses many of the other identified issues.
2. **Litter** – the most visibly noticeable of all watershed impairments and has a direct impact on water quality, wildlife habitat, and recreational enjoyment.
3. **Human health and wellbeing** – the culture, heritage, and history of people are inextricably tied to the resources provided by the Watershed.
4. **Water quality** – water quality is a broad term that reflects a combination of several parameters that are directly tied to the overall health of a watershed. The factors influencing water quality also affect the ability of stakeholders to utilize those waters for any number of uses.
5. **Habitat loss** – loss of pristine upland and wetland habitats due to overdevelopment was noted throughout the planning process.
6. **Environmental health and resilience** – relates to the Watershed's climate vulnerabilities in terms of sea-level rise and storms.
7. **Shoreline erosion and sedimentation** – the shoreline along the Eastern Shore of Mobile Bay has experienced significant erosion which has resulted in an increase in man-made alterations such as seawalls, bulkheads, and rip-rap.

Recommended Management Measures

The following management measures were defined by the Planning Team with input from stakeholders to address critical issues and areas specific to the Eastern Shore WMP. The measures in **bold font** represent the priority recommendations based on document research as well as stakeholder feedback. Some of the priority recommendations were already under development when the WMP was written so are relatively easily targeted projects. More details can be found in Chapter 7.0:

- **Tributary assessment and restoration (Fly Creek, Point Clear Creek, Yancey Branch, and Rock Creek)**
- **Assess flooding causes and determine potential remedies in the underserved community of Twin Beech**
- **Assess the health and functionality of the gully systems along the Eastern Shore**
- **Establish and initiate a water quality monitoring program**

- **Clean Marina Program**
- **Community Resilience Index**
- Develop a stormwater master plan
- Septic to sewer conversion plan (priority: Fly Creek)
- Comprehensive litter abatement plan, including; strategically placed street signage
- Post-storm in-stream debris removal plan
- Increase green spaces throughout the watershed
- Increase community signage in historic communities (i.e., Twin Beech, Barnwell, Historic Downtown Daphne, Historic Downtown Fairhope, Point Clear, Montrose, Daphmont)
- Comprehensive shoreline management plan for entire Mobile Bay
- Inventory and restoration needs assessment of public and private stormwater retention/detention ponds
- Restore degraded wetlands and riparian buffers
- Promote and expand the use of Low Impact Development (LID) practices
- Identify areas for construction of living shoreline or shoreline protection/restoration measures
- Increase public access to Mobile Bay
- Develop a series of oral histories for significant historical communities including those above
- Land acquisition for habitat preservation, wetland protection, and riparian buffers
- Invasive species detection and management program
- Comprehensive study of dilapidated piers along Mobile Bay

Implementation Strategies

A strategic approach with a clear implementation program to successfully implement the management measures identified in this WMP is discussed in Chapter 8. The implementation program includes prioritizing projects, creating a schedule for completing them, and establishing metrics to measure their success. Implementation of the recommended management measures should begin immediately after approval of the WMP. Initial implementation should focus on the most critical issues and the prioritized management measures identified in Chapter 8. Many of the management measures can occur concurrently as soon as the necessary funding is available.

Funding sources and financing alternatives

Obtaining funding for projects and activities throughout an entire watershed is not a simple undertaking. Jurisdictional areas of political entities that may provide financial assistance do not necessarily follow or encompass watershed boundaries, which may create further obstacles to project implementation. To acquire the funding necessary to undertake significant restoration, preservation, and/or management projects, political and private entities should consider and compare all available funding options. Many financial assistance opportunities, primarily in the form of federal grants and cooperative agreements, are available to help restore, enhance, and preserve resources within the watershed. A few of the funding sources identified for this WMP are below:

- Stormwater utility fees
- Federal grants, loans, and revenue sharing
- State of Alabama Revolving Loan Fund
- Impact fees
- Regional collaboration opportunities
- RESTORE Act
- Natural Resource Damage Assessment
- National Fish and Wildlife Foundation Gulf Coast Environmental Benefit Fund
- Gulf Coast Conservation Grants Program
- Coastal Ecosystem Resiliency Grants Program
- Gulf of Mexico Energy Security Act (GOMESA)
- EPA Healthy Watersheds Consortium Grant
- Five Star Restoration Program
- Clean Water Act Section 319(h)
- Wetlands Program Development Grant

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Acronyms and Abbreviations

A or Ac	Acre
ACAMP	Alabama Coastal Area Management Program
ACCP	Alabama Coastal Comprehensive Plan
ACNPCP	Alabama Coastal Nonpoint Pollution Control Program
ADCNR	Alabama Department of Conservation and Natural Resources
ADECA	Alabama Department of Economic and Community Affairs
ADEM	Alabama Department of Environmental Management
ADPH	Alabama Department of Public Health
AFO	Animal Feeding Operations
A&I	Agricultural and Industrial Water Supply
AL	Alabama
ALDOT	Alabama Department of Transportation
ALGAP	Alabama Gap Analysis Program
ALGP	Alabama General Permit
ALNHP	Alabama Natural Heritage Program
AMCMP	Alabama-Mississippi Clean Marina Program
ASY	Alabama Smart Yards
AWPCA	Alabama Water Pollution Control Act
AWW	Alabama Water Watch
BMP	Best Management Practices
BVA	Barry A. Vittor and Associates, Incorporated
CAFO	Concentrated Animal Feeding Operations
CBMPP	Construction Best Management Practices Plan
CBOD	Carbonaceous Biocemical Oxygen Demand
CFR	Code of Federal Regulations
CFS	Cubic Feet Per Second
CHCT	Coastal Habitats Coordinating Team
CNPCP	Coastal Nonpoint Pollution Program
CR	County Road
CRI	Coastal Resilience Index
CRS	Community Rating System
CSO	Combined Sewer Overflows
CWA	Clean Water Act
CWP	Center for Watershed Protection
CZARA	Coastal Zone Act Reauthorization Amendment of 1990
CZMA	Coastal Zone Management Act of 1972
DO	Dissolved Oxygen
ECHO	Environmental Compliance History Online
EPA	Environmental Protection Agency
ESA	Environmental Science Associates
ESA	Endangered Species Act
ESMPO	Eastern Shore Metropolitan Planning Organization
ESWMP	Eastern Shore Watershed Management Plan
ETJ	Extraterritorial Jurisdiction
°F	Degree Fahrenheit
FAQ	Frequently Asked Questions
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Maps
Ft	Feet

F&W	Fish and Wildlife
FWPCA	Federal Water Pollution Control Act
GCN	Greatest Conservation Need
GEBF	Gulf Environmental Benefit Fund
GHG	Greenhouse Gas
GI	Green Infrastructure
GIS	Geographic Information System
GOMA	Gulf of Mexico Alliance
GOMESA	Gulf of Mexico Energy Security Act
GP	General Permit
GSA	Geological Survey of Alabama
Ha	Hectare
Hg	Mercury
HOA	Homeowners Association
HUC	Hydrologic Unit Code
IC	Impervious Cover
ICM	Impervious Cover Model
IEA	Impervious Effect Area
in/yr	inch per year
IPaC	Information for Planning and Conservation
ISA	Impervious Surface Area
IUP	Intended Use Plan
$kg/mi^2/yr$	kilograms per square mile per year
LID	Low Impact Development
LiDAR	Light Detection and Ranging
LRTP	Long Range Transportation Plan
LULC	Land Use Land Cover
LWF	Limited Warmwater Fishery
m	meters
MASGLP	Mississippi-Alabama SeaGrant Legal Program
MBNEP	Mobile Bay National Estuary Program
MGD	million gallons per day
mg/l	milligrams per liter
MPO	Metropolitan Planning Organization
MRLC	Multi-Resolution Land Characteristics
MSA	Metropolitan Statistical Areas
MS4	Municipal Separate Storm Sewer System
NEP	National Estuary Program
NFIP	National Flood Insurance Program
NFWF	National Fish and Wildlife Foundation
NGO	Non-Governmental Organization
NGVD	National Geodetic Vertical Datum
NHD	National Hydrography Dataset
NLCD	National Land Cover Dataset
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NTU	Nephelometric Turbidity Units
NWI	National Wetland Inventory

NWP	Nationwide Permit
NWQMC	National Water Quality Monitoring Council
OAW	Outstanding Alabama Water
ONRW	Outstanding National Resource Water
OSDS	On-Site Sewage Disposal System
OWR	Office of Water Resources (ADECA)
PCN	Preconstruction Notification
PFAS	Polyfluoroalkyl Substances
pH	potential of Hydrogen (measure of acidity)
PIC	Project Implementation Committee
POA	Property Owners Association
POTW	Publicly Owned Treatment Works
ppb	parts per billion
ppm	parts per million
PWS	Public Water Supply
QCI	Qualified Credentialed Inspector
QCP	Qualified Credentialed Professional
RESTORE	Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies
RHMP	Regional Multi-Jurisdictional Hazard Mitigation Plan
RSLC	Relative Sea Level Change
S	Swimming and Other Whole Body Water-Contact Sports
SAC	Science Advisory Committee
SALT	South Alabama Land Trust
SAR	States at Risk
SARPC	South Alabama Regional Planning Commission
SAV	Submerged Aquatic Vegetation
SH	Shellfish Harvesting
SHPO	State Historic Preservation Office
SLAMM	Sea Level Affecting Marshes Model
SLR	Sea Level Rise
SRF	State Revolving Fund
SSO	Sanitary Sewer Collection System Overflows
SSURGO	Soil Survey Geographic Database
SWAP	State Wildlife Action Plan
SWMPP	Storm Water Management Program Plan
TAL	Treasured Alabama Lake
TAZ	Traffic Analysis Zones
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
t/mi2/yr	Tons per square mile per year
TN	Total Organic Nitrogen
TNC	The Natural Conservancy
TOC	Total Organic Carbon
TP	Total Phosphorous
TSS	Total Suspended Solids
µg/L	micrograms per liter
USACE	United States Army Corps of Engineers
USC	United States Code
USEPA	United States Environmental Protection Agency
USFWS	Unites States Fish and Wildlife Service

USGCRP	United States Global Change Research Program
USGS	United States Geological Survey
UT	Unnamed Tributary
WMP	Watershed Management Plan
WOTUS	Waters of the United States
WPC	Warren Pinnacle Consulting
WRAP	Wetland Rapid Assessment Procedure
WWTP	Wastewater Treatment Plant

1.0 Introduction

The Eastern Shore Watershed Management Plan has been developed to provide a community road map for improving environmental management across the watershed for greater community resilience and conservation of the unique environmental and cultural history of the Eastern Shore of Mobile Bay.

The Eastern Shore Watershed area of approximately 22,400 acres (35 square miles) along the eastern shore of Mobile Bay in Baldwin County, Alabama. The 2020 U.S. Census data ranks Baldwin County as the seventh fastest-growing metropolitan area in the country with a 27.2% population increase from 2010, and a 65% increase since 2000. Accelerated growth of this nature can compound existing water quality issues and increase stormwater runoff along with excessive rainfall events. Impacts from rapid runoff and erosion have resulted in increases in nutrient runoff, sediment transport, and loss of biological habitat in downstream streams.

1.1 Plan Overview

The Mobile Bay National Estuary Program (MBNEP), in partnership with the State of Alabama, secured funding through the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States (RESTORE) Act to develop watershed management plans (WMPs) for tidally influenced watersheds along the Alabama coast. MBNEP has partnered with stakeholders to develop these WMPs, which provide a roadmap for restoring or conserving watersheds and improving water and habitat quality in areas where resources could have been damaged by the Deepwater Horizon oil spill.

The Eastern Shore Watershed was identified as one of the priority watersheds by the MBNEP Project Implementation Committee (PIC). Figure 1.1 presents an overview of the Eastern Shore Watershed area.

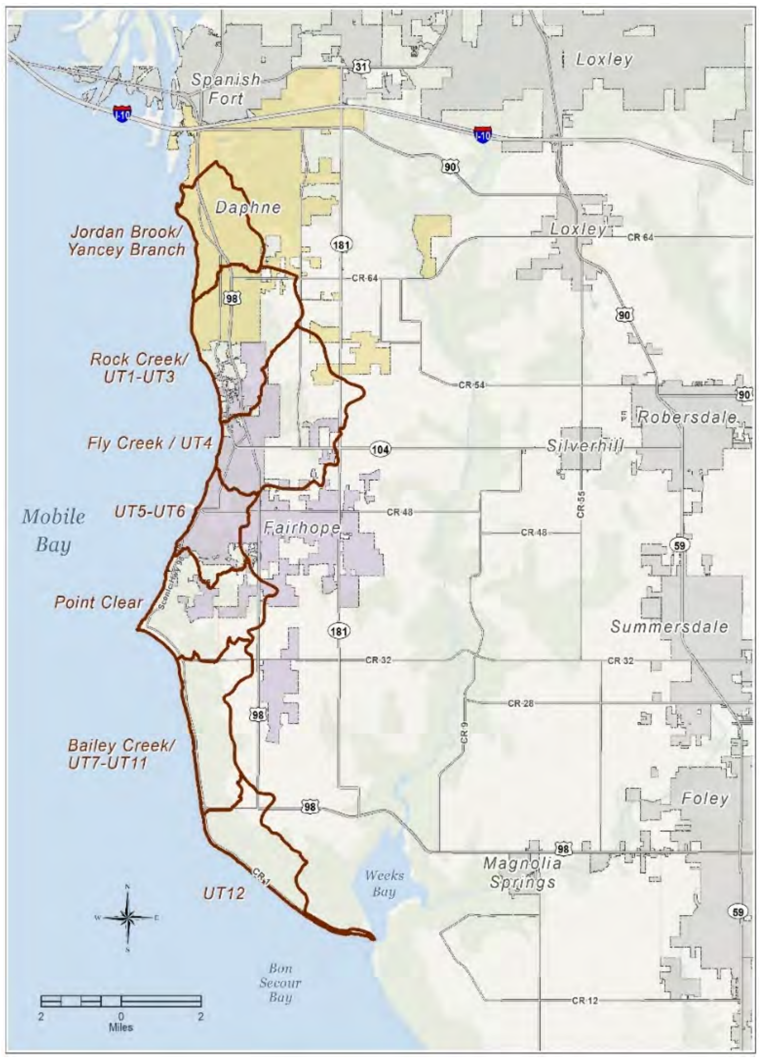


Figure 1.1 Eastern Shore Watershed Area

1.2. Plan Vision

The Eastern Shore WMP was developed to improve and protect the things people value most about living along the Alabama coast, as identified in the MBNEP Comprehensive Conservation and Management Plan (Figure 1.2). The WMP identifies issues and data gaps related to watershed conditions; provides an implementation program recommending a prioritized list of actions to improve water quality, ecological integrity, and resilience; and includes a project implementation schedule, interim milestones, ways to measure or monitor progress, an education/outreach plan, and identification of technical and financial resources needed to address implementation success.

Figure 1.2 MBNEP Comprehensive Conservation and Management Plan Six Values

Water – the coastal community desires water that is drinkable, swimmable, and able to support aquatic and marine life. WMPs identify actions to reduce point and non-point source pollution and remediate past effects of environmental degradation, thereby reducing outgoing pollutant loads into Mobile Bay and the Gulf of Mexico.

Coastlines, beaches, and dunes **–** provide critical edge habitat to aquatic and terrestrial animals and recreational opportunities for residents and visitors. The WMP assessed shoreline conditions and identifies strategic areas for shoreline stabilization and enhancements.

Access – the WMP 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, wildlife, and the habitats that support them **–** the WMP 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. It also provides strategies 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; were classified as most stressed from dredging and filling, fragmentation, and sedimentation – all related to land use change.

Heritage and culture **–** preserving heritage and culture and sense of place was a core concern of many stakeholders on the Eastern Shore. The WMP characterizes customary uses of biological resources and identifies actions to preserve culture, heritage, and traditional ecological knowledge of the watershed.

Resiliency and environmental health **–** the coastal community relies upon coordinated actions to reduce vulnerability to, and recover from, the range of hazards we face – natural and otherwise. The WMP identifies vulnerabilities in the watershed from accelerated sea level rise, storm surge, temperature increases, precipitation, and recommends improvements to watershed resilience through adaptation strategies.

1.3 Plan Goals and Objectives

The goal of this WMP is to guide resource managers, policy makers, community organizations, and citizens to protect the hydrological, biological, and cultural integrity of the Eastern Shore Watershed, and, specifically, its waters and habitats to support healthy populations of fish, shellfish, and wildlife; and provide for recreational opportunities. To achieve this purpose, the WMP documents current conditions within the watershed, evaluates potential management measures to improve impaired conditions and create a healthier watershed, and recommends a prioritized list of actions to improve water quality, ecological integrity, and, by extension, the quality of life for all inhabitants of the Eastern Shore. Specific objectives for this WMP include:

- Improve water quality by identifying critical areas and issues and developing management measures for improvements.
- Protect and restore habitats and sensitive areas to improve ecological function and enhance ecosystem services.
- Manage shorelines along Mobile Bay for long-term sustainability.

This WMP is also intended to build upon past and ongoing planning and implementation efforts. The local municipalities and County along with partners, have made great strides in developing long-range planning documents including:

<u>Eastern Shore Watershed Projects</u>
Eastern Shore Watershed Management Plan – RESTORE B2, in progress
Eastern Shore Baseline Assessment – RESTORE B2, completed

<u>Daphne Projects</u>
Red Gulley Restoration – RESTORE B2, selected for funding
Bayfront Park Access Enhancement – GOMESA, selected for funding

<u>Fairhope Projects</u>
Fairhope Area Community-Based Comprehensive Land Use Plan – RESTORE B3, in progress
Fairhope Sewer Upgrade Phase I – RESTORE B3, E&D
Working Waterfront and Greenspace Restoration Project – RESTORE B1, E&D
Sanitary Sewer Overflow Mitigation Project – RESTORE B2, selected for funding
Stormwater Infrastructure Inventory- RESTORE B2, selected for funding
North Triangle Nature Park -GOMESA, selected for funding
Fly Creek Restoration Assessment – City of Fairhope, completed

1.4 Period Addressed by the Plan

The scope and breadth of the recommended improvements from this WMP will require significant time to implement. This WMP provides a 5-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 two years, with an in-depth assessment at 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.

1.6 Regulatory Conformance

1.6.1 EPA Nine Key Elements

Although there is no formal requirement for U.S. Environmental Protection Agency (EPA) to approve watershed management plans, the EPA has identified elements that are critical for the development of WMPs and requires that "nine key elements" be addressed in watershed plans funded with incremental Clean Water Act section 319 funds (EPA 2008). The MBNEP watershed planning objectives conform to the EPA's "nine key elements" of watershed planning, listed parenthetically in Figure 1.4 below.

Figure 1.3 EPA Nine Key Elements
Source: EPA 2008

1.6.2 Coastal Zone Act Reauthorization Amendment Section 6217 (G)

The MBNEPs watershed planning process also conforms to the National Oceanic and Atmospheric Administration Coastal Zone Act Reauthorization Amendment Section 6217 (g) Management Measures. As the State lead on water quality, the Alabama Department of Environmental Management's Alabama Coastal Nonpoint Pollution Control Program must conform to Section 6217 (g) requirements to be compliant for funding under Section 306 of the Coastal Zone Management Act and Section 319 of the Clean Water Act. These 6217 (g) requirements include geographic scope of the program; the pollutant sources to be addressed; the types of management measures used; the establishment of critical areas; and technical assistance, public participation, and administrative coordination.

2.0 Community Engagement

The Eastern Shore WMP Community and Stakeholder Engagement Program was designed to be an integral part of the watershed management planning process; centered on the principal of building a partnership with the community and local stakeholders, informing them of watershed conditions, and working collaboratively to identify issues and develop implementation strategies.

The challenges of engaging citizens in a watershed study are complex. During development of this plan one specific challenge encountered was the COVID-19 pandemic, which was well underway at the onset of the watershed management planning effort and continued throughout plan development. In recognition of this challenge and other factors, the WMP Team designed a community and stakeholder engagement program to connect with the community in order to maximize trust, participation, and effectiveness. Throughout the course of the project, the Watershed community was kept informed of milestones and accomplishments and was encouraged to participate in community meetings, surveys, and engagement activities.

The primary mechanisms for community and stakeholder engagement were steering committee meetings, public meetings, small-group meetings, an educational video, local print and social media.

2.1 Steering Committee

Figure 2.1 Steering Committee Kick-Off Meeting, April 2021

The Eastern Shore WMP Steering Committee was assembled to help guide development and assist in the future implementation of the plan. The goal in building the Steering Committee was to get participation from a diverse set of community members and stakeholders with comprehensive knowledge of watershed conditions and community perspectives. The Steering Committee served not only as a conduit for the watershed management planning team to share information and status about planning efforts with the community, but to also bring community feedback to the Steering Committee and WMP team to incorporate into the WMP. Steering Committee meetings were generally scheduled to coincide with Plan milestones; and scheduled with consideration to other WMP meetings. These meetings were also scheduled around Covid-19 surges to minimize safety impacts.

Steering Committee meetings were held on April 13, 2021 (Figure 2.1); July 30, 2021 and April 20, 2022. The Eastern Shore WMP Steering Committee consisted of representatives from the following groups:

- Alabama Association of Conservation Districts
- Auburn Extension
- City of Fairhope Residents
- Baldwin County Commission Highway Department
- Baldwin County Commission Planning & Zoning Department
- Coastal Conservation Association/Alabama Wildlife Federation
- City of Daphne, Environmental Programs
- City of Fairhope, Planning and Zoning Department
- Clean Water Alabama
- Coastal Alabama Community College
- Daphne Utilities
- Eastern Shore Chamber of Commerce
- Local Environmental Expertise
- Fairhope City Council
- Fly Creek Marina
- Old Towne Daphne Association
- Riviera Utilities
- South Alabama Land Trust
- Village Point Park Preserve

In May 2021 an on-line survey was posted on Mobile Bay NEP's website and advertised through multiple print media and social media sources to gauge citizens' views of conditions on the Eastern Shore. The survey remained open until October 2022. There were 117 responses to the survey, with 83% of respondents identifying as Eastern Shore homeowners (Figure 2.2) and a large percentage of respondents who utilize the resources for recreational purposes (47%).

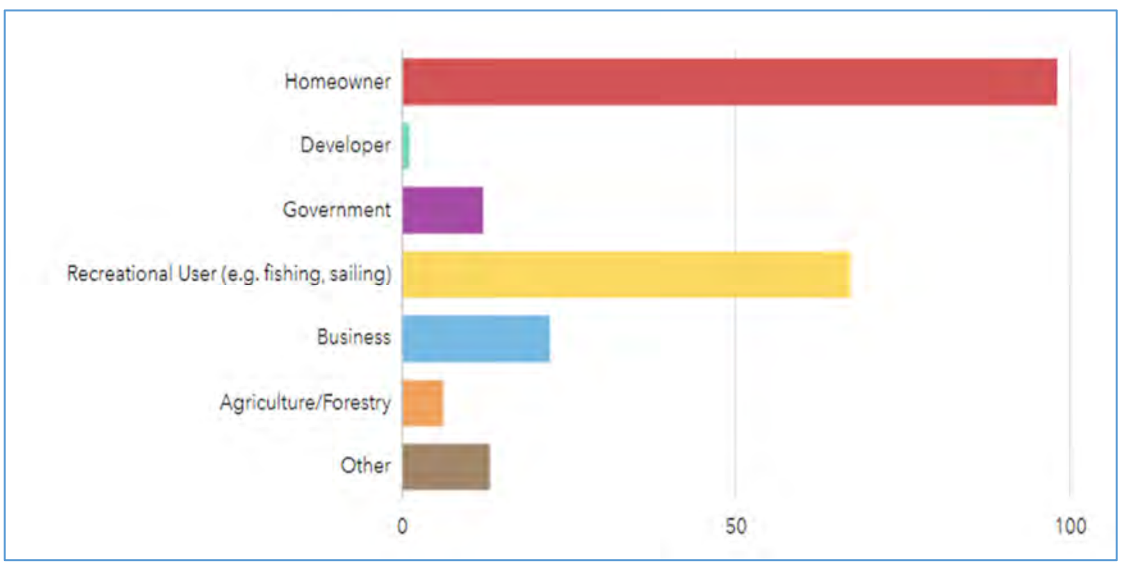


Figure 2.2 Survey totals: What group(s) are you most closely related to?

A word cloud of the question, "*What are the things that make the Eastern Shore most unique and desirable that should be protected or improved?*" is below (Figure 2.3). A word cloud is a collection, or cluster, of words depicted in different sizes. The bigger and bolder the word appears, the more often it's mentioned within a given text and the more important it is. A large number of respondents had answers that referenced Mobile Bay, water, natural areas, and natural beauty.

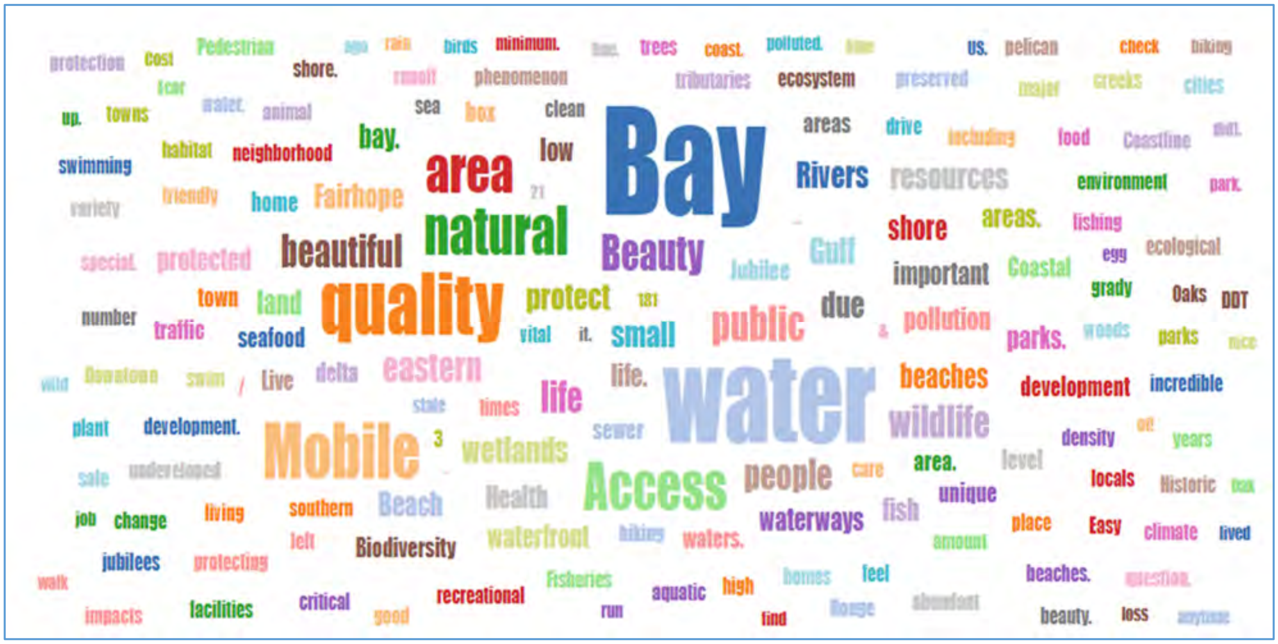


Figure 2.3 Survey word cloud: What are the things that make the Eastern Shore most unique and desirable that should be protected or improved?

Another word cloud was created from the question, "*What is threatening our community?*" As seen below (Figure 2.4) a large number of respondents had answers that referenced development, growth, sewage, infrastructure, water, runoff, and quality.

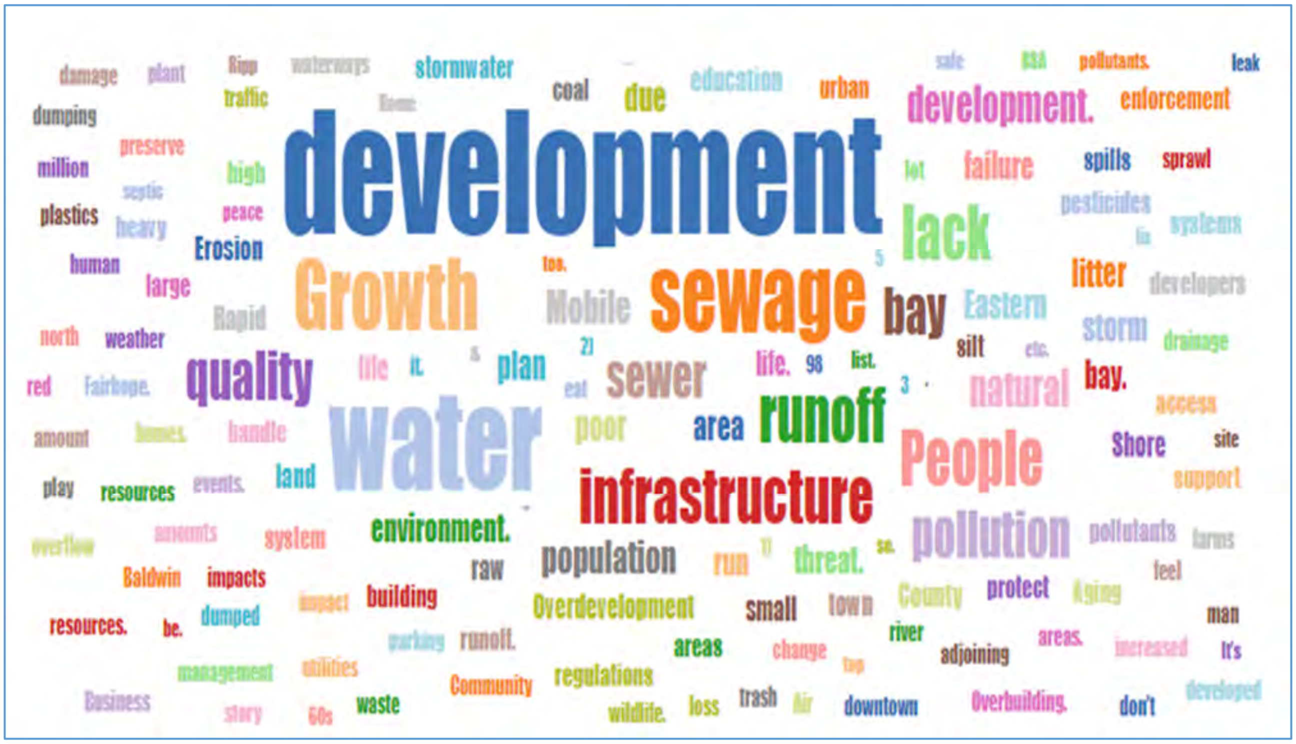


Figure 2.4 Survey word cloud: What is threatening our community?

When asked what those threats were most related to the majority of respondents answered that SSO's (53%), development pressure (49%), and stormwater run-off (41%) were the largest (Figure 2.5).

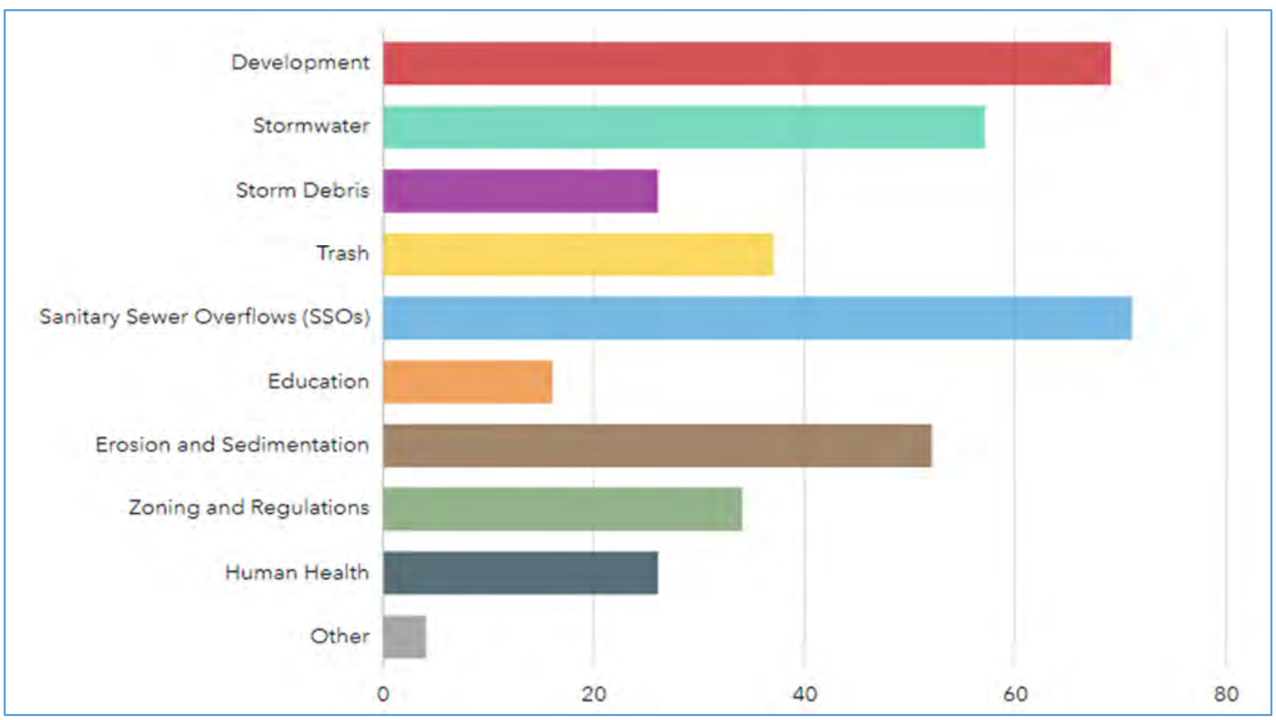


Figure 2.5 Survey totals: What are the threats to the community most related to?

2.2 Public Outreach and Participation

Three stakeholder workshops were held at various points in the WMP process. The intent of these workshops was for the planning team to share progress and information the team and Steering Committee had gathered (from above) and to get public feedback about the identified critical issues and management measures.

The first round of workshops were held in December 2021. Given the extensive range of the watershed boundary it was decided to hold two workshops in different geographies to capture as many stakeholders as possible. The first workshop was held at Oak Hollow Farms in Fairhope, Alabama and the second one was held at Daphne City Hall in Daphne, Alabama. The goal for these workshops was to obtain stakeholder input on the issues, opportunities, and challenges for drafting the Eastern Shore WMP. A total of 20 people attended the two workshops and the team was able to to get quality feedback on the critical issues (Figure 2.6).

Figures 2.6 December 2021 Stakeholder Meeting Photos (Fairhope and Daphne)

The next stakeholder workshop was held in May 2022 in Daphne with the goal of gathering feedback on management measures the team had identified to address the critical issues that had previously been vetted through the Steering Committee and December stakeholder workshops. Twenty-five (25) invited guests were divided into breakout groups to address three questions:

1. What is missing?
2. Identify the top 3 most urgent/attainable management measures.
3. Pick one of the top 3 and brainstorm an action plan for it (Figure 2.7).

The results of the breakout groups were used to help develop the Management Measures and Implementation Strategies Chapters of the Plan. Minutes from all of the stakeholder workshops are presented in Appendix A.

Figure 2.7 Breakout group at May 2022 Stakeholder Workshop

2.3 Small Group Meetings (Virtual and In-Person)

The WMP team also met with a variety of individuals and stakeholders to share information and updates about the WMP planning process. Members of the planning team had personal in-depth conversations with long-time residents of the City of Fairhope, Twin Beech Community, Barnwell Community, and others. The planning team also presented at smaller group meetings such as the Polo Ridge Homeowners Association Monthly Meeting (February 2022) and attended public meetings for other efforts such as the City of Fairhope's Comprehensive Land Use Plan.

2.4 Multimedia Outreach

MBNEP and the WMP team utilized a variety of information technologies to educate and inform the public about the watershed planning process, and conditions and issues on the Eastern Shore. The primary mechanisms for this aspect of the watershed planning process were the MBNEP website and social media platforms (e.g., Facebook).

2.5 Community Engagement Summary

Through polls and surveys conducted with the Eastern Shore community and stakeholders over this planning process, there was a general consensus that conditions are getting worse over time, despite efforts by local and regional leadership to address the many complex issues. Top issues throughout the community and stakeholder process have consistently been related to development pressure, sanitary sewer overflows, flooding, and shoreline erosion (see Chapter 6 for further discussion).

Community and stakeholder engagement is a critical element in the watershed management planning process. Input and feedback from the communities on the Eastern Shore, Steering Committee, and stakeholders guided the development of this Plan and their participation and engagement will be paramount to implementing the Plan after completion.

3.0 Watershed Characterization

3.1 Watershed Boundary

The Eastern Shore Watershed, located in southwest Baldwin County, Alabama, along the eastern shore of Mobile Bay, encompasses approximately 22,400 acres (35 square miles). The Watershed includes the Fly Creek United States Geological Survey (USGS) 12-digit HUC 031602050205 and the southern portion of the Tensaw River–Apalachee River Hydrologic Unit Code (HUC 031602040505). The official USGS Fly Creek HUC 12 was modified and re-delineated on its northern end to add an area of approximately 639 acres (0.99 square miles) of the Tensaw River-Apalachee River HUC12, making the Watershed study area approximately 18 miles long and 3.5 miles wide.

The Watershed comprises the following seven Subwatersheds identified for this study: Fly Creek/UT4, the Jordan Brook/Yancey Branch, the Rock Creek/UT1-UT3, Fairhope Core/UT5-UT-6, Point Clear, Bailey Creek/UT7-UT11, and UT12. These Subwatersheds were delineated based on the major streams and tributaries, and their basins that flow into Mobile Bay (Figure 3.1).

Figure 3.1 Eastern Shore Watershed Boundary

Portions of the municipalities of Daphne and Fairhope lie within the Eastern Shore Watershed, as well as a portion of the communities of Montrose, Houstonville, Point Clear, and Barnwell.

3.2 Hydrology

According to Gillett et al. (2000), the major aquifer underlying the Eastern Shore Watershed is the Miocene-Pliocene aquifer. This aquifer consists of the Miocene-Series undifferentiated and the Citronelle Formation. The Miocene-Pliocene aquifer consists of beds of sand, gravel, and clay that are irregular in thickness and have limited lateral extent. Groundwater flows through these sand and gravel beds. The clay intervals between the sand beds are considered "aquitards" because the clays are not laterally extensive enough to prevent the downward movement of groundwater. The clay intervals do provide a semi-confining layer for many of the deeper sand and gravel intervals.

Rain is the primary source of recharge to the aquifer. The average rainfall in Baldwin County is approximately 64 inches per year (in/yr). About 28 in/yr of rainfall runs off during and immediately after storms (Reed and McCain, 1971); a small percentage of rainfall infiltrates the subsurface as recharge to the aquifer, and the remainder is returned to the atmosphere by evaporation and transpiration from trees and other plants. The recharge area for the aquifer includes all Mobile and Baldwin counties. The amount of water that infiltrates the soil depends on the permeability and hydraulic conductivity of the soil, the amount of water present in the soil during rainfall, and the slope of the land surface. Infiltration is greater in a flat area that is underlain by gravel and coarse sands than in an area with a sloping land surface underlain by dense clay (Gillett et al., 2000).

Groundwater discharges primarily into streams, water bodies, and wells. The cities of Fairhope and Daphne have some of the county's larger groundwater pumping centers for potable water usage. In addition to groundwater use for public water supply, groundwater is heavily utilized for self-supplied domestic and agricultural purposes. The groundwater quality in the Miocene-Pliocene aquifer is generally good, and many self-supplied homeowners use groundwater with no treatment (Robinson et al., 1996).

3.2.1 Climate and Rainfall

The climate of the Eastern Shore Watershed is considered humid subtropical with abundant rainfall. Summers are normally dominated by high pressure and southerly winds that frequently result in afternoon thunderstorms. Summer temperatures generally range from 80° to 90° F with 100° F not uncommon. Winters are generally mild, with frequent cold fronts and showers originating from the northwest and low temperatures of 20° F or below occurring most every year. The ground rarely freezes.

Tropical storms and cyclones are also common along the northern Gulf coast. Although "direct hits" are not particularly frequent, approximately 16 total hurricane-strength storms made landfall within 50 nautical miles of Baldwin County between 1900 and 2010, of which seven were major. The estimated return frequency for a hurricane passing within 50 nautical miles of Baldwin County is 10 years and the return frequency for a major hurricane (Category 3 or higher) is 28 years (NOAA National Hurricane Center http://www.nhc.noaa.gov/climo/). When these events do occur, significant amounts of rainfall can occur resulting in flooding conditions, high erosion rates, and the transport of large amounts of sediment and debris into the wetlands, rivers, and bay. Destruction of trees from wind damage and saltwater intrusion from storm surge flooding often results in the land being converted from forest land to other uses (Bianchette et al., 2009). In addition to potential changes in forest cover, estuarine emergent wetlands can also be significantly impacted by hurricanes (Rodgers et al., 2009) having long-term impacts to stormwater runoff patterns and the environment.

Rainfall is the primary natural factor affecting soil loss and stormwater runoff within the Eastern Shore Watershed. Stormwater generated from rainfall is also the main transport mechanism for eroded soils and other pollutants (nutrients, pathogens, etc.), particularly in urban areas with high percentages of impervious cover. The mild, humid climate favors rapid decomposition of organic matter and hastens chemical reactions in the soil. On uplands, the large amount of moisture and the warm temperature favor the growth of bacteria and fungi and speed the decomposition of organic matter, resulting in soils that are low in organic content. The plentiful rainfall leaches large amounts of soluble bases and carries the less soluble fine particles downward, resulting in acidic soils that have a sandy surface layer low in natural fertility.

The Alabama Gulf coast is one of the wettest areas in the United States, second only to the Pacific Northwest, with average annual rainfall of 67 inches and approximately 60 rain days per year. Rainfall occurs throughout the year with the most precipitation during the months of April through September. Rainfall is usually in the form of rain showers, meaning light rainfall that has a short duration and is more scattered across the area. Storms with long periods of continuous rainfall are less common. Tropical summer thunderstorm events are capable of producing localized heavy rainfall totals of several inches with a one-to-two-hour timeframe. The annual mean rainfall from 1991-2020 reported for Fairhope was 65.7 in. (NOAA-National Weather Service, http://w2.weather.gov/climate/) (Figure 3.2).

Also of significance is the intensity and type of rainfall events occurring along the Gulf Coast. The Natural Resources Conservation Service (NRCS) (formerly the Soil and Water Conservation Service) categorizes rainfall into four types of distribution patterns (I, IA, II, III) based on rainfall intensity (inches/hour). Most of the northern Gulf coast, including the southern 2/3 of Alabama, experience NRCS Type III events with approximately 50% of the rain falling during a short interval around the middle of the event. Another measure of the intensity of rainfall events is reflected in the Universal Soil Loss Equation by the "R" factor, a value determined from the raindrop energy, rainfall intensity, rainfall frequency, and storm duration. The R factor along the Alabama coast is around 650 (Figure 3.3). By comparison, the R factor in the Olympic National Forest in Washington State, which receives on average twice the volume of rain (~ 120 inches/year), is only 340. These high intensity rainfall events occurring in the Eastern Shore Watershed make the proper use of appropriate best management practices and stormwater management practices that much more critical.

3.2.2 Surface Water Resources

The Eastern Shore Watershed drains an estimated 51.7 miles of surface water streams and approximately 22.9 miles of coastline, according to the USGS National Hydrology Dataset (NHD) (2021). There are six named streams within the Watershed and 12 unnamed tributaries (UTs), which have been simply named UT1 through UT12 from north to south for identification in this study. The streams and tributaries in our study area consist primarily of perennial streams. The flow of some of these streams transition through ponds or marshes where the NHD classifies these flow segments as "artificial paths" strictly for the purpose of hydrologic modeling. For the streams of Fly Creek and Point Clear, these artificial paths over ponds are not included in the calculations of overall stream lengths. However, for the UT7-UT12 streams, these artificial paths through marshland were included in the stream length calculations (as noted in Table 3.1) as the water flow continues over these with an eventual terminus or exit into Mobile Bay. The stream lengths are therefore not absolute, as water flow through marshes is not a direct path.

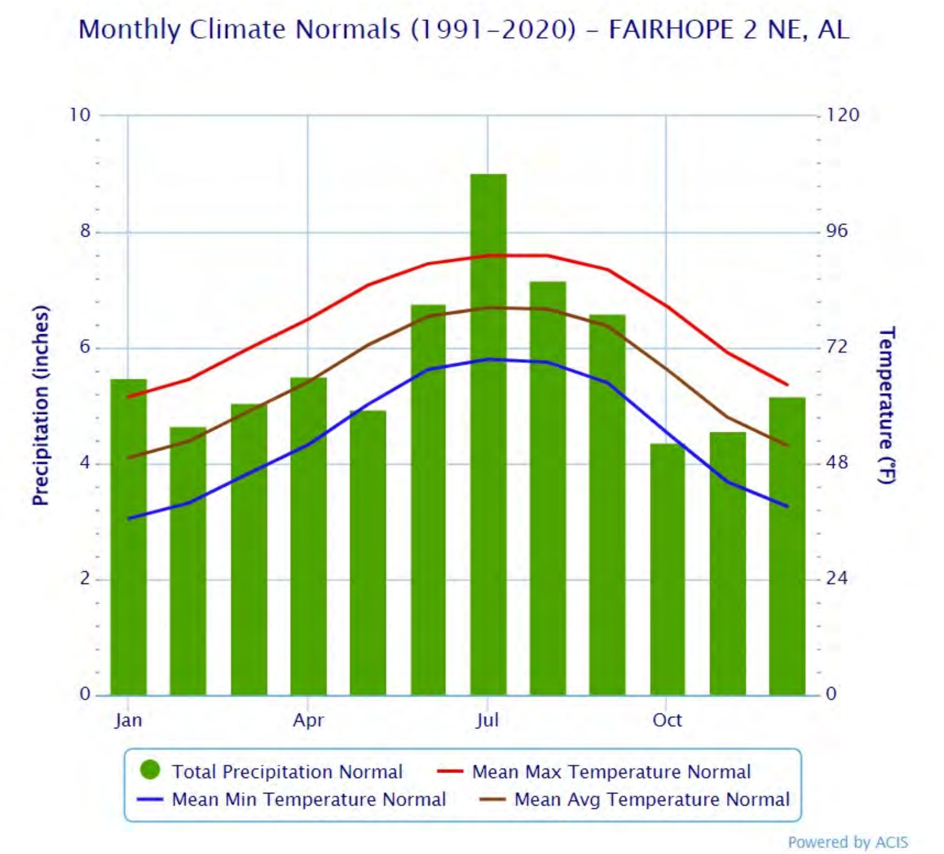


Figure 3.2 Monthly Climate Normals 1991-2020, Fairhope, AL
Source: NWS

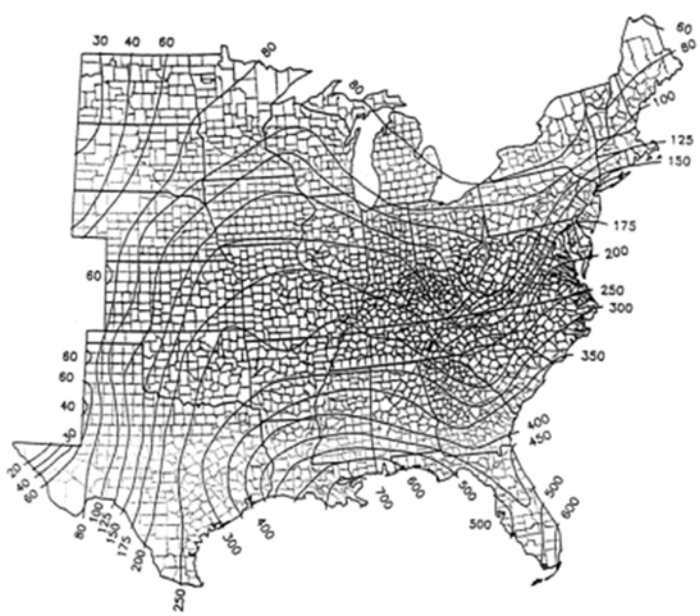


Figure 3.3 Isoerodent Map of Eastern U.S.
Source: Renard et al., 1987

Table 3.1 and Figure 3.4 show the streams and stream lengths for each stream system in the Watershed. The freshwater stream segments are typical blackwater streams with both low pH and planktonic activity (GOMA, 2013b).

Table 3.1 Eastern Shore Stream Segment Lengths by Subwatershed

Subwatershed	Stream/Stream Segment	Length (Miles)	NHD Classification
Jordan Brook/Yancey Branch	Jordan Brook	0.89	Perennial Stream
	Yancey Branch	3.47	Perennial Stream
Total		4.36	
Rock Creek/UT1-UT3	Rock Creek	6.17	Perennial Stream
	UT1	0.76	Perennial Stream
	UT2	0.76	Perennial Stream
	UT3	1.93	Perennial Stream
Total		9.62	
Fly Creek/UT4	Fly Creek	13.12	Perennial Stream
	UT4	1.34	Perennial Stream
Total		14.16	
UT5-UT6	UT5	1.03	Perennial Stream
	UT6	2.79	Perennial Stream
Total		3.82	
Point Clear	Point Clear	6.89	Perennial Stream
Total		6.89	
Bailey Creek/UT7-UT11	Bailey Creek	2.66	Perennial Stream
	UT7	2.79	Perennial Stream/Artificial Path*
	UT8	1.09	Perennial Stream/Artificial Path/Canal-Ditch*
	UT9	1.05	Perennial Stream/Artificial Path*
	UT10	1.19	Perennial Stream/Artificial Path*
	UT11	1.73	Perennial Stream
Total		10.51	
UT12	UT12	2.03	Perennial Stream/Artificial Path*
Total		2.03	
Total Watershed Streams		51.69	

This total includes a portion of NHD segment(s) classified as "Artificial Path" or "Canal/Ditch"
Source: USGS National Hydrology Dataset, 2021

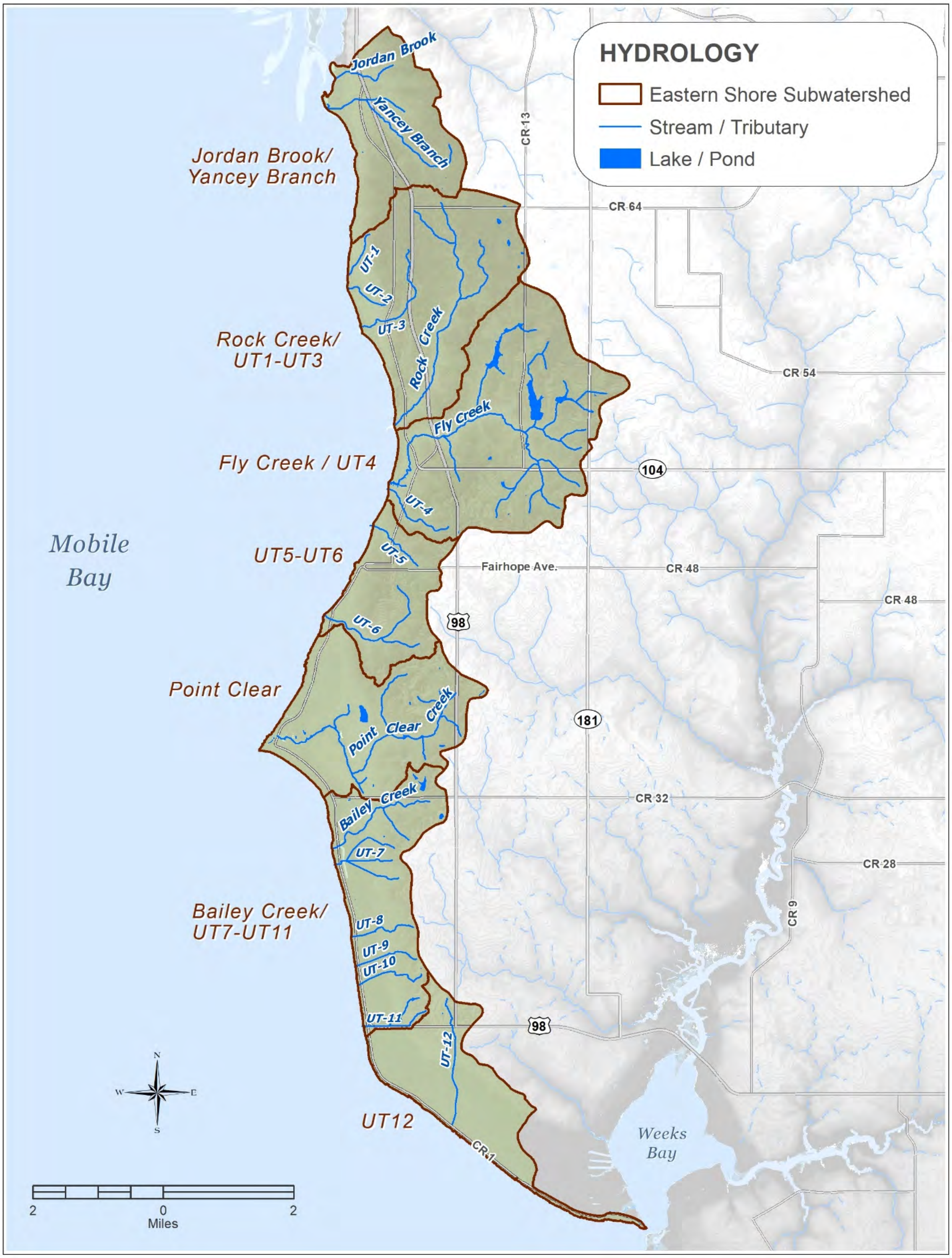


Figure 3.4 Stream Network within the Eastern Shore Watershed

Source: USGS National Hydrology Dataset, 2021

3.2.3 Subwatershed Streams and Drainage Basins

The Eastern Shore Watershed (primarily the Fly Creek HUC12) was subdivided into seven Subwatersheds for this study. Each Subwatershed was delineated based on the primary six named streams. USGS Streamstats, the most recent topographic data (2005 Lidar Contours), and other geographical features were utilized to redefine each stream's drainage basin and delineate the Subwatersheds.

The Jordan Brook/Yancey Branch Subwatershed comprises approximately 2,429 acres. This Subwatershed includes the drainage basin of Yancey Branch (part of USGS Fly Creek HUC 12) and the drainage basin of Jordan Brook, which abuts on the north and is within the USGS Tensaw River-Apalachee River HUC 12. The Jordan Brook basin is approximately 639 acres and lies between the D'Olive Watershed study area to the north and east, and Fly Creek to the south. Because this basin is not part of the D'Olive drainage basin, it was not included in the D'Olive Watershed Management Plans; it has thus been annexed to the Fly Creek HUC12 as part of this Plan.

Jordan Brook was named after Hurtis Glen Jordan (1922-1991), a three-term mayor of Daphne. It flows from Park City Church on Moore Lane westward toward Mobile Bay. Yancey Branch begins on the east side of U.S. Hwy 98 and ends at the City of Daphne's Bay Front-Village Point Park, along Mobile Bay. This Subwatershed has experienced commercial and residential growth, resulting in increased stormwater runoff over the past few decades.

The Rock Creek/UT1-UT3 Subwatershed comprises approximately 4,168 acres. Rock Creek begins just north of County Road (CR) 64 with one tributary beginning at the Target store on the corner of County Road 64 and Hwy 98. A second tributary of Rock Creek begins along Jonesboro Road with little development around it with the exception of a dirt pit at the end of Friendship Road. Rock Creek's Alabama Department of Environmental Management (ADEM) use classifications are Fish and Wildlife. UT1, UT2, and UT3 are arranged from north to south, respectively. UT1 and UT2 both begin west of Scenic Hwy 98/Main Street and flow west to Mobile Bay. UT3 begins in earnest along Hwy 98 from north to south then flows westward and into Mobile Bay. This Subwatershed has mixed uses including agricultural, residential, commercial, and recreational. It includes portions of Daphne and the community of Montrose.

The Fly Creek/UT4 Subwatershed is the largest in the study area, comprising approximately 5,429 acres. The lower end of Fly Creek watercourse is within the tidal influence of Mobile Bay and the Gulf of Mexico, with UT4 and remaining tributaries consisting of approximately 14 miles of perennial streams and 20 man-made lakes/ponds. Fly Creek's ADEM use classifications are Swimming and Fish & Wildlife. The 3.32-mile portion of Fly Creek (from its source to approximately 0.16 miles westward of Highway 98) is listed on ADEM's 303d list for pathogens. The source of contamination is listed as pasture grazing despite vegetative buffers of more than 200 feet in areas adjacent to agricultural properties. The majority of the Fly Creek Subwatershed lies within unincorporated Baldwin County (3,331 acres). The remainder of its acreage is located within the City of Fairhope (1,918 acres) and the City of Daphne (180 acres).

The UT5/UT6 Subwatershed is approximately 1,831 acres in size. UT5 begins north of Fairhope Avenue and flows northwest into Mobile Bay. UT6 begins at two points south of Fairhope Avenue and west of Highway 98 before converging into a single watercourse and flowing into Mobile Bay. The City of Fairhope is central to this Subwatershed and includes most of its area. Uses include residential, commercial, and, to a lesser extent, undeveloped. The largest swaths of undeveloped land can be found in the southern portions of this Subwatershed.

The Point Clear Subwatershed totals 3,379 acres. Point Clear Creek starts east of Highway 98. Several unnamed tributaries contribute to the main watercourse as it flows westward to Mobile Bay. Uses in this Subwatershed include recreational, residential, agricultural, and undeveloped.

The Bailey Creek/UT7-UT11 Subwatershed includes the second largest amount of undeveloped property in the Eastern Shore Watershed study area, comprising 2,845 acres. Other uses include agricultural and residential. Its primary tributary is Bailey Creek with seven unnamed tributaries.

The vast majority of the UT12 Subwatershed's 2,317 acres is covered by undeveloped wetland area. Minor uses in the watershed include residential, recreational, and agricultural. UT12 begins north of Hwy 98 in the Barnwell area and flows southward to Mobile Bay.

3.2.4 Groundwater Resources

The Eastern Shore Watershed is underlain by two major aquifers: the watercourse aquifer (sometimes referred to as the Beach Sand aquifer) and the Miocene-Pliocene aquifer. The watercourse aquifer consists of the Quaternary alluvial, coastal, and terrace deposits and is hydraulically connected to the underlying Miocene-Pliocene aquifer. The Miocene-Pliocene aquifer consists of the Citronelle Formation and the Miocene Series undifferentiated and is approximately 3,400 feet thick in southern Baldwin County (Gillett et al., 2000). The Pliocene Graham Ferry Formation overlies the Pascagoula Formation in southern Mobile County (and possibly in southern Baldwin County). The Pliocene-Pleistocene Citronelle Formation occurs at higher elevations in Mobile and Baldwin counties, everywhere unconformably overlying older Miocene or Pliocene formations (Geological Survey of Alabama, 2018).

The Miocene-Pliocene aquifer system flows through sand and gravel beds that are irregular in thickness and of limited lateral extent. The clay intervals between the sand units are considered aquitards because the clays are not laterally extensive enough to prevent downward movement of groundwater. However, they do provide semi-confinement to many of the deeper sand and gravel intervals. The watercourse aquifer system also flows through sand and gravel beds. The watercourse aquifer and the sand and gravel beds at shallow depths in the Miocene-Pliocene aquifer are hydraulically connected to the land surface and therefore are considered unconfined (Gillett et al., 2000).

3.2.4.1 Groundwater Use and Recharge

The Eastern Shore Watershed is 100 percent dependent on groundwater for potable water supply. Public-water supply wells within the Eastern Shore Watershed derive water from the Miocene-Pliocene aquifer. The Miocene-Pliocene aquifer system is also heavily utilized for self-supplied domestic, agricultural, and recreational purposes (Robinson et al., 1996). According to the Estimated Use of Water in Alabama study (Harper and Turner, 2010), 60 percent of Baldwin County's groundwater use was for irrigation and 37 percent was for public supply in 2010. In Baldwin County, groundwater moves in a southwesterly direction toward Mobile Bay (Geological Survey of Alabama, 2018).

According to the ADEM 2013 public well supply data; there are a total of 11 public supply wells from the watercourse aquifer and 15 public supply wells from the Miocene-Pliocene aquifer in the Eastern Shore Watershed. There are five public supply wells in the Jordan Brook/Yancey Branch Subwatershed, five public supply wells in the Rock Creek/UT1-UT3 Subwatershed, two public supply wells in the Fly Creek/UT4 Subwatershed, four public supply wells in the UT5/UT6 Subwatershed, seven public water supply wells in the Point Clear Creek Subwatershed, one public supply well in the Bailey Creek/UT7-YT11 Subwatershed, and two public supply wells in the UT12 Subwatershed. Figure 3.5 identifies each well location.

The source of recharge to the aquifers is rainfall. The amount of water that infiltrates the soil depends on the hydraulic conductivity and permeability of the soil, the amount of water present in the soil during rainfall, and the slope of the land surface. Infiltration is greater in a flat area that is underlain by gravel and coarse sands rather than in an area with a sloping land surface that is underlain by dense clay. The amount of recharge to the aquifers may be estimated from the base (dry weather) flow of streams, which is groundwater discharge (Gillett et al., 2000).

A literature search for impacts of impervious cover on groundwater recharge found a 1996 report titled "*Ground-Water Resource Data for Baldwin County, Alabama*" performed by the U.S. Geological Survey (Robinson et al., 1996). In that report, geologic and hydrologic data for 237 wells were collected, and water levels in 223 wells in Baldwin and Escambia counties were measured. Data was collected during the period of investigation from September 1994 to November 1995. Long-term water level data, available for many wells, indicated that groundwater levels in most of Baldwin County showed no significant decline. This suggested that groundwater use levels at the time of the study were sustainable in Baldwin County. However, groundwater levels showed that there may be a declining trend in the general area of Spanish Fort and Daphne (both cities with major growth). Additionally, groundwater levels in Gulf Shores and Orange Beach areas were less than five feet above sea level in places.

3.2.4.2 Groundwater Quality

The quality of water in the Miocene-Pliocene aquifer system of Baldwin County generally is good, and many self-supplied homeowners use groundwater with no treatment. Wells in the Miocene-Pliocene aquifer generally yield soft water with dissolved solids content of less than 250 milligrams per liter (mg/L). Water in alluvium and low terrace deposits generally is soft and has a dissolved solids content less than 100 mg/L but commonly contains iron in excess of 0.3 mg/L and may be corrosive (Gillett et al., 2000).

The Miocene-Pliocene and watercourse aquifers are considered highly vulnerable to contamination from surface sources throughout the Watershed due to their unconsolidated nature and the permeability of the soils. Numerous surface sources of potential contamination include point sources such as gasoline/diesel tanks, chemical spills, etc. and nonpoint sources such as pesticides and herbicides applied to agricultural fields, lawns, and gardens, urban run-off, etc. (Gillett et al., 2000).

In a 2006-2007 study to assess the extent and source of nitrate contamination in the aquifer system of southern Baldwin County, isolated pockets of severe nitrate contamination present in the Miocene-Pliocene aquifer were discovered. The study concluded that the likely source of this nitrate contamination is related to sewer breakthrough from leaking, outdated, and/or improperly installed septic tanks. The chloride and nitrate concentrations for points located within this area are consistent with contamination derived from sewer breakthrough, animal waste, and, to some extent, the application of fertilizers (Murgulet and Tick, 2009).

Figure 3.5 Public Groundwater Wells and Aquifer Recharge Areas
Source: MBNEP, Alabama Coastal Resources Comprehensive GIS Inventory

3.3 Geologic Setting

3.3.1 Physiographic Provinces

The Eastern Shore Watershed is located entirely within the East Gulf Coastal Plain section for the Coastal Plain physiographic province. Portions of each Subwatershed are located in both the Southern Pine Hills and the Coastal Lowlands districts (Figure 3.6). The Southern Pine Hills district consists of mostly upland areas with terrain sloping gradually southward. The Coastal Lowlands district consists of flat to gently rolling plains, tidal streams, marshes, and wetlands (Gillett et al., 2000).

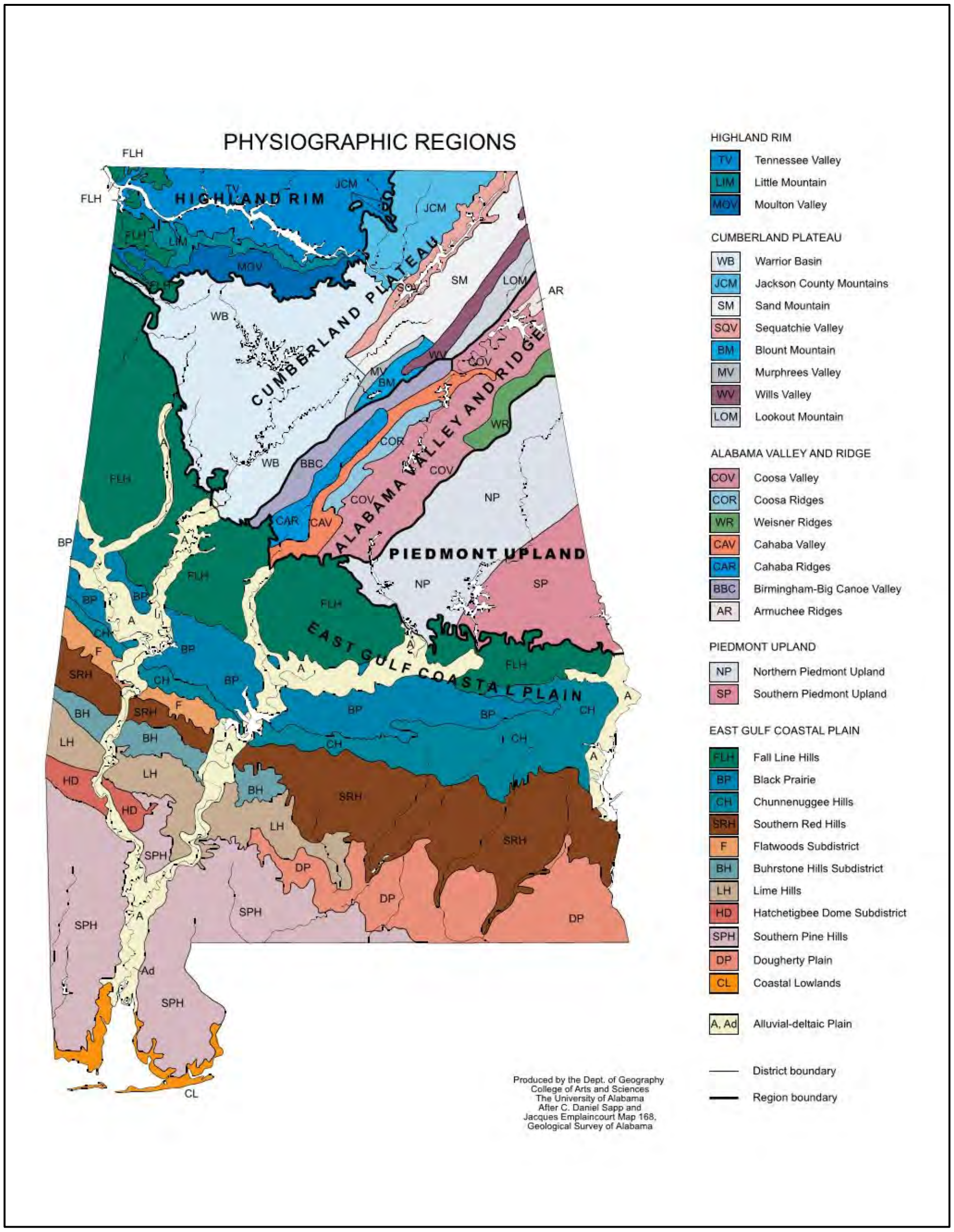


Figure 3.6 Physiographic Provinces of Alabama
Source: University of Alabama (2017)

3.3.2 Topography

The terrain in the northern and eastern portions of the Eastern Shore Watershed is marked by long, rolling hills, entrenched streams, and rivers with steep banks. The streams and rivers drop to base level in relatively short distances and are characterized by as much as 170 feet of relief. Relief in the southern portions of the Watershed is comparatively limited; most streams and rivers there have broad channels and low, gently sloping banks (Davis, 1987).

The elevations within the Eastern Shore Watershed range from zero/sea level along the bottoms of creeks and rivers and in western/southern portions of the Watershed to approximately 170 feet National Geodetic Vertical Datum (NGVD) in the Watershed's northeastern portions (Figure 3.7).

3.3.3 Geological Formations

The Eastern Shore Watershed is located within the Coastal Lowlands District in the East Gulf Coastal Plain physiographic section. The Coastal Lowlands district in Alabama includes the coastal areas and the mainland plains sunken by many tidal streams and edged by tidal marshes and barrier islands. These barrier islands and tidal marshes are continually being modified by erosion and deposition. The Coastal Lowlands district is characterized by flat to gently undulating, locally swampy plains (Gillett, Raymond, Moore, and Tew, 2000).

The most commonly exposed geologic formations occurring within the Eastern Shore Watershed are the Miocene Undifferentiated Series, Citronelle Formation, and the Alluvium, low-terrace, and coastal deposits as depicted in Figure 3.8. These strata were deposited as a result of sea level variations and fluvial and deltaic deposition that occurred over millions of years.

The deepest materials exposed by the Watershed streams and creeks are of the Miocene Undifferentiated Series. According to Gillett et al. (2000), sediments of the Miocene Series outcrop in central and northern Mobile and Baldwin counties. The unit ranges in thickness from 100 feet in northern Baldwin County to 3,400 feet in the subsurface in southern Mobile County. According to Reed (1971),

"…the Miocene Series consists of light-gray, yellowish-gray, yellow, and white laminated to thin-bedded and massive clay, sand, and sandy clay. The sands generally range from fine- to coarse-grained and are locally cross-bedded. Distinct beds of light-gray massive sandy clay at the top of the Miocene Series contrast sharply with the gravelly sand in the overlying Citronelle Formation."

The Miocene Series was subdivided into the Ecor Rouge Sand and the Mobile Clay formations by Isphording (1977). According to Isphording (2011), the Miocene aged geologic unit exposed in the Watershed is the Ecor Rouge Sand. The Ecor Rouge Sand consists of white, pale yellow, pink, and light gray sands; silty sands; and white, thin-to-massive, bedded clay and sandy clays and locally occurring gravel composed of quartz or light-colored chert.

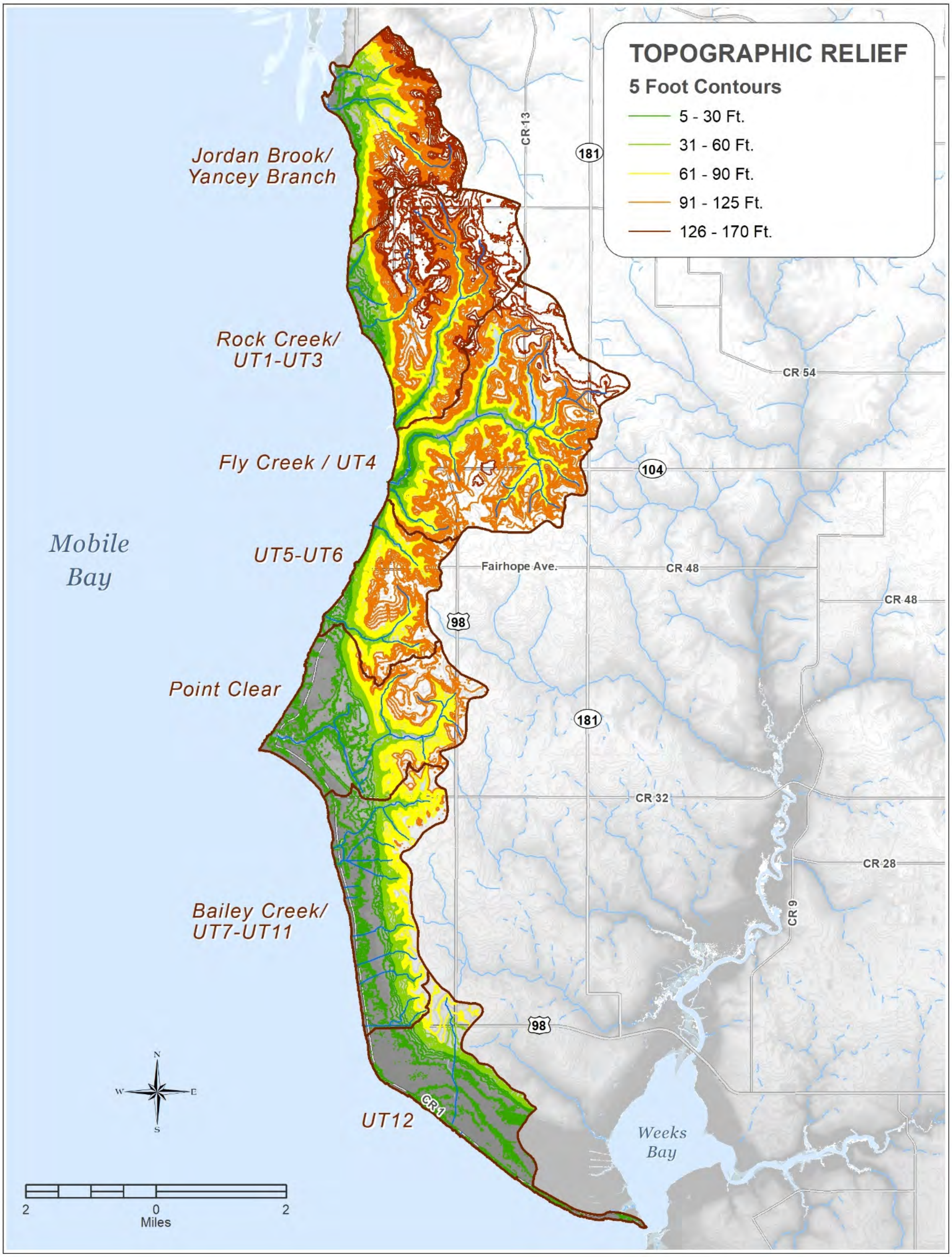


Figure 3.7 Topography of Eastern Shore Watershed
Source: Baldwin County, GIS 1-foot contour data, 2005

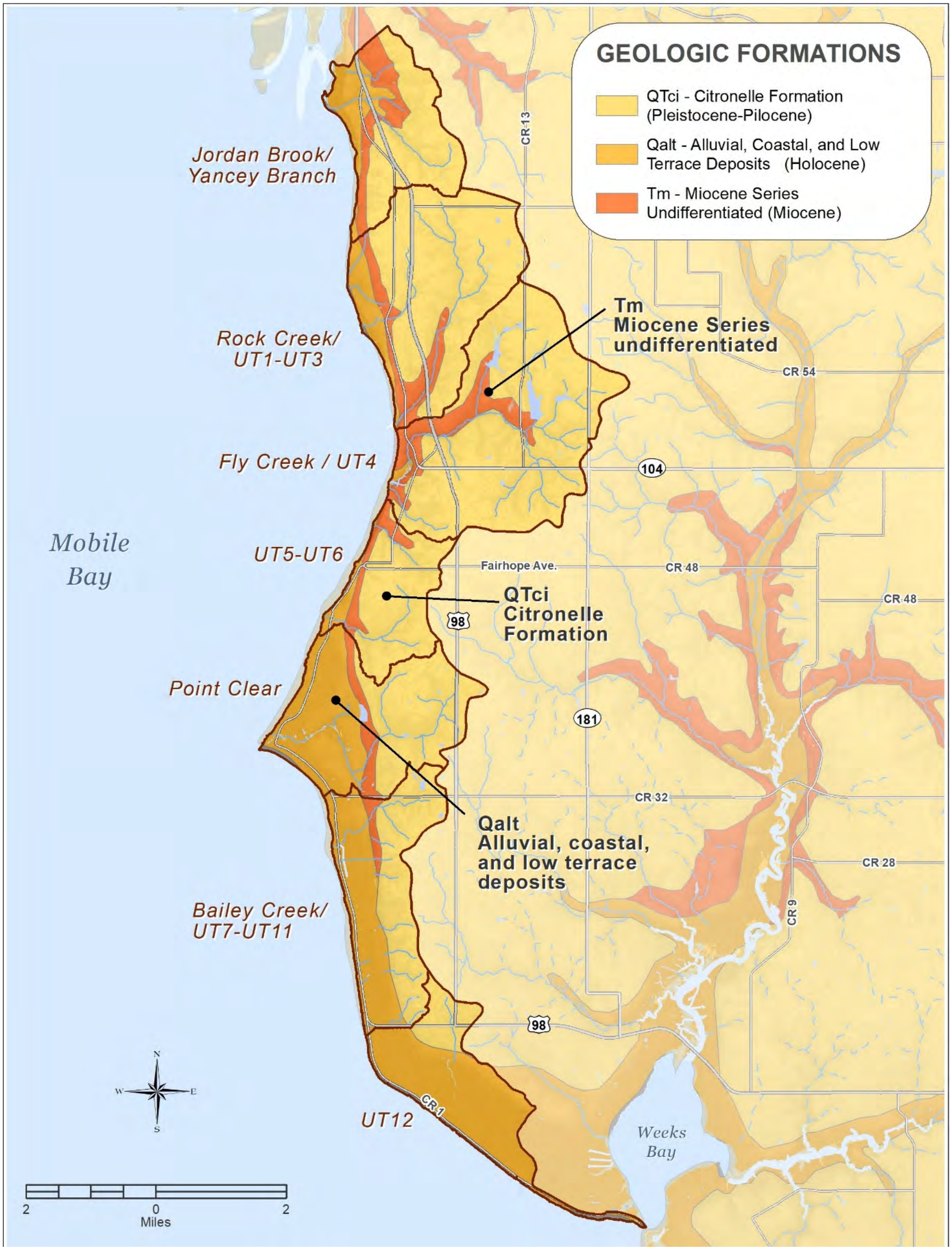


Figure 3.8 Geologic Map of Eastern Shore Watershed
Source: USGS Digital Geologic Map of Alabama

The majority of the Eastern Shore Watershed overlies the Citronelle Formation, which is Pliocene in age and overlies the Miocene materials. The Citronelle Formation outcrops in the central and southern parts of Mobile and Baldwin counties. The formation is confined to higher elevations in these counties due to erosion that has occurred along streams and the edges of Mobile Bay, so that the Miocene Undifferentiated is exposed along the bay and instream channels.

The Citronelle Formation sediments were deposited under a combination of fluvial and estuarine conditions and vary both laterally and vertically (Gillett et al., 2000). The Citronelle Formation consists of layers and lenses of interbedded sands and clays with occasional beds of gravel. Sediment type often changes abruptly over short distances. According to Reed (1971), the Citronelle Formation:

"…is as much as 130 feet thick and consists of dark reddish-brown gravelly sand, which locally contains light-gray clay balls and partings, and light-gray, orange, and brown sandy clay. Gravel in the Citronelle in Baldwin County generally is light-colored quartz that is, in some exposures, as much as one inch in diameter. Lenticular (lens shaped) beds of light-gray to orange-brown sandy clay and clayey sand that are five to 15 feet thick are interbedded with gravelly sands in many areas. The base of the formation is marked in many exposures by a dark yellowish-brown sandstone bed that locally contains gravel. A similar gravelly sand overlying massive clay is present about 25 feet below the contact; however, the upper horizon was mapped as the Citronelle-Miocene boundary because it is exposed over a broader area and because the clay is present throughout the area and is not lenticular and discontinuous as are clays in the Citronelle."

The Alluvium, low terrace, and coastal deposits of Holocene age are exposed along the Mobile Bay banks and at the mouth of Fly Creek. The Alluvial, low terrace, and coastal deposits unconformably overlie older geologic units in lowland areas in parts of Baldwin County (Reed, 1971). An unconformity is a buried erosion surface separating two types of strata of different ages, indicating that sediment deposition was not continuous. This may indicate a time of regression, in which the sea level falls relative to the land and exposes former sea bottom.

The Alluvial, low terrace, and coastal deposits represent complex beach, dune, lagoonal, estuarine, and deltaic depositional environments (Szabo and Copeland, 1988). The deposits consist of white, gray, orange, and brown very-fine-to-coarse sand that is gravelly in many exposures. Gray and orange clay and sandy clay are interbedded with the sand locally. The Alluvial, low terrace, and coastal deposits are estimated to range in thickness from zero to 200 feet, based on the first occurrence of coarse siliciclastic sediments (Gillett et al., 2000).

The sand and gravel beds represent buried channel deposits. Their widths and depths are similar to those of present riverbed sediments. The length of individual sand and gravel beds probably ranges from a few hundred to a few thousand feet. These buried channel deposits are surrounded by silt and clay sediment similar to those being deposited on the present flood plain of the Mobile River (Gillett et al., 2000).

3.3.4 Soils

The principal soil associations located within the Eastern Shore Watershed include the Bowie-Tifton-Sunsweet association, the Marlboro-Faceville-Greensboro association, the Lakeland-Plummer association, and the Norfolk-Klej-Goldsboro association. These associations comprise a few major soils and several minor soils grouped together based on characteristic patterns (McBride and Burgess, 1964).

The Bowie-Tifton-Sunsweet association is characterized predominantly by well-drained or excessively drained, nearly level-to-moderately-steep soils of uplands. The soils in this association are well suited for agriculture. The Marlboro-Faceville-Greenville association is characterized by nearly level to gently sloping well drained soils. The soils in this association developed in unconsolidated Coastal Plain material and are highly developed for agriculture in the area. The Lakeland-Plummer association is characterized by deep, somewhat excessively drained to very-poorly-drained, nearly level soils of bottom lands and nearly level to moderately steep soils of uplands. A large acreage in this association is probably best suited to pines and has little potential for row crops. The Norfolk-Klej-Goldsboro association is characterized by nearly level or gently sloping soils of uplands and of soils of the associated bottom lands. The soils in this association are well drained, but depressions in the level areas and bottom lands along small streams may drain poorly. They are also well suited for both crop and livestock agriculture (McBride and Burgess, 1964). There are 88 different soil types located within the Eastern Shore Watershed. Figure 3.9 shows the soil groups within the Watershed. A detailed description of each soil group is provided in Appendix B.

The soil erodibility factor (K factor) indicates the susceptibility of a soil to erosion and the rate of runoff. The K factor is based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity. Values of K range from the lowest erodibility, 0.02, to the highest, 0.69. All other factors being equal, the higher the K value, the greater the susceptibility of the soil to rill and sheet erosion by rainfall. In general, soils with greater permeability, higher levels of organic matter, and improved soil structure have a greater resistance to erosion and, therefore, lower K values.

Typically, subsoils have higher K-factors and are more erodible than topsoils. When land clearing and grading activities expose subsoils, the K-factor increases. Exposed subsoils can be expected to erode faster because they have less organic matter and plant root mass to hold soil particles together structurally. The formation of micropores allowing percolation of rainfall is reduced in subsoils, resulting in increased runoff. Increased runoff produces greater sheer forces for detaching soil particles from the surface, and accelerating erosion.

The parent subsoil materials within the Eastern Shore Watershed are more highly variable with clay, silt, and sand strata, than are the weathered and more homogenous superficial soils. As such, some of these subsoil strata contain fine sand and silty stratum that are highly erodible when exposed to precipitation and stormwater runoff.

The K factors for the soil series occurring within the Eastern Shore Watershed vary from 0.02 to 0.37 (Web Soil Survey). Soils having K factors less than 0.23 are considered to have low erodibility, soils with K factors from 0.23 to 0.36 are considered moderately erodible, and soils having K factors from 0.37 to 0.69 are highly erodible. Figure 3.10 presents a visual summary of the soil erodibility within the Watershed based on the soil K factors. The summary of K factor ratings within the Watershed is found in Appendix B.

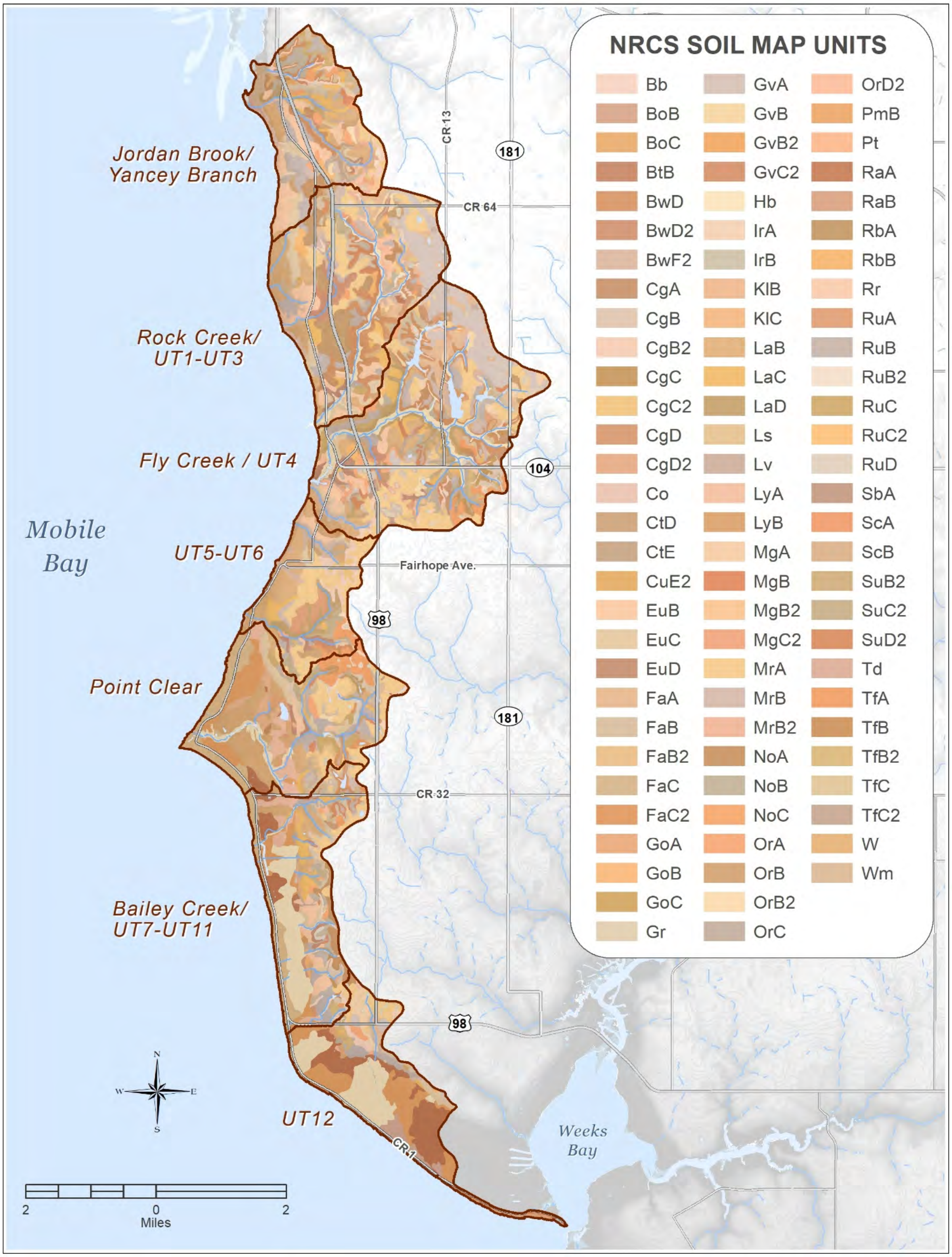


Figure 3.9 Major Soil Types within Eastern Shore Watershed

Source: USDA-NRCS Soil Survey Geographic Database (SSURGO)

Note: soil map unit descriptions described in the Appendix B

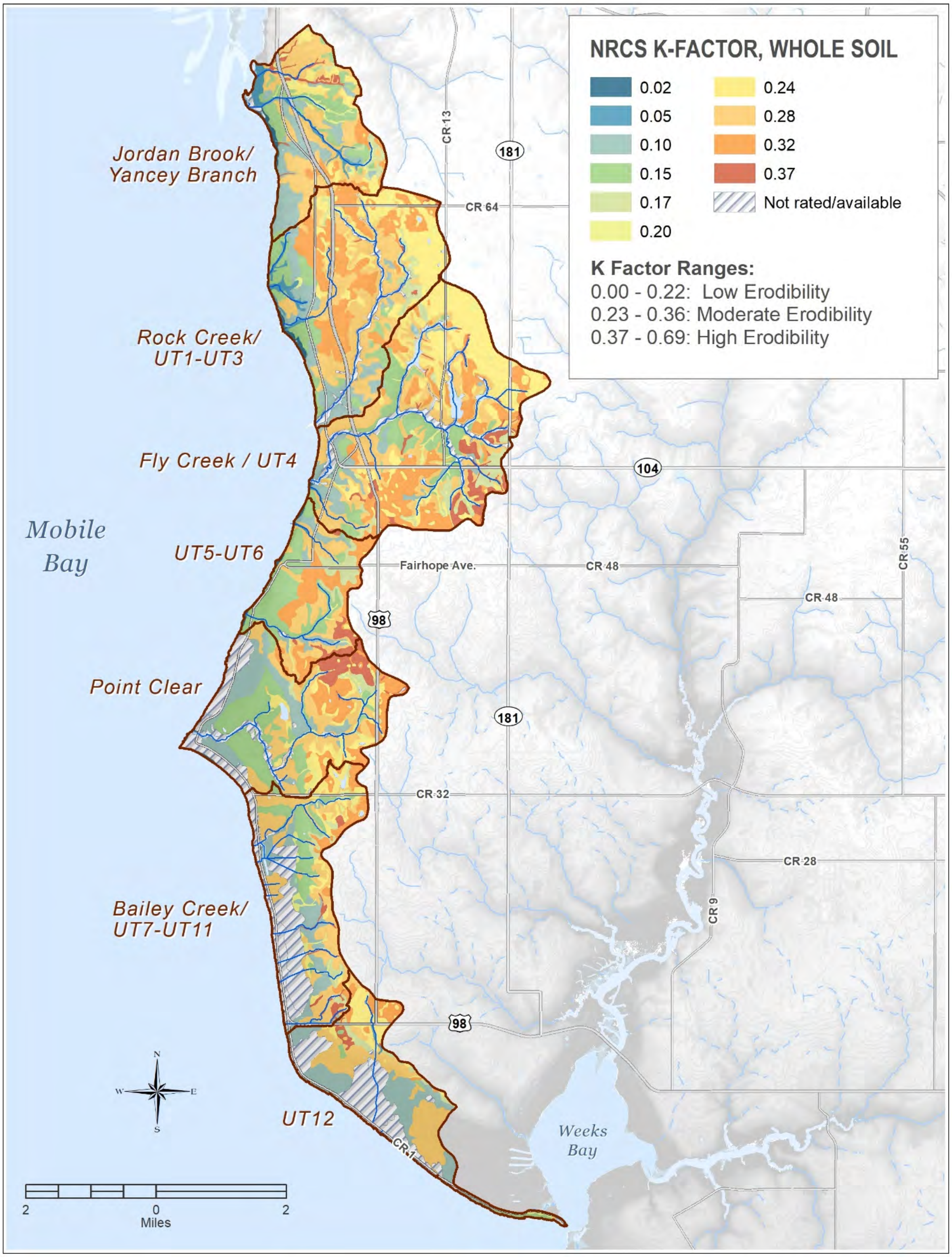


Figure 3.10 Soil Erodibility K Factors within Eastern Shore Watershed

Source: USDA-NRCS Soil Survey Geographic Database (SSURGO)

Note: Erosion factor aggregation report can be found in Appendix B

3.4 Floodplains and FEMA Flood Zones

Floodplains within the Eastern Shore Watershed and their flood hazard area designations are depicted in Figure 3.11. The flood hazard areas shown are designated by the Federal Emergency Management Agency (FEMA) and include Zone A (subject to inundation by the 1-percent-annual-chance flood event [referred to as the "100 year storm" in other literature] with no base flood elevation (BFE) determined), Zone AE (subject to inundation by the 1-percent-annual-chance flood event with BFE determined), and Zone VE (subject to inundation by the 1-percent-annual-chance flood event with additional hazards due to storm waves with BFE determined).

The effective date of all Flood Insurance Rate Maps (FIRMs) within the Eastern Shore Watershed is 2020. In 2017, FEMA updated all flood maps within Baldwin County through a cooperative agreement with the Alabama Department of Economic and Community Affairs (ADECA), Office of Water Resources (OWR) (ADECA, 2017). The update identified 55 riverine miles and 111 coastal miles for detailed study through hydrologic and hydraulic modeling.

Riverine studies use the characteristics of the Watershed, such as topography and precipitation, to determine flood depths and flood profiles. These are used to describe the special flood hazard areas associated with riverine features on flood maps. Riverine flooding occurs in defined inland waterways such as rivers, streams, and ditches when these waterbodies overflow their banks, resulting in flooding, flash floods, and inundation of urban storm sewer systems.

Coastal flood studies include storm surge with wave modeling, wave hazard analysis, and mapping. Hurricanes cause storm surge, which is the rise of water level associated with a storm. Wave modeling determines the magnitude of the surge, based on a number of parameters. These parameters include track and speed of the storm, atmospheric pressure, offshore water depths, and location of landfall. The results of the modeling are stillwater elevations, which are used to establish the special flood hazard areas along the coastline. The maps and studies may be found on the ADECA website (http://adeca.alabama.gov/Divisions/owr/floodplain/Pages/default.aspx).

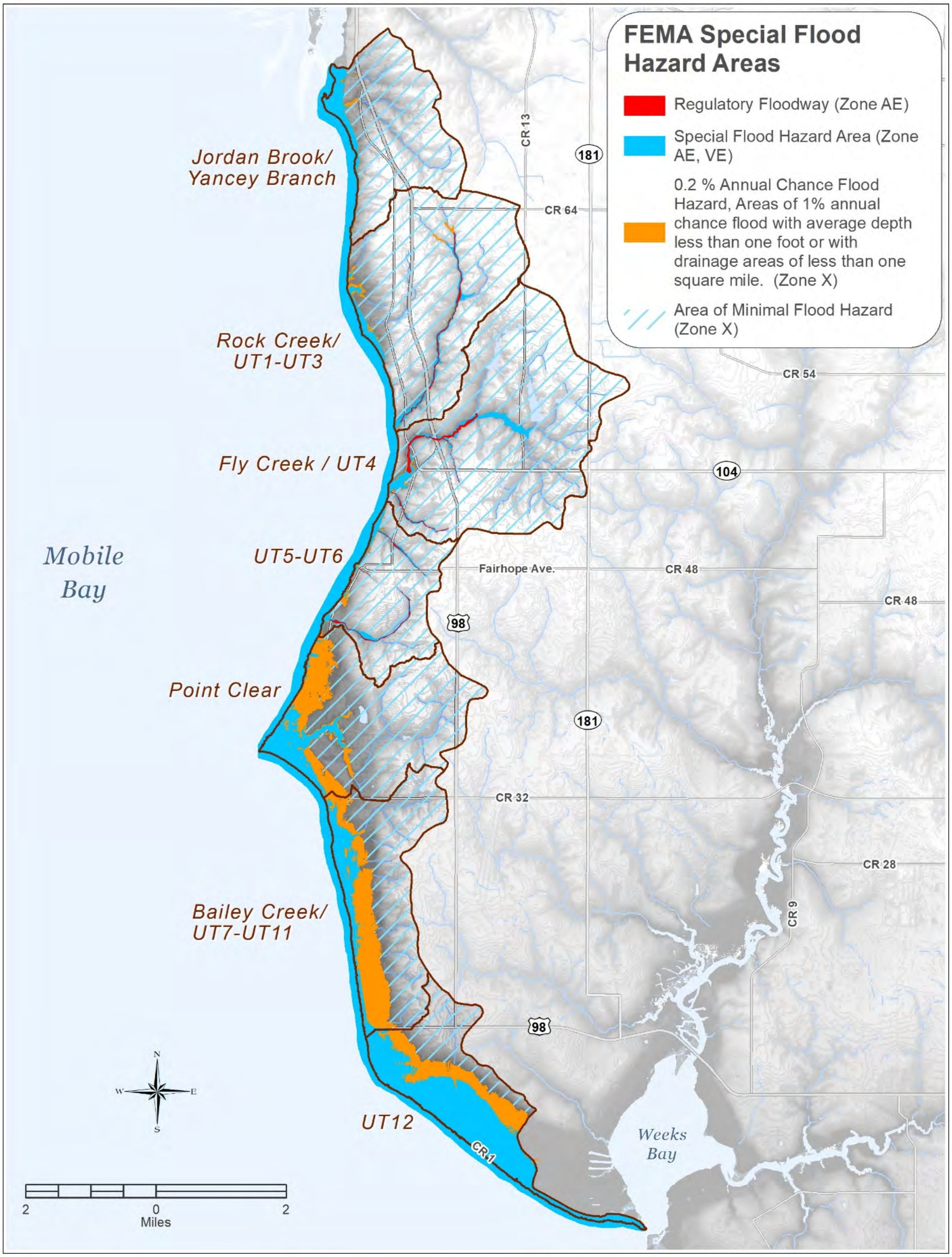


Figure 3.11 Federal Emergency Management Agency Flood Zones within Eastern Shore Watershed
Source: FEMA

3.5 Shorelines

3.5.1 Shoreline Types

The Geological Survey of Alabama (Jones, Tidwell, and Darby, 2009) was reviewed to categorize the shorelines in the Eastern Shore Watershed. Table 3.2 provides a description of the various shoreline types identified within the Eastern Shore Watershed.

Table 3.2 Applicable Shoreline Type Classifications, as Defined in the GSA Phase I Report

Shoreline Type	Description
Artificial Shorelines	Shorelines built in areas previously occupied by water. Typically built for industrial and commercial use; examples include causeways, infilling, and shoreline extensions.
Vegetated Bank Shorelines	
a. Bluff	Greater than 20 feet above the high tide line (within 50 yards of the shoreline).
b. High Bank	5-20 feet above the high tide line (within 50 yards of the shoreline).
c. Low Bank	0-5 feet above the high tide line (within 50 yards of the shoreline).
Organic Bank Shorelines	
a. Open Shoreline Vegetated Fringe	Occurs where water grasses flourish just in front of the shoreline in shallow water.
b. Marsh	Occurs where saltwater or freshwater marsh habitat adjoins open water.
Sediment Bank Shorelines	
a. Bluff	Greater than 20 feet above the high tide line (within 50 yards of the shoreline).
b. High Bank	5-20 feet above the high tide line (within 50 yards of the shoreline).
c. Low Bank	0-5 feet above the high tide line (within 50 yards of the shoreline).
Inlet	Where unnavigable tributaries meet the open water, at the farthest mapped upstream locations, and in shallow channels within marsh habitat.
Pocket Beach	Mainly located between two shoreline protections structures extending into the water.

Source: Jones, Tidwell, and Darby, 2009

The 11 shoreline types found in the Watershed are shown in Figure 3.12. The dominant shoreline type in the Watershed is Low Vegetated Bank (51%), followed by Low Sediment Bank (23%), with the other shoreline types ranging from 1% to 6%. Figure 3.13 presents the percentage abundance of these 11 shoreline types for the total Watershed shoreline length of approximately 143,200 linear feet.
The Jordan Brook/Yancey Branch Subwatershed (length of approximately 17,400 linear feet) is characterized by inlet (2.0%), marsh organic (7.6%), open vegetated fringe organic (13.8%), bluff sediment bank (3.5%), high sediment bank (1.0%), low sediment bank (51.0%), bluff vegetated bank (10.8%), and high vegetated bank (10.5%). The Rock Creek/UT1-UT3 Subwatershed (length of approximately 16,210 linear feet) is characterized by inlet (1.7%), bluff sediment bank (19.4%), high

sediment bank (1.1%), low sediment bank (50.8%), bluff vegetated bank (10.1%), high vegetated bank (11.9%), and low vegetated bank (5.0%). The Fly Creek/UT4 Subwatershed (length of approximately 20,780 linear feet) is characterized by artificial (3.1%), inlet (0.7%), low sediment bank (3.3%), bluff vegetated bank (23.4%), high vegetated bank (3.8%), and low vegetated bank (65.7%). The UT5/UT6 Subwatershed (length of approximately 12,920 linear feet) is characterized by inlet (0.5%), open vegetated fringe organic (1.5%), bluff sediment bank (1.2%), high sediment bank (27.3%), low sediment bank (12.3%), bluff vegetated bank (1.4%), high vegetated bank (14.3%), and low vegetated bank (41.3%). The Point Clear Subwatershed (length of approximately 22,430 linear feet) is characterized by artificial (8.3%), pocket beach (3.4%), high sediment bank (9.6%), low sediment bank (40.9%), high vegetated bank (2.2%), and low vegetated bank (35.6%). The Bailey Creek/UT7-UT11 Subwatershed (length of approximately 20,250 linear feet) is characterized by inlet (0.3%), low sediment bank (0.2%), and low vegetated bank (99.5%). The UT12 Subwatershed (length of approximately 33,190 linear feet) is characterized by artificial (2.3%), inlet (0.2%), open vegetated fringe organic (8.4), low sediment bank (12.3%), and low vegetated bank (76.9%).

More detailed shoreline protection change information (Jones, Tidwell, and Darby 2009) is provided and discussed in Chapter 4.5 of this report, plus an analysis of historic aerial photography and recent high-resolution aerial photography to identify primary areas of change.

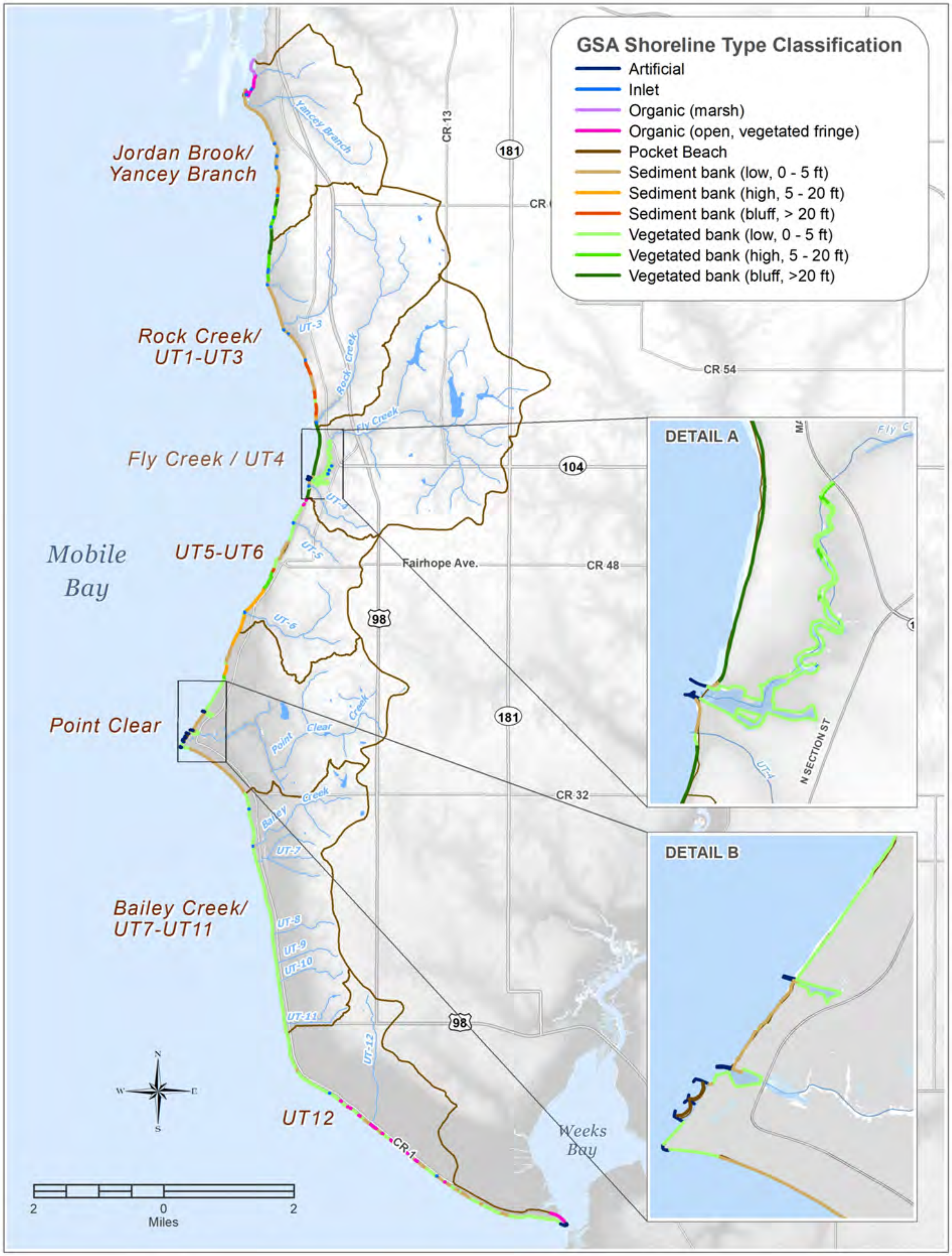


Figure 3.12 GSA Shoreline Type Classification Map

Source: Jones, Tidwell, and Darby, 2009

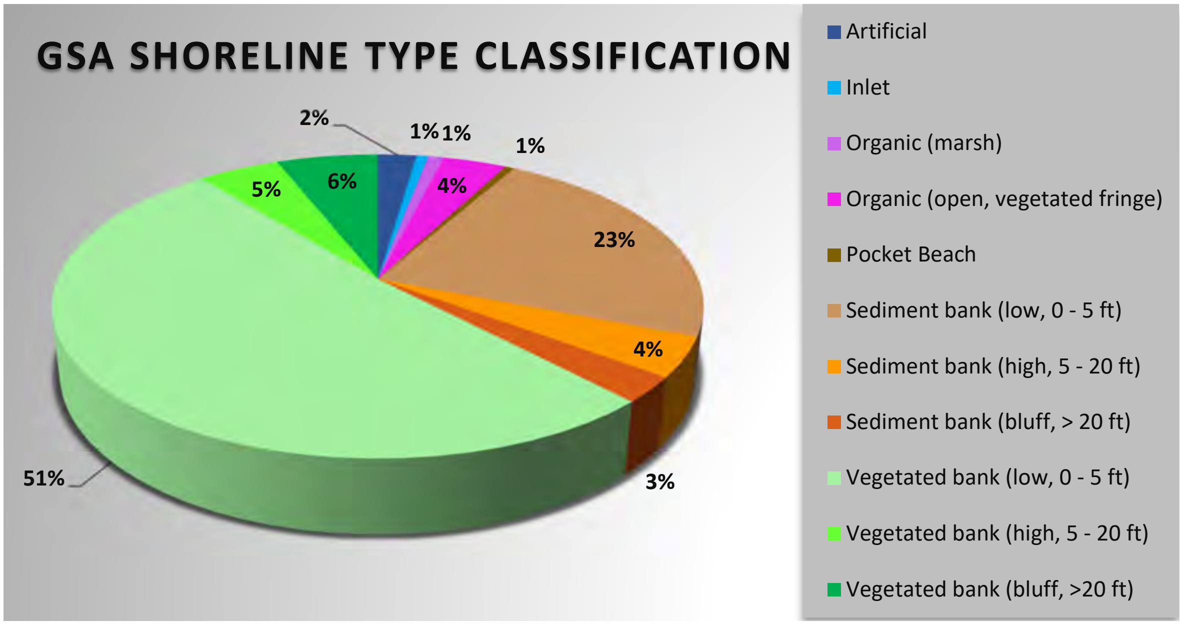


Figure 3.13 GSA Shoreline Type Classification Percentages
Source: Jones, Tidwell, and Darby, 2009

3.6 Flora and Fauna

3.6.1 Ecoregions

The natural communities that comprise the Eastern Shore Watershed reside within three physiographic or ecoregions: the Southern Pine Plains and Hills (Ecoregion 65f), the Gulf Coast Flatwoods (Ecoregion 75a), and the Gulf Barrier Islands and Coastal Marshes (Ecoregion 75k) which are described as follows (Griffith et al., 2001; O'Neil and Chandler, 2003, in GOMA 2013a):

Ecoregion 65f. The Southern Pine Plains and Hills have a different mix of vegetation and land use compared to 65d, and streams tend to be darker tea-colored and more acidic as one moves south. The oak-hickory-pine forest of the north in 65d grades into southern mixed forest and longleaf pine forest in this region. The longleaf pine forest provided habitat for now rare or endangered species such as the red-cockaded woodpecker, gopher tortoise, eastern indigo snake, and Florida pine snake. Loblolly and slash pine plantations now cover wide areas. The hill summits and higher elevations are composed of the Citronelle formation, generally sandy, gravelly, and porous, and more resistant to erosion than the older underlying Miocene sandstones.

Ecoregion 75a. The Gulf Coast Flatwoods ecoregion stretches from eastern Louisiana, across southern Mississippi and Alabama, and into west central Florida. In Alabama, it is a narrow region of nearly level terraces and delta deposits composed of Quaternary sands and clays. Wet, sandy flats and broad depressions that are locally swampy are usually forested, while some of the better-drained land has been cleared for pasture or crops.

Ecoregion 75k. The Gulf Barrier Islands and Coastal Marshes region contains salt and brackish marshes, dunes, beaches, and barrier islands that enclose Mississippi Sound and Mobile Bay. Cordgrass and saltgrass are common in the intertidal zone, while xeric coastal strand and pine scrub vegetation occurs on parts of the dunes, spits, and barrier islands.

The Eastern Shore Watershed lies in a transition zone between the Southeastern Plains and Southern Coastal Plain Level III Ecoregions (Griffith et al., 2001). The Southeastern Plains is a geographically broad area ranging from southern Virginia to south Florida and westward across Alabama, Mississippi, and Louisiana into eastern Texas. The Southern Coastal Plain has near-coastal lands, generally lower in elevation and with less relief and wetter soils than the Southeastern Plains.

The Southeastern Plains and Southern Coastal Plain are subdivided into three Level IV Ecoregions in the Watershed. The Southern Pine Plains and Hills is a component of the Southeastern Plains and represents 37% of the total Watershed area. Natural land cover in the Southern Pine Plains and Hills is typically mixed (deciduous and evergreen) forest and pine forest. The Southern Pine Plains and Hills is positioned along the highest elevation areas of the Watershed (Figure 3.14), and of the seven Subwatersheds covers a majority of the area in the Rock Creek/UT1-UT3 and Fly Creek-UT4 Subwatersheds (Table 3.3).

Table 3.3 Watershed acreage by Level IV Ecoregion

Eastern Shore Subwatershed	Acreage by Level IV Ecoregion		
	Southern Pine Plains and Hills	Gulf Coast Flatwoods	Gulf Barrier Islands and Coastal Marshes
Jordan Brook-Yancey Branch	957.9	1445.6	-
Rock Creek/UT1-UT3	2646.4	1531.2	-
Fly Creek-UT4	4453.1	980.4	-
UT5-UT6	54.0	1784.1	-
Point Clear Creek	615.9	2759.4	-
Bailey Creek-UT7-UT8-UT9-UT10-UT11	133.5	1321.3	1395.7
UT12	-	534.1	1780.9
Total	8,860.8	10,356.1	3,176.6

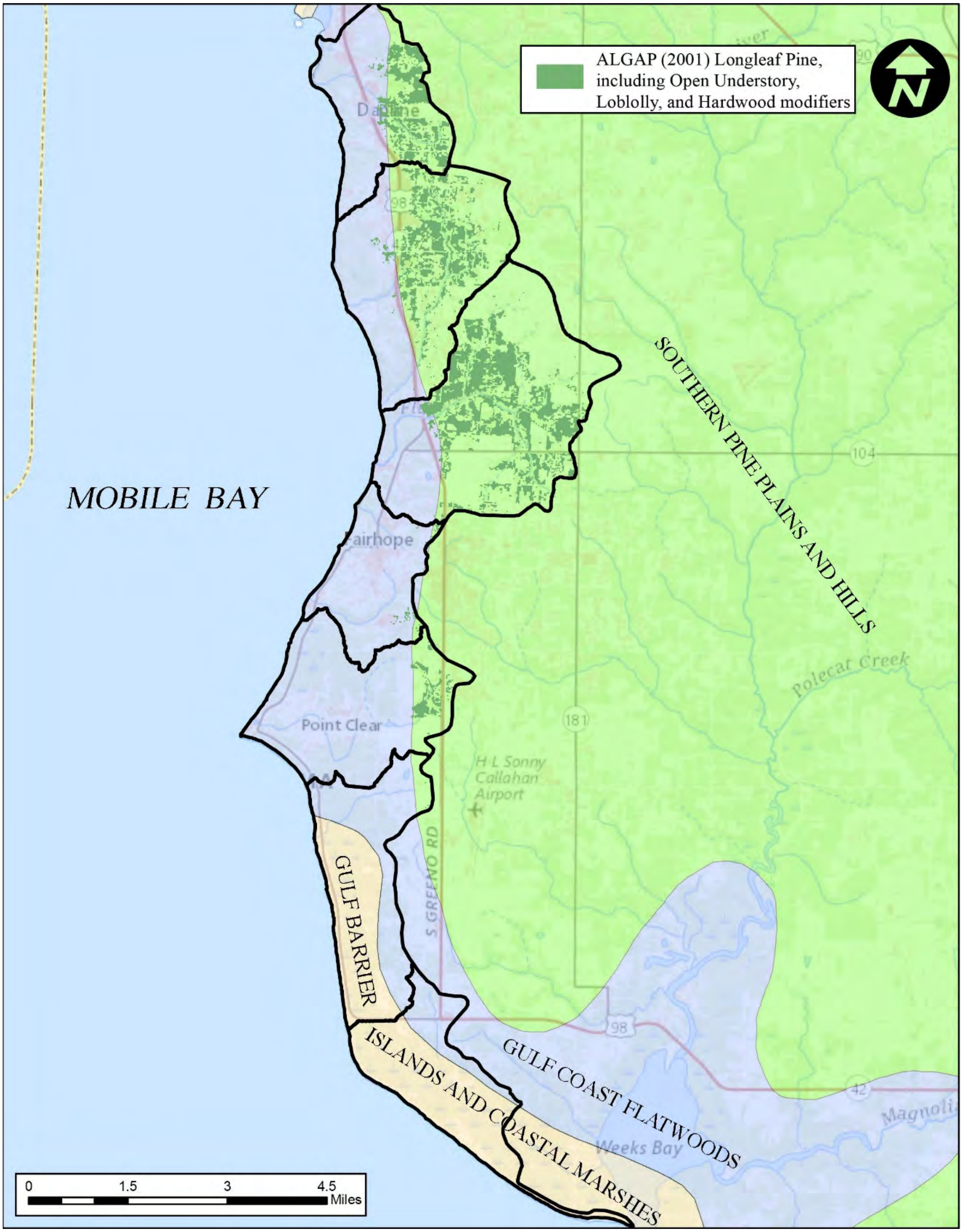


Figure 3.14 Level IV Ecoregions in the Eastern Shore Watershed
Source: ALGAP 2001

The Southern Coastal Plain Level III Ecoregion is subdivided into the Gulf Coast Flatwoods and Gulf Barrier Islands and Coastal Marshes Level IV ecoregions (Figure 3.14). The Gulf Coast Flatwoods has wet, sandy flats and broad depressions that are locally swampy and usually forested, while some of the better-drained lands have been cleared for pasture or crops (Griffith et al., 2001). Portions of all seven Subwatersheds lie in the Gulf Coast Flatwoods, which encompasses 46% of the total Watershed area.

The southwestern portion of the Watershed along the Mobile Bay shoreline is in the Gulf Barrier Island and Coastal Marshes ecoregion. This region generally contains natural communities of salt and brackish marshes, forested wetlands, and xeric coastal strand and pine scrub vegetation. The Gulf Barrier Islands and Coastal Marshes ecoregion comprises the majority of the area in the two southernmost Subwatersheds (Bailey Creek-UT7 to UT11 and UT12) (Table 3.2).

The Watershed includes named and unnamed streams and drainage ways that generally flow toward Mobile Bay. Freshwater from streams ultimately mixes with diluted saltwater from the Gulf of Mexico to produce a brackish water estuarine environment. The Watershed supports an abundant and diverse mix of freshwater and estuarine species.

3.6.2 Uplands

In the drier and warmer climate that followed the Pleistocene glaciations of 8,000 to 12,000 years ago, longleaf pine (*Pinus palustris*) came to dominate upland forests of the Southeastern U.S. (Conner et al., 2001). Historically, approximately 62 million acres of longleaf pine-dominated communities occurred across the Southeastern Coastal Plain (Conner et al., 2001). Today, these native pinelands occupy less than 3% of their former range (Outcalt and Sheffield, 1996). Mohr (1901) and Harper (1913) described vegetation of the Coastal Plain region of Alabama, noting that large tracts of continuous longleaf pine dominated upland forests of the time.

Changes in land use resulted in a marked reduction in the natural pineland's former range (Frost, 2006; Carr et al., 2010; Napton et al., 2010). After depletion of the native cypress forest of the Mobile-Tensaw Delta, longleaf pine forests became the main timber source at coastal Alabama sawmills (Mohr, 1901). In the early 1900s, cutover pinelands of Baldwin County were increasingly converted to farms (Harper, 1913).

The Alabama Gap Analysis Program (ALGAP, 2001) mapped longleaf pine and associated communities using remote sensing techniques and a classification scheme of open understory (true) longleaf, a loblolly modifier, and a hardwood modifier. The classification was produced to describe current vegetation that exists on land that once had longleaf woodlands. Former longleaf areas in the Watershed are shown in Figure 3.14. Today these areas mostly are upland hardwood forest on the slopes above stream floodplains. Modern-day fire suppression has promoted colonization by fire-intolerant hardwoods, which has eliminated the natural and diverse longleaf pine vegetative community (Carr et al., 2010). Silvicultural timberlands with planted slash pine (*Pinus elliottii*) and loblolly pine (*Pinus taeda*) plantations have replaced much of the natural longleaf systems that once dominated the landscape.

Near some streams, upland forests are of the hammock type (Harper, 1913), which skirt the lower river swamps of the Alabama near-coastal region (Mohr, 1901). The species common to hammocks include southern magnolia (*Magnolia grandiflora*), laurel oak (*Quercus laurifolia*), water oak (*Quercus nigra*), and beech (*Fagus grandifolia*), with characteristic understory shrubs such as wax myrtle (*Morella cerifera*) and yaupon (*Ilex vomitoria*).

National Land Cover Dataset (NLCD) (NLCD, 2016) data include upland forested lands totaling 6,456 acres in the Watershed, approximately 29% of its total area. These forests consist primarily of mixed pine/hardwood and pine. Other upland land cover types include developed/urban areas (7,313 ac, 33% of the Watershed total) and agricultural lands (4,472 ac, 20%).

3.6.3 Riparian Buffers

Upland areas can have gradual or abrupt transitions to lower elevation waters and wetlands. Riparian buffers are transitional areas between upland habitats and aquatic and wetland habitats. Natural buffer zones support vegetation along the length of streams and rivers, often including uplands and wetlands. Forested uplands act as wetland buffers, helping to improve water quality by filtering pollutants and moderating stormwater runoff. Vegetation in the riparian corridor benefits water quality and habitat by regulating temperature, adding organic matter, assisting in pollution reduction, stabilizing streambanks, and providing wildlife habitat to a broad range of mammals, birds, reptiles, amphibians, and insects (Semlitsch and Bodie, 2003; Marczak et al., 2010). Floodplains and their associated rivers and streams are among the world's most valuable resources in providing ecosystem services (Costanza et al., 2014). There is substantial potential for ecosystem service provision by forests in urban green spaces (Ziter and Turner, 2018).

Undisturbed riparian zones with natural vegetation help maintain highly diverse and functional aquatic communities, whereas narrow and impaired riparian zones, such as those associated with roads, pastures, cropland, lawns, and impervious surfaces, often result in poor water quality and impaired biological condition in the receiving waters (Figure 3.15).

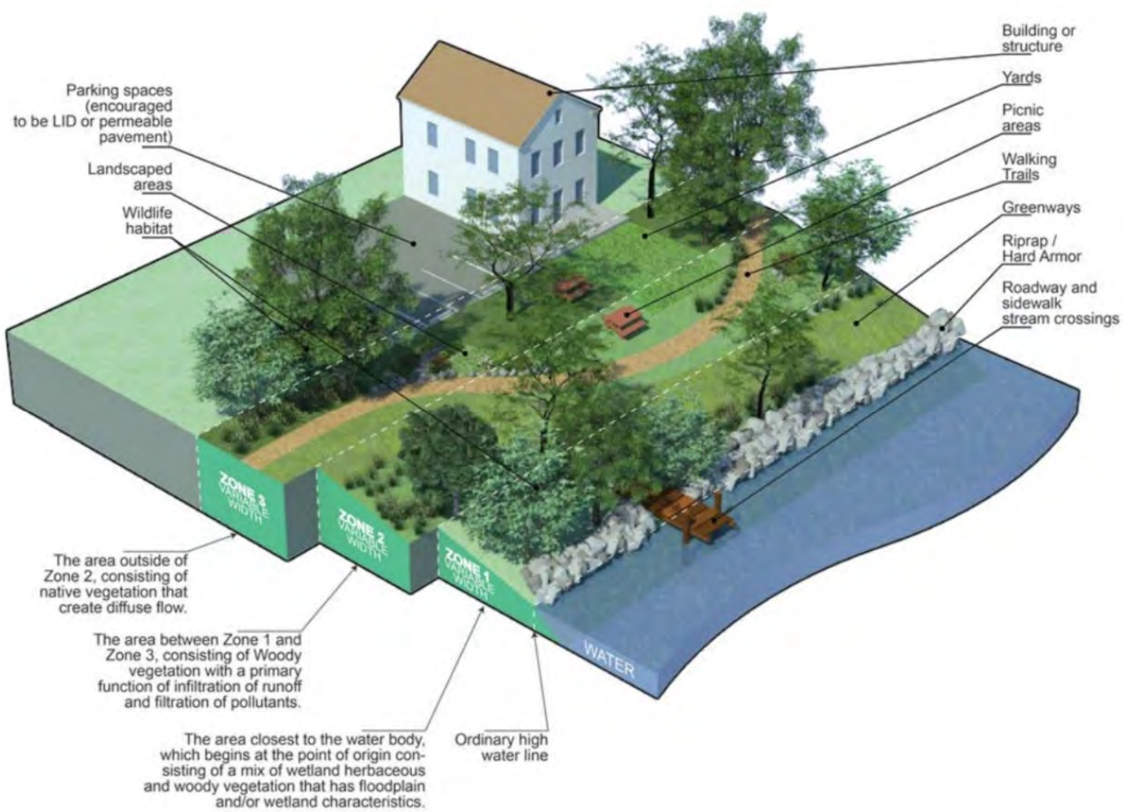


Figure 3.15 Riparian Buffer Diagram
Source: Mobile Baykeeper

3.6.4 Wetlands

Wetland ecosystems share a number of features, including extended periods of inundation or saturation, hydrophytic vegetation, and hydric soils. Wetlands occur under a wide range of geologic and physiographic situations and exhibit a wide variety of physical, chemical, and biological characteristics and processes (Cowardin et al., 1979).

The Watershed has freshwater palustrine, lacustrine, and estuarine wetlands sustained by the brackish tidal waters of Mobile Bay. Palustrine systems include non-tidal freshwater wetlands dominated by trees, shrubs, and emergent herbaceous plants. In the Watershed, these primarily include forested floodplain systems associated with perennial streams and intermittent drainage ways, and broad, flat areas typically saturated or inundated for extended periods. Lacustrine wetlands include natural and man-made ponds, lakes, and impoundments. Tidally influenced forested and herbaceous estuarine wetlands occur in the lower reaches of the major streams and along Mobile Bay.

The National Wetland Inventory (NWI) map (USFWS, 2000) was updated for the Watershed at a landscape-scale, using recent aerial photography, Baldwin County Light Detection and Ranging (LiDAR) elevation contour data (2014-2016), and field observations. Watershed wetlands are shown in Figure 3.16. Individual wetland maps for the seven Subwatersheds are shown as Figures 3.17 to 3.23.

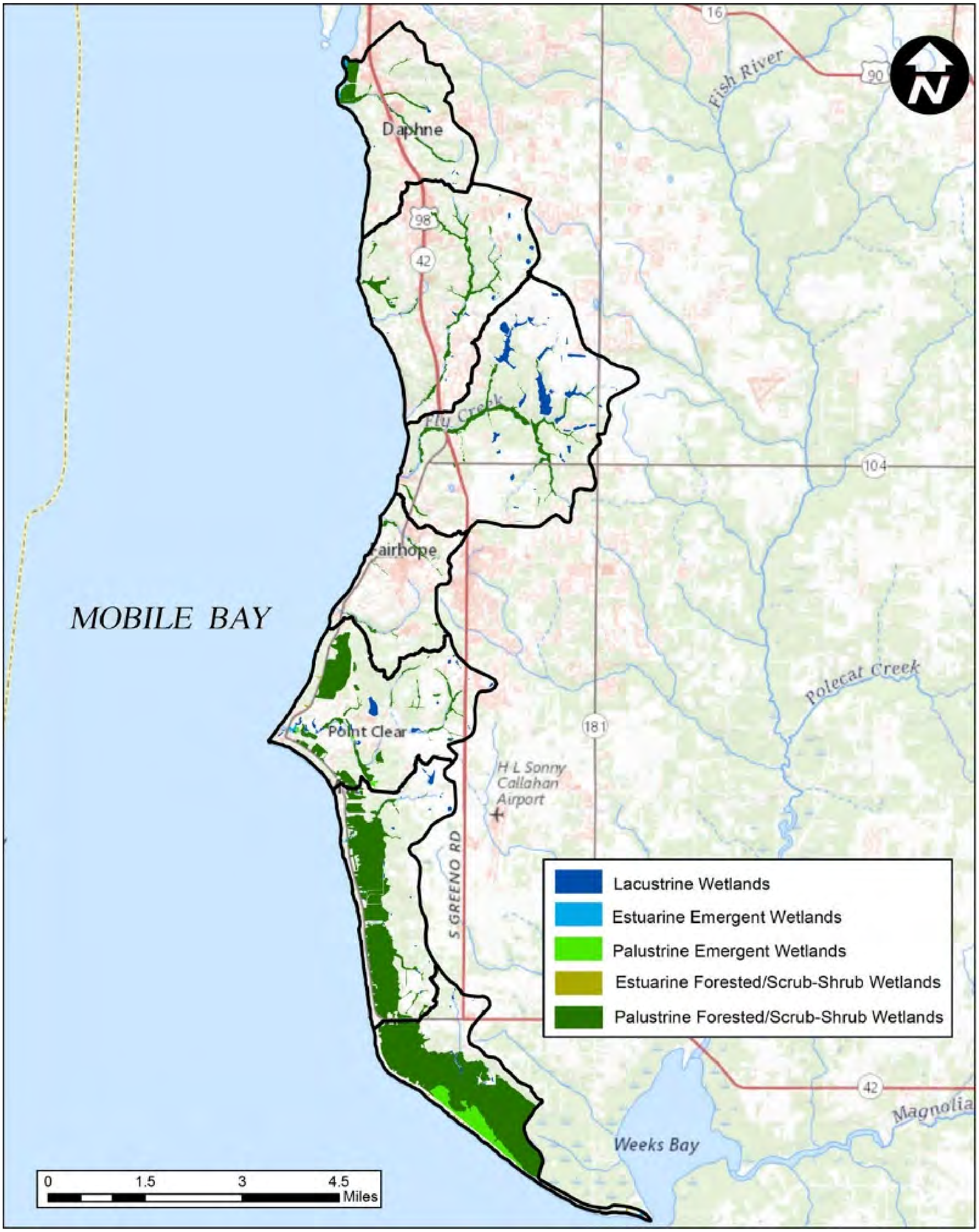


Figure 3.16 Wetlands in the Eastern Shore Watershed

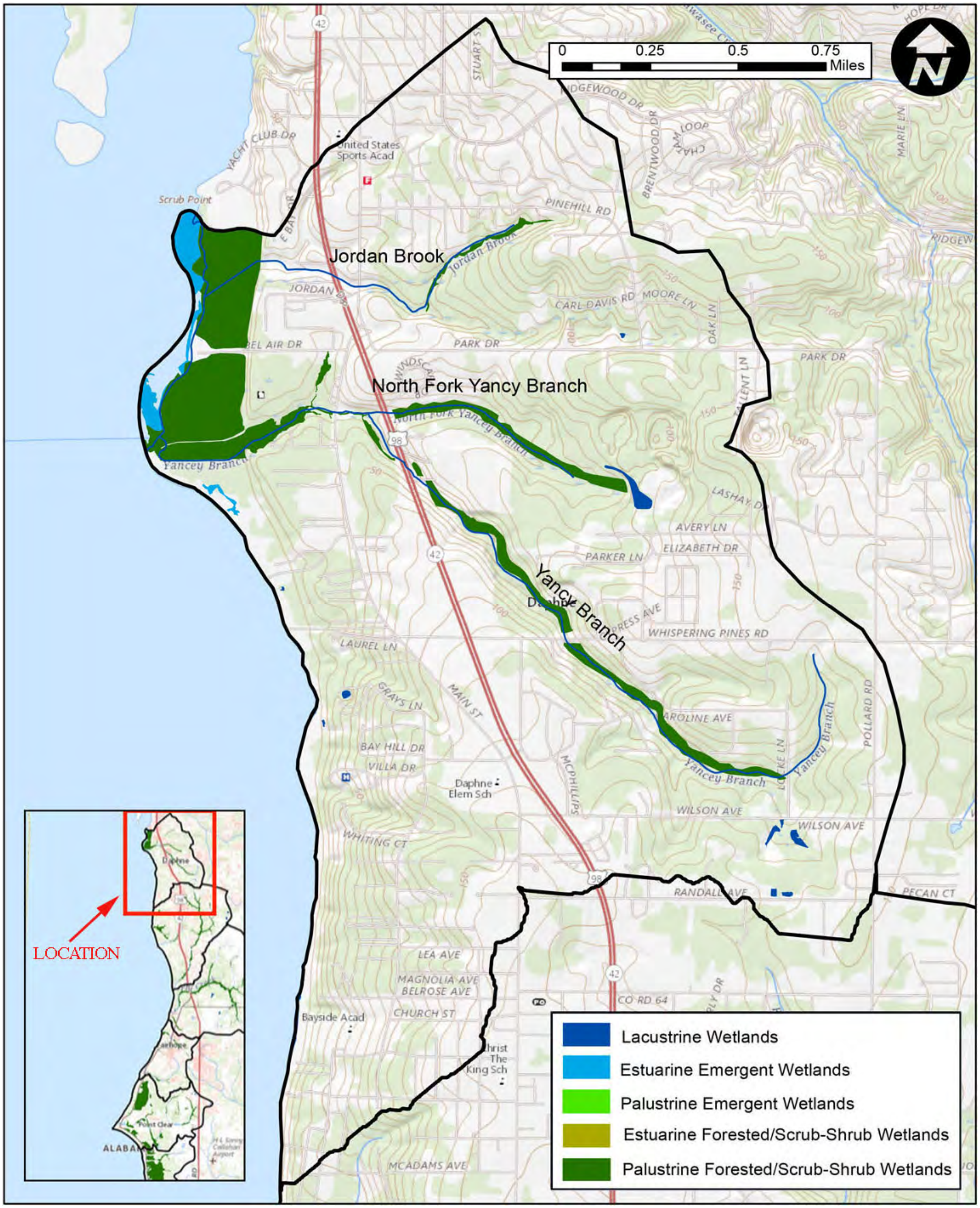


Figure 3.17 Wetlands in the Jordan Brook/Yancey Branch Subwatershed

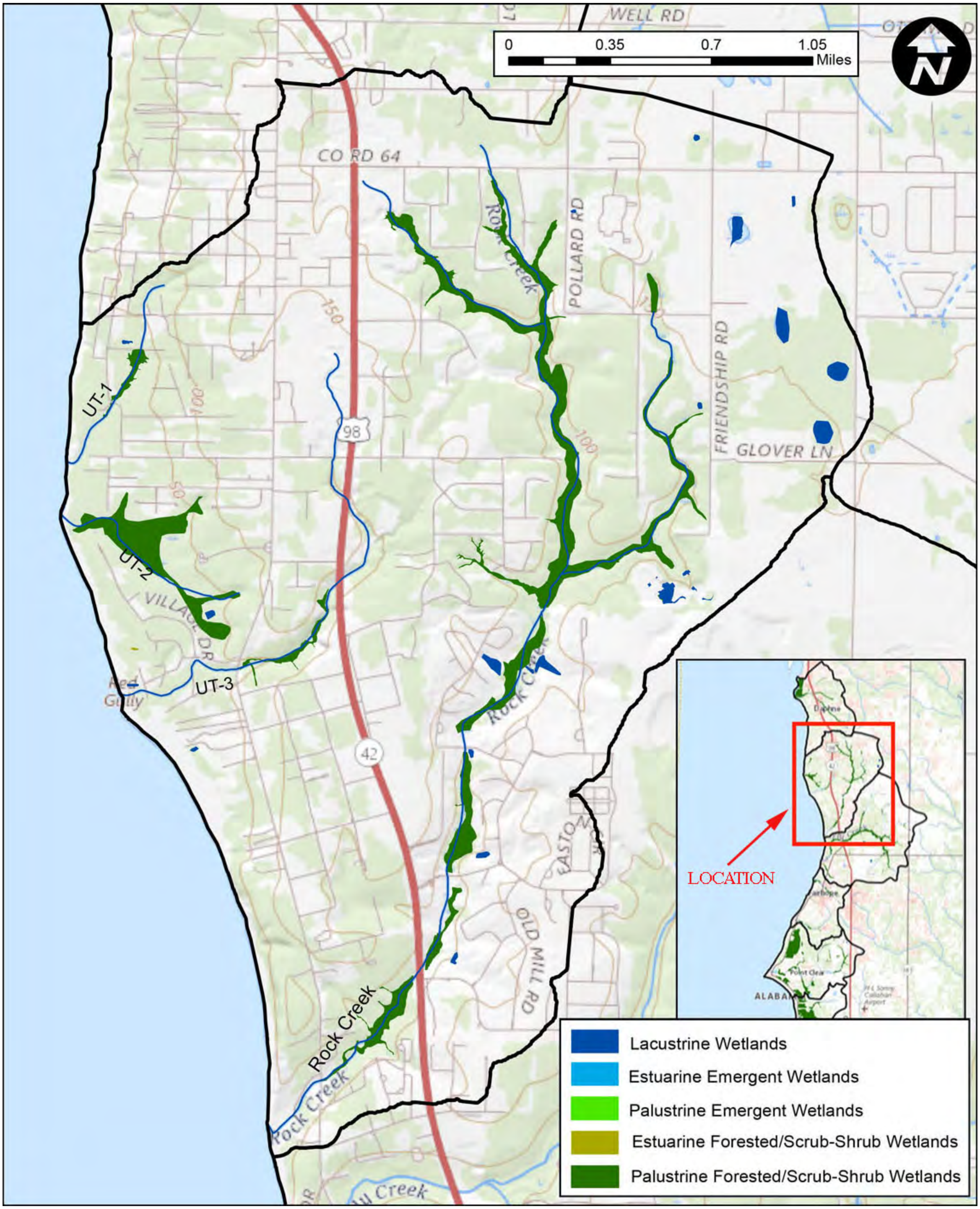


Figure 3.18 Wetlands in the Rock Creek / UT1-UT3 Subwatershed

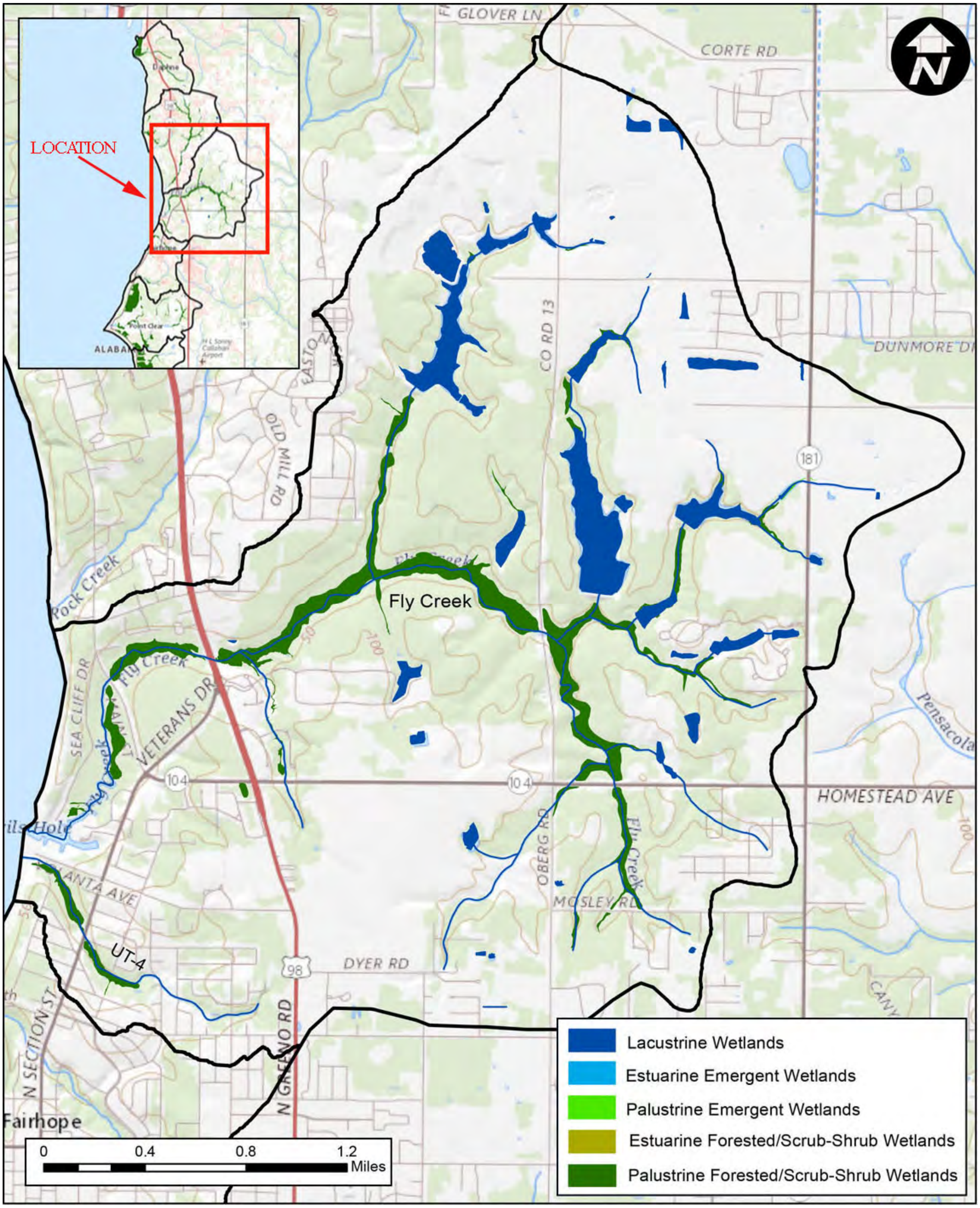


Figure 3.19 Wetlands in the Fly Creek/UT4 Subwatershed

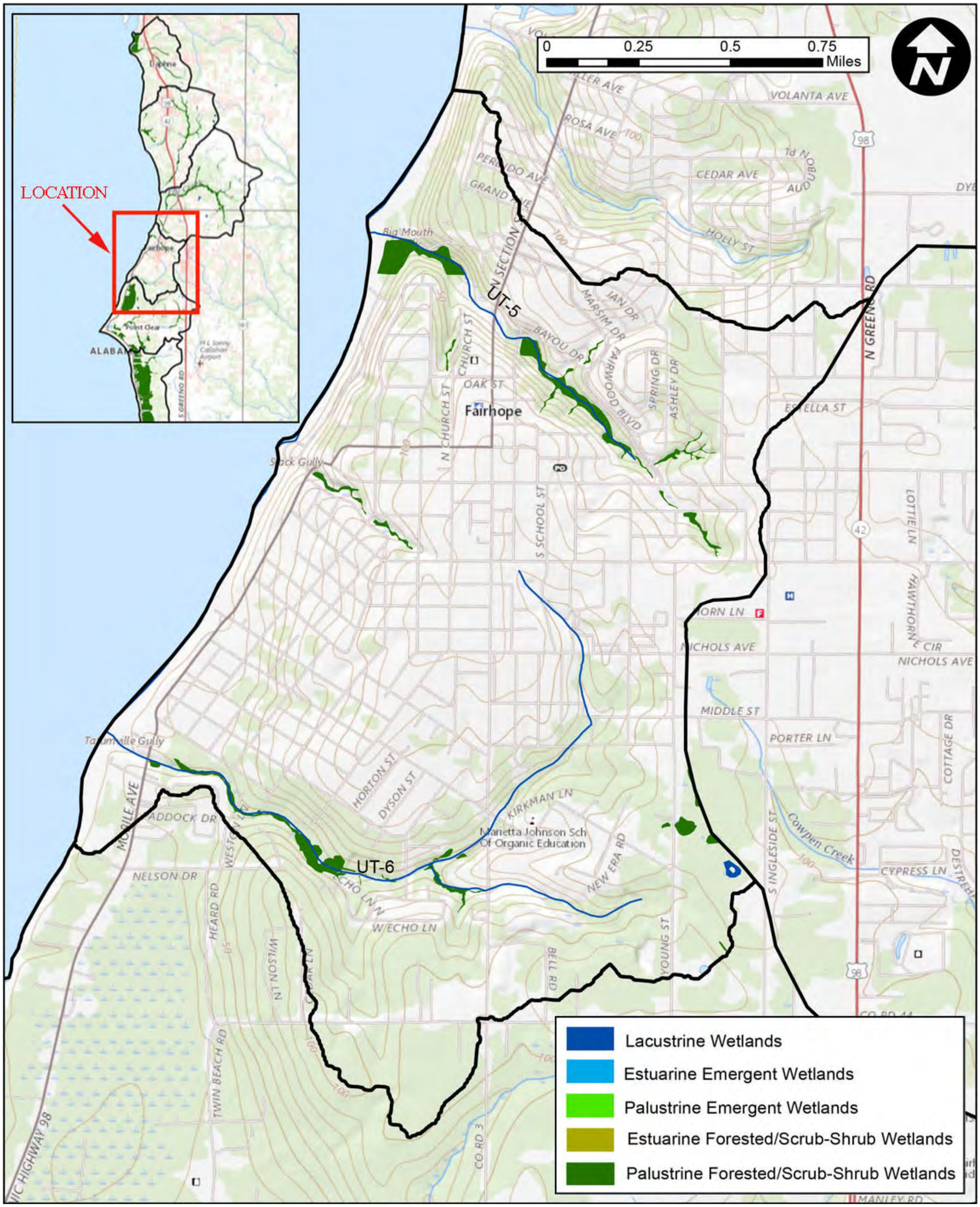


Figure 3.20 Wetlands in the UT5-UT6 Subwatershed

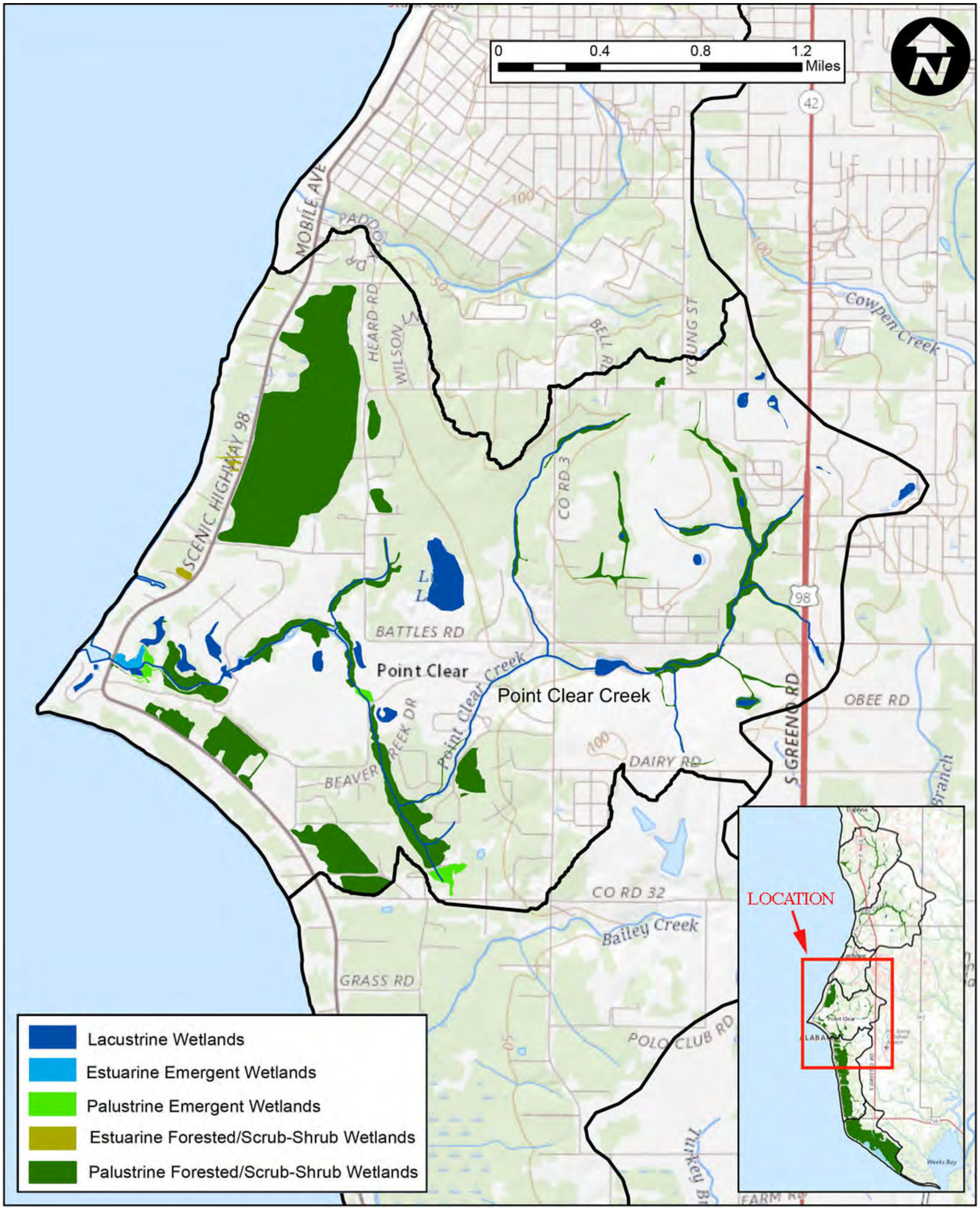


Figure 3.21 Wetlands in the Point Clear Subwatershed

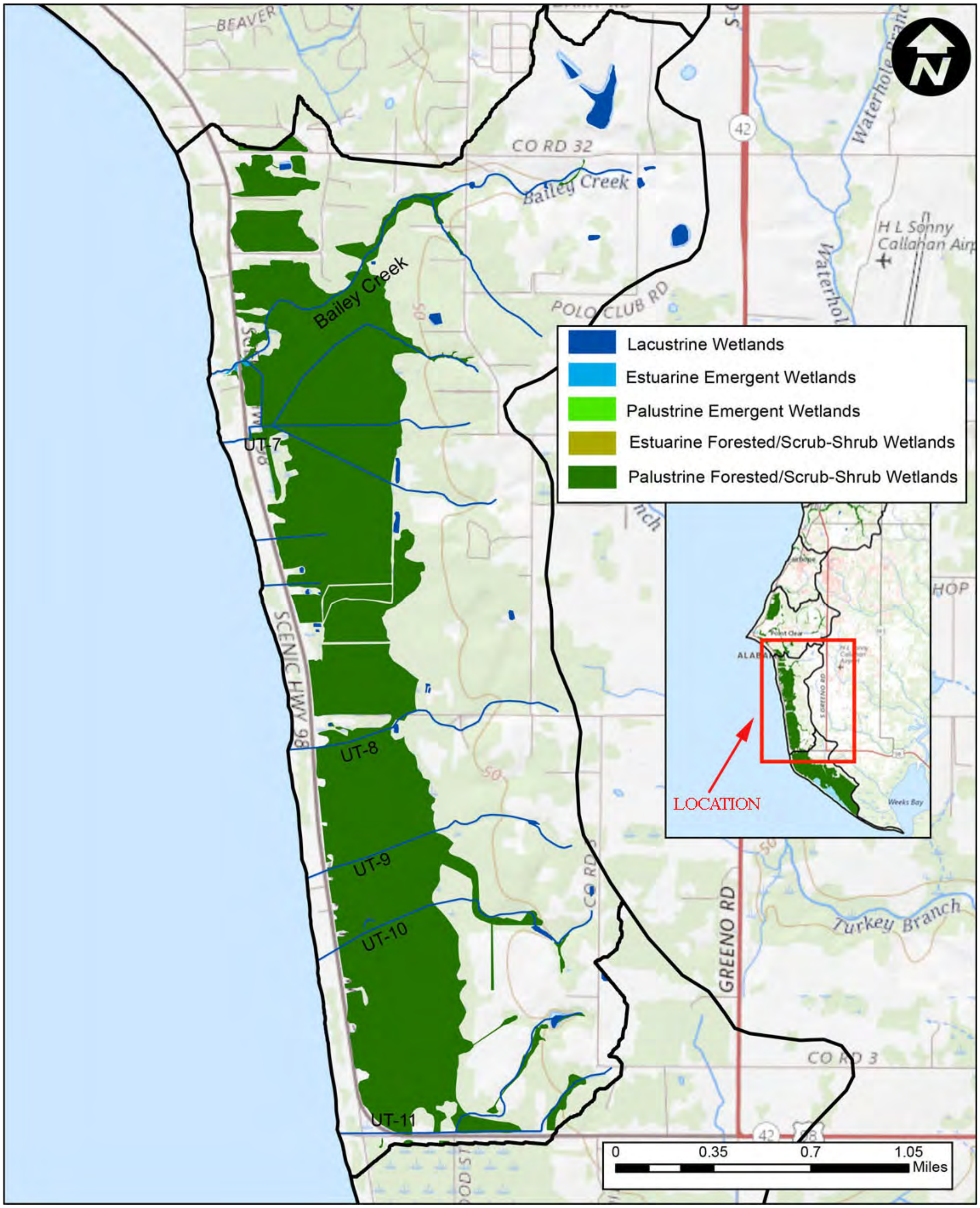


Figure 3.22 Wetlands in the Bailey Creek / UT7-UT11 Subwatershed

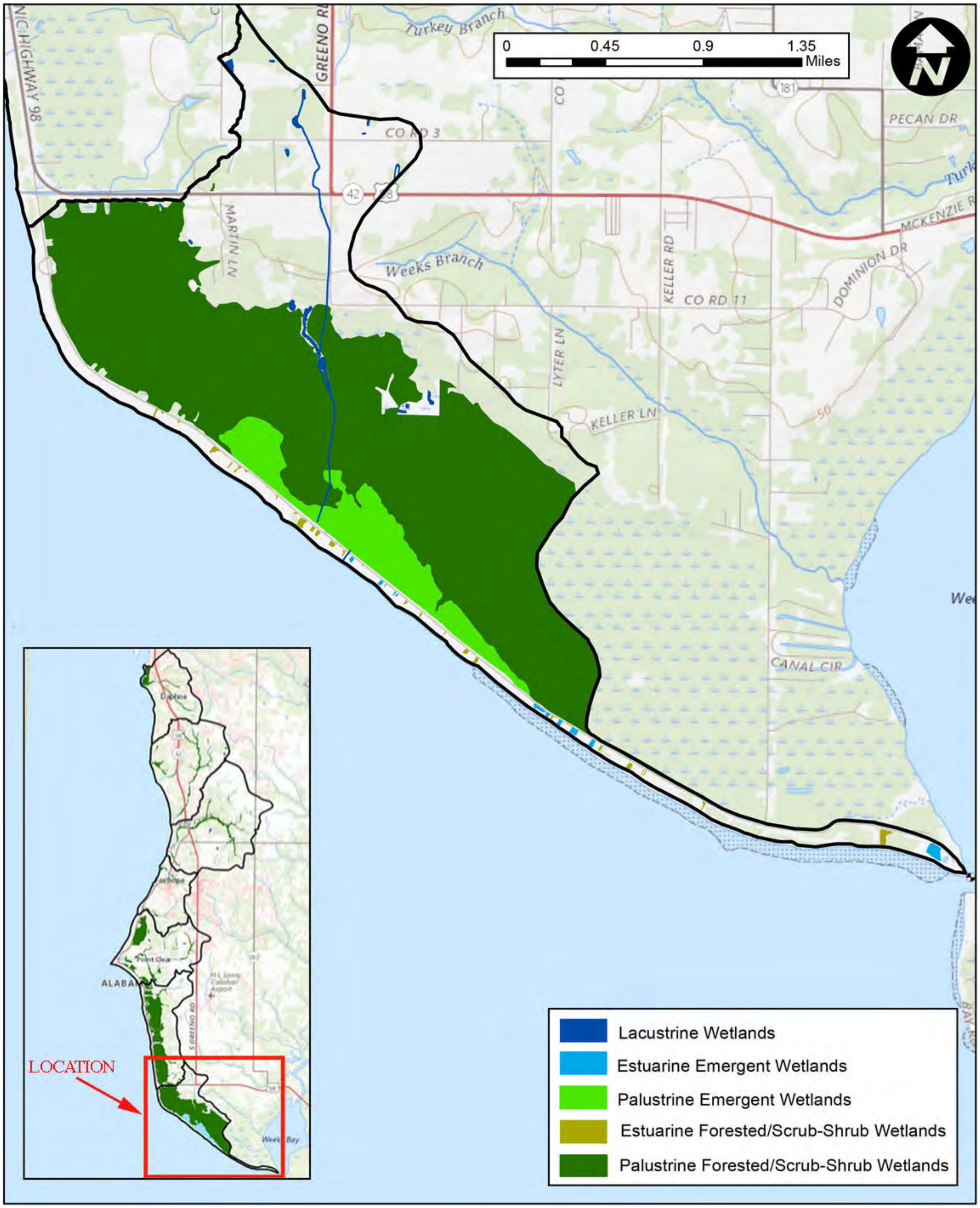


Figure 3.23 Wetlands in the UT12 Subwatershed

Table 3.4 presents the total acreage of modified NWI wetlands by type and Subwatershed. There are 3,498 acres of wetlands in the Eastern Shore Watershed, mostly palustrine shrub/forested (2,992.2 acres), followed by lacustrine (297.2 ac), palustrine emergent (174.8 ac), estuarine emergent (24.3 ac), and estuarine shrub/forested (9.4 ac).

The UT12 Subwatershed contains 40.7% of the total Watershed wetland area and has mostly palustrine shrub/forested (1,239 ac) and palustrine emergent (159.1 ac) wetlands. The Bailey Creek Subwatershed contains another 25.8% of the total Watershed wetland area. The UT5-UT6 Subwatershed has the smallest total wetland area (30.8 ac), contributing just 0.9% of the Watershed total. Most of the lacustrine wetlands (192.4 ac) are in Fly Creek/UT4. Palustrine emergent wetlands, predominately with sawgrass, are found in low elevation locations, especially in UT12. Most estuarine emergent wetlands are in the Jordan Brook/Yancey Branch Subwatershed in lower D'Olive Bay near Bay Front Park.

Table 3.4 Wetland Acreage by Subwatershed and Type

Subwatershed	Wetland Category					
	Palustrine Shrub/ Forested	Palustrine Emergent	Lacustrine[1]	Estuarine Shrub/ Forested	Estuarine Emergent	Total
Jordan Brook/Yancey Branch	123.4	0.0	4.5	0.0	13.9	141.8
Rock Creek/UT1-UT3	158.1	0.0	19.2	0.1	0.0	177.4
Fly Creek/UT4	184.1	0.6	192.4	0.0	0.0	377.1
UT5-UT6	30.0	0.0	0.8	0.0	0.0	30.8
Point Clear	381.3	9.0	48.4	2.5	3.6	444.8
Bailey Creek/UT7-UT11	876.3	6.1	20.5	0.0	0.6	903.5
UT12	1,239.0	159.1	11.4	6.8	6.2	1,422.5
Total	2,992.2	174.8	297.2	9.4	24.3	3,497.9

[1]*Includes surface water area of lakes and ponds.*

Rivers, streams, and many of the bays in coastal Alabama are bordered by forested wetlands (Harper, 1913; Stout and Lelong, 1981). Non-alluvial peaty swamps bordering small streams are the most common type of forested wetland in Baldwin County (Harper, 1913).

Typical plant species of forested wetland communities in the Watershed are listed in Table 3.5. The periodicity and duration of inundation has a large influence on the distributions of palustrine wetland species. The degree of shading is also an important factor in forested systems, particularly for mid-canopy and ground cover, such as shrubs and herbaceous plants.

Typical plant species found in marshes and emergent herbaceous wetland communities are listed in Table 3.6. There is an overlap in species occurrence between the freshwater and brackish marshes, with saw grass, wild rice, cattail, and Mauritius reed (common cane) occurring in both types of systems.

Table 3.5 Typical Plants in Forested Wetland Communities

Forested Wetland Types	Typical Plant Species
Bay-Tupelo-Cypress Swamp	Bald cypress (Taxodium distichum) Tupelo gum (Nyssa aquatica)
Deep-acid Swamp	Water oak (Quercus nigra) Water hickory (*Carya aquatica*) Sweet bay (Magnolia virginiana) Red maple (*Acer rubrum*) Swamp tupelo (*Nyssa biflora*) Swamp bay (Persea palustris) Tulip tree (Liriodendron tulipifera) Atlantic white cedar (*Chamaecyparis thyoides*)
Shade-tolerant shrubs in forested swamps	Virginia willow (*Itea virginica*) Star anise (Illicium floridanum) Doghobble (Leucothoe axillaris) Devilwood (Cartrema americanum) Possumhaw (*Ilex decidua*)
Shade-tolerant herbaceous plants in swamps	Netted chain fern (*Woodwardia areolata*) Virginia chain fern (*Woodwardia virginica*) Cinnamon fern (Osmundastrum cinnamomeum) American royal fern (*Osmunda spectabilis*) Spiderlily (Hymenocallis choctawensis) Arrow arum (Peltandra virginica)
Seepage swamps	Red bay (Persea borbonia) Sweet bay (Magnolia virginiana) Loblolly bay (Gordonia lasianthus) Red maple (*Acer rubrum*) Slash pine (Pinus elliottii) Wax myrtle (Morella cerifera) Dahoon (Ilex cassine) Large gallberry (*Ilex coriacea*) Virginia willow (*Itea virginica*) Buttonbush (Cephalanthus occidentalis) Laurel greenbrier (*Smilax laurifolia*) Poison ivy (Toxicodendron radicans) Cinnamon fern (Osmundastrum cinnamomeum) Netted chain fern (*Woodwardia areolata*)
Wet pine meadows and forests	Slash pine (Pinus elliottii) Longleaf pine (*Pinus palustris*) Atlantic white cedar (*Chamaecyparis thyoides*) Gallberry (*Ilex glabra*) Wax myrtle (Morella cerifera) Saw palmetto (*Serenoa repens*) Sedges (Cyperaceae) Grasses (Poaceae) Rushes (Juncaceae)

Table 3.6 Typical Plants in Herbaceous Wetland Communities

Emergent Marsh Types	Typical Plant Species
Freshwater Marshes	Mauritius reed (Phragmites mauritianus) Switch grass (Panicum virgatum) Wild rice (Zizania aquatica) Saw grass (Cladium jamaicense) Cattail (*Typha* spp.) Beak rushes (*Rhynchospora* spp.) Spikerushes (*Eleocharis* spp.) Flatsedges (*Cyperus* spp.) Rushes (*Juncus* spp.)
Brackish Marshes	Wild rice (Zizania aquatica) Cattail (*Typha* spp.) Mauritius reed (Phragmites mauritianus) Bullrushes (*Scirpus* spp. and *Schoenoplectus* spp.) Sawgrass (*Cladium jamaicense*) Spikerushes (*Eleocharis* spp.) Black needlerush (*Juncus roemerianus*)

3.6.5 Mobile Bay Ecosystems

3.6.5.1 Submerged Aquatic Vegetation

In subtidal waters, submerged aquatic vegetation (SAV) and oyster reefs provide important nursery habitat for many shrimp, crab, and fish, as well as baffling wave energy, preventing erosion, sequestering nutrients, improving water quality, and maintaining high levels of biodiversity. In recent history, these habitats have undergone significant decreases in distribution and extent worldwide, including Mobile Bay and adjacent waters.

Baldwin (1957) reported that extensive SAV once grew along the eastern shore of Mobile Bay between Daphne and Point Clear, particularly beds of wild celery. SAV along the Eastern Shore was much reduced by the late 1960s and almost completely gone in the 1970s (Borom, 1975). Loss of SAV coverage has been caused by dredging and filling, shoreline armoring, and increased turbidity due to clearing and development.

SAV along the Eastern Shore area today is mostly limited to lower D'Olive Bay and along the Mobile Bay shoreline of Jordan Brook-Yancey Branch Subwatershed (Barry A. Vittor & Associates, Inc., 2020). Wild celery (*Vallisneria neotropicalis*), Eurasian watermilfoil (*Myriophyllum spicatum*), southern naiad (*Najas guadalupensis*) water stargrass (*Heteranthera dubia*), and widgeon grass (*Ruppia maritima*) typically occur in this area, which has been relatively stable in SAV extent since at least 2002. In 2019, there were 212 acres of SAV offshore and along the Mobile Bay shoreline of the Jordan Brook/Yancey Branch Subwatershed (Figure 3.24). By comparison, in 1966, the same area contained 338 acres (Vittor & Associates, 2005). The extent of SAV along the Bay shoreline of this area also declined. In 1966, SAV extended another 4,689 feet (0.9 miles) to the south, compared to 2019 (Figure 3.25).

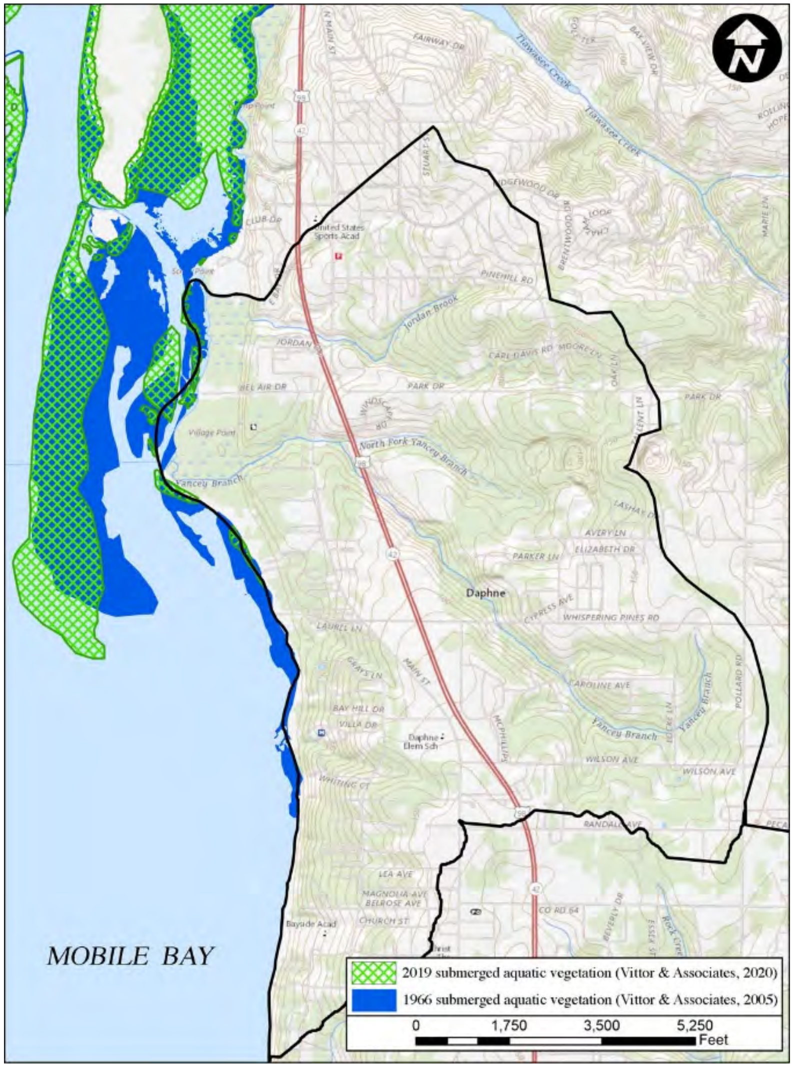


Figure 3.24 2019 and 1966 Submerged Aquatic Vegetation

Figure 3.25 1980 and 1955 Submerged Aquatic Vegetation

SAV was once abundant along the Mobile Bay shoreline south of Point Clear. In 1955, there were 459 acres of SAV along a nearly 10-mile stretch of the Watershed shoreline (Figure 3.24). By 1980, only 17 acres were found in this area (Stout and Lelong, 1981). Coast-wide surveys in 2002, 2009, 2015, and 2019 did not map any SAV in the Bay south of Point Clear (Vittor & Associates, 2004; 2010; 2016; 2020). It is likely that additional, undetected areas with SAV exist in the Eastern Shore area, at least intermittently. Potential areas of SAV occurrence include shallow bends of the lower portions of Fly Creek, Point Clear Creek, and Bailey Creek, and along the Mobile Bay shoreline.

3.6.5.2 Oyster Reefs

As recently as 1968, there were viable oyster reefs off Point Clear covering 366.5 acres, including the Klondike and Pt. Clear Reef complex (Figure 3.26). Poor water-quality conditions and overharvesting were likely the primary causes of the loss of productivity of these reefs. Subsequently, oyster shell mining removed much of the foundation of these reefs. Thousands of acres of natural bay bottom were deepened in areas of the northeastern and central portion of Mobile Bay to depths greater than 15 feet through the mining of dead reef oyster shell. The majority of dredging occurred east of the main ship channel. These mining operations were first permitted in 1946 and were ultimately ended in 1982. The shell mining created numerous holes that remain today, located primarily in the central portion of the Bay. It is likely these holes have since been filled with silt and mud.

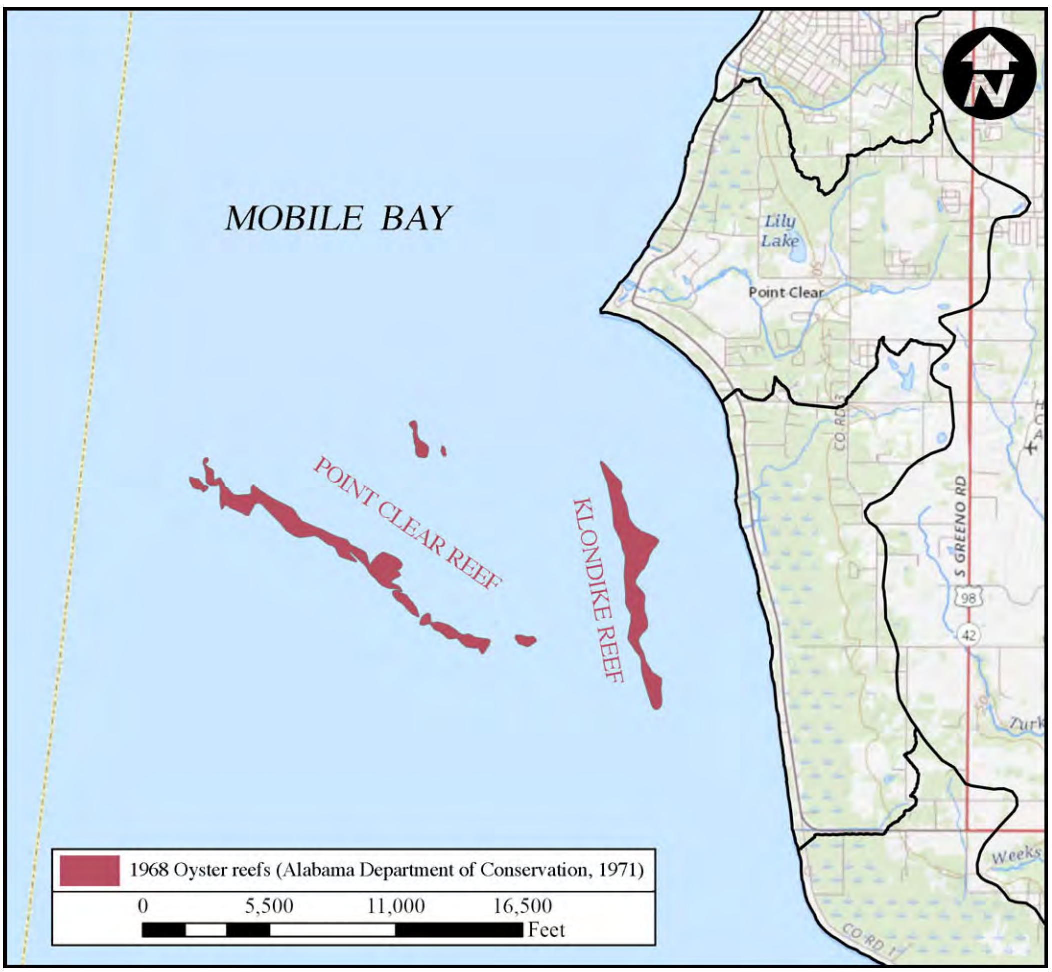


Figure 3.26 1968 Oyster Reefs Near Point Clear

3.6.6 Terrestrial Fauna

Native animal communities of the Southern Pine Plains and Hills and Gulf Coast Flatwoods ecoregions are highly diverse. Natural habitats include upland forests and transitional areas to stream and river floodplain forests, swamps, flatwoods, coastal scrub, marshes, and the estuarine bay system. Non-natural lands including urban areas cover much of the Watershed. Table 3.7 lists common animals found in urbanized areas.

Table 3.7 Common fauna in urbanized areas

Fauna Types	Typical Urban Species
Frogs	Green tree frog (*Hyla cinerea*) Squirrel tree frog (*Hyla squirella*) Southern leopard frog (*Rana utricularis*)
Lizards	Green anole (Anolis carolinensis) Ground skink (Scincella lateralis) Racerunner (Aspidoscelis sexlineatus)
Snakes	Cottonmouth (Agkistrodon piscivorus) Eastern kingsnake (*Lampropeltis getula*) Rat snake (Pantherophis spiloides) Southern black racer (*Coluber constrictor*)
Birds	Blue jay (Cyanocitta cristata) Carolina chickadee (*Poecile carolinensis*) Eastern towhee (Pipilo erythrophthalmus) House finch (Haemorhous mexicanus) Mourning dove (*Zenaida macroura*) Northern cardinal (Cardinalis cardinalis) Northern mockingbird (*Mimus polyglottos*) Brown thrasher (*Toxostoma rufum*) Tufted titmouse (*Baeolophus bicolor*)
Mammals	Common raccoon (*Procyon lotor*) Gray squirrel (Sciurus carolinensis) Nine-banded armadillo (*Dasypus novemcinctus*) Southeastern shrew (*Sorex longirostris*) Striped skunk (Mephitis mephitis) Virginia opossum (Didelphis virginiana) Whitetail deer (Odocoileus virginianus)

A diverse native fauna is dependent on minimally disturbed, natural habitats. Watershed habitats identified by the Alabama Department of Conservation and Natural Resources (ADCNR) and federal and State agency experts as those in greatest need of conservation include floodplain forests, swamps, wet pine flatwoods, coastal scrub, and estuarine systems. The ADCNR Wildlife and Freshwater Fisheries Division developed an update to Alabama's Comprehensive Wildlife Conservation Strategy, in a plan to conserve wildlife and their native habitats (ADCNR, 2015). The State Wildlife Action Plan (SWAP) was developed to provide a strategy for wildlife conservation in the State.

Data obtained from the SWAP pertain to species that are federally protected under the Endangered Species Act (ESA) of 1973 (listed endangered, threatened, proposed or candidate for listing) and species identified by ADCNR as requiring the greatest conservation need (GCN). GCN species of highest conservation concern (Priority 1) and high conservation concern (Priority 2) that potentially occur in the Watershed are presented in Table 3.8. Priority 1 species require immediate research and/or conservation action. Priority 2 species require timely research and/or conservation action. Many of the listed species at present have a low probability of occurrence, such as eastern indigo snake (*Drymarchon couperi*). Others are likely to occur, but infrequently, including Alabama red-bellied turtle (*Pseudemys alabamensis*) and black bear (*Ursus americanus floridanus*).

Table 3.8 ADCNR Priority Species of Concern with Potential to Occur in the Watershed Region

Common Name	Scientific Name	SWAP[1] Status	ESA[2] Status
CRAYFISH			
Angular Dwarf Crawfish	Cambarellus lesliei	P1	
Speckled Burrowing Crayfish	Creaserinus danielae	P2	
FISHES			
Gulf Sturgeon	Acipenser oxyrinchus desotoi	P2	LT
Alabama shad	Alosa alabamae	P1	
Ironcolor Shiner	Notropis chalybaeus	P1	
Blackmouth Shiner	Notropis melanostomus	P2	
AMPHIBIANS			
Gopher Frog	Lithobates capito	P1	
River Frog	Lithobates heckscheri	P1	
Dusky Gopher Frog	Lithobates sevosus	P1	LE
Reticulated Flatwoods Salamander	Ambystoma bishopi	P1	LE
Eastern Tiger Salamander	Ambystoma tigrinum	P2	
One-Toed Amphiuma	Amphiuma pholeter	P1	
Southern Dusky Salamander	Desmognathus auriculatus	P1	
REPTILES			
Coal Skink	Plestiodon anthracinus	P2	
Slender Glass Lizard	Ophisaurus attenuatus	P2	
Southeastern Five-lined Skink	Plestiodon inexpectatus	P2	
Eastern Indigo Snake	Drymarchon couperi	P1	LT
Rainbow Snake	Farancia erytrogramma	P1	
Southern Hognose Snake	Heterodon simus	P1	
Eastern Kingsnake	Lampropeltis getula	P2	
Eastern Speckled Kingsnake	Lampropeltis nigra holbrooki	P2	
Gulf Saltmarsh snake	Nerodia clarkii	P2	
Florida Pinesnake	Pituophis melanoleucus mugitus	P2	
Harlequin Coralsnake	Micrurus fulvius	P1	
Eastern Diamond-Backed Rattlesnake	Crotalus adamanteus	P2	
Alligator Snapping Turtle	Macrochelys temminckii	P2	
Mississippi Diamond-backed Terrapin	Malaclemys terrapin pileata	P1	
Alabama Red-Bellied Turtle	Pseudemys alabamensis	P1	LE
Gopher Tortoise	Gopherus polyphemus	P2	C (see note)[3]
MAMMALS			
Southeastern Pocket Gopher	Geomys pinetis	P2	
Marsh Rabbit	Sylvilagus palustris	P2	
Brazilian Free-tailed Bat	Tadarida brasiliensis	P2	
Northern Yellow Bat	Lasiurus intermedius	P2	

Common Name	Scientific Name	SWAP[1] Status	ESA[2] Status
Tricolored Bat	Perimyotis subflavus	P2	
Rafinesque's Big-eared Bat	Corynorhinus rafinesquii	P1	
Southeastern Myotis	Myotis austroriparius	P1	
American Black Bear	Ursus americanus	P1	
Long-tailed Weasel	Mustela frenata	P2	
Eastern Spotted Skunk	Spilogale putorius	P2	
West Indian Manatee	Trichechus manatus	P1	LT
BIRDS			
Mottled Duck	Anas fulvigula	P2	
Yellow Rail	Coturnicops noveboracensis	P2	
Eastern Black Rail	Laterallus jamaicensis	P2	LT
King Rail	Rallus elegans	P2	
American Oystercatcher	Haematopus palliatus	P1	
Piping Plover	Charadrius melodus	P1	LT
Wilson's Plover	Charadrius wilsonia	P1	
Snowy Plover	Charadrius nivosus	P1	
Red Knot	Canidis canutus rufa	P2	LT
Gull-billed Tern	Gelochelidon nilotica	P2	
Wood Stork	Mycteria americana	P2	LT
Least Bittern	Ixobrychus exilis	P2	
Reddish Egret	Egretta rufescens	P2	
Swallow-tailed Kite	Elanoides forficatus	P2	
Short-eared Owl	Asio flammeus	P2	
American Kestrel	Falco sparverius paulus	P2	
Bewick's Wren	Thryomanes bewickii	P1	
Bachman's Sparrow	Peucaea aestivalis	P2	
Seaside Sparrow	Ammospiza maritima	P2	
Nelson's Sparrow	Ammospiza nelsoni	P2	
Henslow's Sparrow	Centronyx henslowii	P1	
Rusty Blackbird	Euphagus carolinus	P2	
Cerulean Warbler	Setophaga cerulea	P1	

[1]Swap Status - P1=Priority 1, Highest Conservation Concern; P2=Priority 2, High Conservation Concern
[2]ESA Status - LE – Listed Endangered; LT – Listed Threatened; C– Candidate
[3]Gopher tortoise eastern population removed as candidate on October 11, 2022 by USFWS

The Watershed contains a diversity of habitats important for migratory birds. Table 3.9 lists some important migratory bird species of high conservation concern likely to occur in the Eastern Shore area (USFWS, 2021). Some of these species are uncommon to rare, or accidental visitors. Many are resident breeders expected to be in the Watershed area, including Kentucky warbler, prothonotary warbler, and wood thrush. Common wintering migrants include Le Conte's sparrow and Nelson's sparrow (Rosenberg et al., 2016).

The Alabama Coastal Birding Trail has three stops within the Watershed, part of the Trail's South Baldwin County Loop. These sites from north to south include the Village Point Park, Fairhope Municipal Pier, and Mullet Point County Park (Figure 3.27).

Table 3.9 Migratory birds in the Watershed Area

Wintering Residents
Bonaparte's Gull (Chroicocephalus philadelphia)
Dunlin (Calidris alpina arcticola)
Le Conte's Sparrow (*Ammodramus leconteii*)
Lesser Yellowlegs (*Tringa flavipes*)
Magnificent Frigatebird (*Fregata magnificens*)
Marbled Godwit (*Limosa fedoa*)
Nelson's Sparrow (*Ammodramus nelsoni*)
Pomarine Jaeger (Stercorarius pomarinus)
Red-breasted Merganser (*Mergus serrator*)
Ring-billed Gull (*Larus delawarensis*)
Ruddy Turnstone (Arenaria interpres morinella)
Rusty Blackbird (*Euphagus carolinus*)
Short-billed Dowitcher (*Limnodromus griseus*)
Breeding Residents
American Kestrel (Falco sparverius paulus)
American Oystercatcher (*Haematopus palliates*)
Bachman's Sparrow (*Aimophila aestivalis*)
Bald Eagle (Haliaeetus leucocephalus)
Black Skimmer (*Rynchops niger*)
Brown Pelican (Pelecanus occidentalis)
Clapper Rail (*Rallus crepitans*)
Common Ground-dove (Columbina passerina exigua)
Common Loon (G*avia immer*)
Common Tern (*Sterna hirundo*)
Double-crested Cormorant (*Phalacrocorax auritus*)
Gull-billed Tern (Gelochelidon nilotica)
Herring Gull (*Larus argentatus*)
Kentucky Warbler (*Oporornis formosus*)
King Rail (Rallus elegans)
Least Tern (Sterna antillarum)
Prairie Warbler (*Dendroica discolor*)
Prothonotary Warbler (*Protonotaria citrea*)
Red-headed Woodpecker (Melanerpes erythrocephalus)
Royal Tern (Thalasseus maximus)
Seaside Sparrow (Ammodramus maritimus)
Swallow-tailed Kite (*Elanoides forficatus*)
Willet (Tringa semipalmata)
Wilson's Plover (*Charadrius wilsonia*)
Wood Thrush (Hylocichla mustelina)

Source: USFWS, 2021

Figure 3.27 Alabama Coastal Birding Trail stops along the Eastern Shore
Source: Vittor and Associates

3.6.7 Aquatic fauna

Aquatic environments in the study area include the named and unnamed streams and tributaries, ponds and lakes, shallow subtidal waters along the Eastern Shore, and the broader Bay system. Aquatic fauna include benthic invertebrates (clams, insect larvae, worms), epifauna (snails, shrimps, crayfishes), resident and transient fishes, amphibians and reptiles, waterfowl, and mammals, including porpoises and manatees.

Mobile Bay and its connecting waterways provide foraging, nursery, migratory, and spawning habitat to numerous invertebrate and fish species. Abundant invertebrates and fishes of coastal Alabama have been collected by Swingle and Bland (1974), Shipp (1979), Rozas et al. (2013), and others, and are listed in Table 3.10. These species comprise important forage and fishery populations (Shipp, 1979; Valentine et al., 2006) and are among the most abundant fishery species across the northern Gulf of Mexico. Species such as spot, Atlantic croaker, and mullet occupy the estuary seasonally. Strong seasonal patterns of assemblage composition are related to recruitment of juveniles to the estuary (Gorecki and Davis, 2013; Rozas et al., 2013).

Freshwater systems have characteristic faunal communities including benthic macroinvertebrates, crayfishes, and fishes. Aquatic macroinvertebrates, especially larval and juvenile insect stages, process live organic material and consume decomposing organic matter as well as feed on other small organisms. They are a key trophic link in freshwater systems, serving as food for fish, amphibians, reptiles, aquatic birds, and mammals. Stream macroinvertebrate communities can be extremely diverse, with particular genera and families indicative of either healthy or degraded systems.

Table 3.10 Abundant Estuarine Invertebrates and Fishes in Alabama

Aquatic Fauna Groups	Typical Species
Invertebrates	Grass shrimp (*Palaemonetes* spp.) Brown shrimp (Farfantepenaeus aztecus) White shrimp (Litopenaeus setiferus) Blue crab (Callinectes sapidus)
Fishes	Gulf menhaden (Brevoortia patronus) Striped Mullet (*Mugil cephalus*) Atlantic croaker (Micropogonias undulatus) Bay anchovy (Anchoa mitchilli) Spot (Leiostomus xanthurus) Tidewater silverside (*Menidia beryllina*) Rainwater killifish (*Lucania parva*)

Information on fish species occurrence in the Watershed is limited, though prior surveys of nearby areas of southern Baldwin County have been conducted and the most abundant species collected in those efforts are likely common also in Eastern Shore streams. These surveys found that deeper streams with consistent flow support many fish species. Abundant fishes collected in these surveys are listed in Table 3.11.

Table 3.11 Abundant Fishes Collected in Southern Baldwin County Streams

South Baldwin County Fish Collections	Fish Species
Fish River, Cowpen Creek, and Green Branch (O'Neil et al., 2004)	Bay anchovy (Anchoa mitchilli) Weed shiner (Notropis texanus) Striped Mullet (*Mugil cephalus*) Bluegill (Lepomis macrochirus) Spotted gar (Lepisosteus oculatus)
Fish River (AL Highway 104 and AL Highway 90) and Cowpen Creek (Co. Highway 33) (O'Neil and Shepard, 2012).	Blackbanded darter (*Percina nigrofasciata*) Flagfin shiner (Pteronotropis signipinnis) Weed shiner (Notropis texanus) Speckled darter (Etheostoma stigmaeum)
Baker Branch, Cowpen Creek, Magnolia River, Pensacola Branch, and Perone Branch (Colvin et al., 2016)	Redfin pickerel (*Esox americanus*) Lake chubsucker (*Erimyzon sucetta*) Blackbanded darter (*Percina nigrofasciata*) Bluegill (Lepomis macrochirus) Green sunfish (Lepomis cyanellus) Longear sunfish (*Lepomis megalotis*) Largemouth bass (Micropterus salmoides) Weed shiner (Notropis texanus)

3.6.8 Federal-Listed Threatened and Endangered Species

Federal-listed threatened and endangered species are protected under ESA Section 7. Species listed as Endangered are in danger of extinction throughout all or a significant portion of their range. Threatened species are considered likely to become endangered within the foreseeable future throughout all or a significant portion of their range. Candidate species are under consideration for official listing for which there is sufficient information to support listing.

The United States Fish and Wildlife Service (USFWS) Information for Planning and Conservation (IPaC) decision support system (USFWS, 2021) identifies several ESA species as potentially affected by activities within the Watershed (Table 3.12). Critical habitat has been designated for some of these species, but none of these areas occur within the Watershed.

Table 3.12 ESA species potentially occurring in the Watershed

Species	Federal Status
Fishes	
Gulf Sturgeon (Acipenser oxyrinchus desotoi)	Threatened
Reptiles	
Alabama Red-bellied Turtle (*Pseudemys alabamensis*)	Endangered
Eastern Indigo Snake (Drymarchon corais couperi)	Threatened
Gopher Tortoise (Gopherus polyphemus)	Candidate (see update in note below)
Kemp's Ridley Turtle (*Lepidochelys kempii*)	Endangered
Loggerhead Turtle (*Caretta caretta*)	Threatened
Birds	
Eastern Black Rail (Laterallus jamaicensis)	Threatened
Wood Stork (Mycteria americana)	Threatened
Mammals	
West Indian Manatee (*Trichechus manatus*)	Threatened

Source: USFWS, 2021 and Outdoor Alabama, 2022
***KEY: E** – Endangered; **T** – Threatened; **C** – Candidate Species*
Note: Eastern portion of the gopher tortoise range removed from list of Candidate species October 11, 2022

Gulf sturgeon is an anadromous fish, with reproduction occurring in fresh water. They are thought to return to breed in the river system in which they hatched. Genetically distinct subunits of Gulf sturgeon have been identified throughout the Gulf of Mexico (Stabile et al., 1996), but the Mobile River basin is not known to support a breeding sub-population. There are both historic and recent records of Gulf sturgeon from Mobile Bay. Hastings and Parauka (2004) cite recent collections (since 1991) of Gulf sturgeon from the Tensaw and Blakely Rivers in the Delta, and a recent survey collected two Gulf sturgeons in Mobile Bay near Fairhope (Mettee et al., 2009).

Alabama red-bellied turtle is found in Mobile and Baldwin counties. Its distribution is primarily restricted to the lower Mobile Tensaw Delta in densely vegetated backwater areas of freshwater streams, rivers, and bays adjacent to Mobile Bay. These turtles occur in tidal creeks and bask on debris or beaches in tidally influenced habitats. A three-year trapping survey performed by Nelson and Turner (2004) did not capture any red-bellied turtles from brackish waters in Alabama, though records of occurrence in the Watershed vicinity exist. Wandering individuals may occur infrequently as rare, accidental waifs.

Godwin (2004) listed only four documented occurrences (all over 50 years old) of Eastern Indigo Snake from the state of Alabama, with the last confirmed record from Covington County in 1954. The species was considered extirpated from the state when an experimental restocking program was initiated in 1979 and continues with current efforts to reintroduce the species to their native longleaf pine forest habitat. Eastern indigo snakes are the longest snakes native to the U.S., able to grow to more than 8 feet. They prey on a variety of small mammals, amphibians, and reptiles, including venomous snakes such as copperhead. Indigos are active during the warmer months and seek refuge in the gopher tortoise burrows during winter.

Gopher tortoise is a common inhabitant of fire maintained upland sandhill communities containing a lush herbaceous groundcover and little woody cover (Aresco and Guyer, 2004; Ashton and Ashton, 2008). In Alabama, gopher tortoise is federally protected only in Mobile, Washington and Choctaw counties. The eastern population of this species (east of the Tombigbee and Mobile Rivers) does not receive federal protection in Baldwin County (or other portions of the eastern range in Alabama, Florida, Georgia, and South Carolina, because the USFWS withdrew the petition to list this candidate species (October 11, 2022). The USFWS's species status assessment indicated that the eastern population is robust. The gopher tortoise is however, protected by Alabama's nongame regulation act, which prohibits the outright killing of individual tortoises.

Kemp's ridley and loggerhead sea turtles do not nest within the study area. Juvenile sea turtles are the life stage most likely to occur in Mobile Bay.

The Eastern subspecies of black rail was designated as threatened on October 7, 2020. Black rail is considered rare in spring and occasional in other seasons in the Gulf Coast region. There are known occurrences of the species from the Alabama State Port Authority's Blakeley Mud Lakes property, located on the east side of the Mobile River south of the Africatown Cochran Bridge. The majority of records from the Mud Lakes site occurred during the late 1980s, and involved calling birds in late May, suggesting the possibility of local breeding. Marshes are important habitat for black rails. They prefer damp soils in relatively drier areas of salt, brackish, and freshwater marshes, and partially flooded fields and meadows. They often occur near marsh edges where thin-stemmed emergent vegetation such as rushes, cordgrasses, sedges, and pickleweed are present (Eddleman et al., 1994).

Wood storks are typically found in Alabama during periods of post-breeding dispersal in mid to late summer. Wood stork utilizes a wide variety of habitats for foraging including ponds, marshes, swamps, depression wetlands, oxbow sloughs, ditches, and flooded fields (Natureserve, 2015). During times of drought, draw-down areas with shallow water constitute an important foraging source, allowing easy access to aquatic prey. In Alabama, inland freshwater habitats are typically favored for foraging, but brackish marshes near the coast are occasionally visited. Individuals can also be infrequently found utilizing farm ponds in coastal Alabama. Wood storks are uncommon visitors to the Eastern Shore Watershed area, and would only occur as wandering individuals, and not breeding storks.

The West Indian manatee is protected under both the ESA and the Marine Mammal Protection Act of 1972, and state classified as a P1 GCN. West Indian manatee sightings in Alabama, including along the Eastern Shore, have been increasing in recent years as they extend their presence farther west of Florida during warmer months, seeking foraging and breeding grounds. Manatees are opportunistic herbivores, consuming aquatic vegetation in marine, estuarine, and freshwater systems.

Table 3.13 lists manatee sightings in the study area recorded in the last six years (Dauphin Island Sea Lab's Manatee Sighting Network, 2021). Most of the sightings and individuals seen during this time were in Mobile Bay.

Table 3.13 Manatee sightings recorded from 2015 to 2020 in or near the Eastern Shore Watershed

Year	Total No. Individuals	No. Sightings	Months	Locations
2020	12	11	May, June, July, Aug., Dec.	Mobile Bay, Fly Creek
2019	12	9	July, Sept., Nov., Dec.	Mobile Bay, Fly Creek
2018	24	11	May, June, July, Aug., Nov.	Mobile Bay, Fly Creek
2017	44	14	June, July, Aug., Sept.	Mobile Bay, Pt. Clear Creek
2016	19	13	May, June, July, Oct., Dec.	Mobile Bay, Fly Creek
2015	11	10	May, June, July, Aug., Sept.	Mobile Bay, Pt. Clear Creek

Source: Dauphin Island Sea Lab's Manatee Sighting Network, 2021

3.6.9 Invasive Flora and Fauna

The introduction of invasive exotic plants such as Chinese privet (*Ligustrum sinense*), Chinese tallowtree (*Triadica sebifera*), and cogongrass (*Imperata cylindrica*) has resulted in changes to natural vegetative structure and plant species composition across virtually every type of upland and wetland habitat in coastal Alabama. These aggressive species can spread rapidly to outcompete native flora, with consequent loss of biodiversity and habitat degradation. Invasive plants are prevalent in and near disturbed areas, especially maintained lands such as along roadsides and trails, farmland fringes, and urbanized areas generally. Many exotic plant species have invaded floodplains, perhaps more than in any other habitat type in Alabama (ADCNR, 2015).

The management and control of invasive species infestations is a necessary component of land management and habitat restoration efforts. Table 3.14 lists the most prevalent invasive species in southern Baldwin County, including the Eastern Shore Watershed.

Table 3.14 Frequently Encountered Invasive Exotic Plants

Species	Occurrence	
	Uplands	Wetlands
Alligatorweed (Alternanthera philoxeroides)		√
Camphortree (Cinnamomum camphora)	√	√
Chinese privet (*Ligustrum sinense*)	√	√
Chinese tallowtree (*Triadica sebifera*)	√	√
Cogongrass (Imperata cylindrica)	√	
Coral ardisia (*Ardisia crenata*)	√	√
Japanese honeysuckle (*Lonicera japonica*)	√	
Japanese climbing fern (*Lygodium japonicum*)	√	√
Mimosa (Albizia julibrissin)	√	
Torpedograss (*Panicum repens*)	√	√

3.7 Political Institutions

The Eastern Shore Watershed area of approximately 22,400 acres (35 square miles) falls under the jurisdiction of three different local government entities: Baldwin County and the cities of Daphne and Fairhope (Figure 3.28).

Located on the Eastern Shore of Mobile Bay, portions of five of the seven Subwatersheds fall within the corporate limits of the cities of Daphne and Fairhope. With ever-increasing development pressure from population growth, these Subwatersheds will likely continue to have additional areas annexed into these municipalities. Being nestled between city centers and the major north-south, east-west corridors of the watershed (such as U.S. Hwy 98, CR13 and 181; CRs 64, 104, 48 and 32), this pressure is particularly higher for the Subwatersheds of Rock Creek, Fly Creek, UT5-UT6, and Point Clear. The Jordan Brook-Yancey Branch Subwatershed is entirely incorporated with the exception of approximately 10 acres.

As a whole, the Eastern Shore Watershed is almost evenly divided between unincorporated and incorporated lands. About 58% of the Watershed lies in unincorporated Baldwin County, and the remaining 42% within the jurisdictions of the cities of Daphne and Fairhope (20% and 22% respectively).

The cities of Fairhope and Daphne have 51% and 38% of their total incorporated areas inside the Watershed, respectively, as shown on Table 3.15. The breakdown of this jurisdictional control within the seven Subwatersheds is shown in Table 3.16.

Table 3.15 Total Jurisdictional Acreage in the Eastern Shore Watershed

Total Jurisdictional Acreage in Eastern Shore Watershed			
Jurisdiction	Acreage in Watershed	% of Watershed Area	% of Total Jurisdictional Area in Watershed
Daphne	4,479.09	20%	38%
Fairhope	4,939.13	22%	51%
Unincorporated Baldwin County	12,985.99	58%	NA

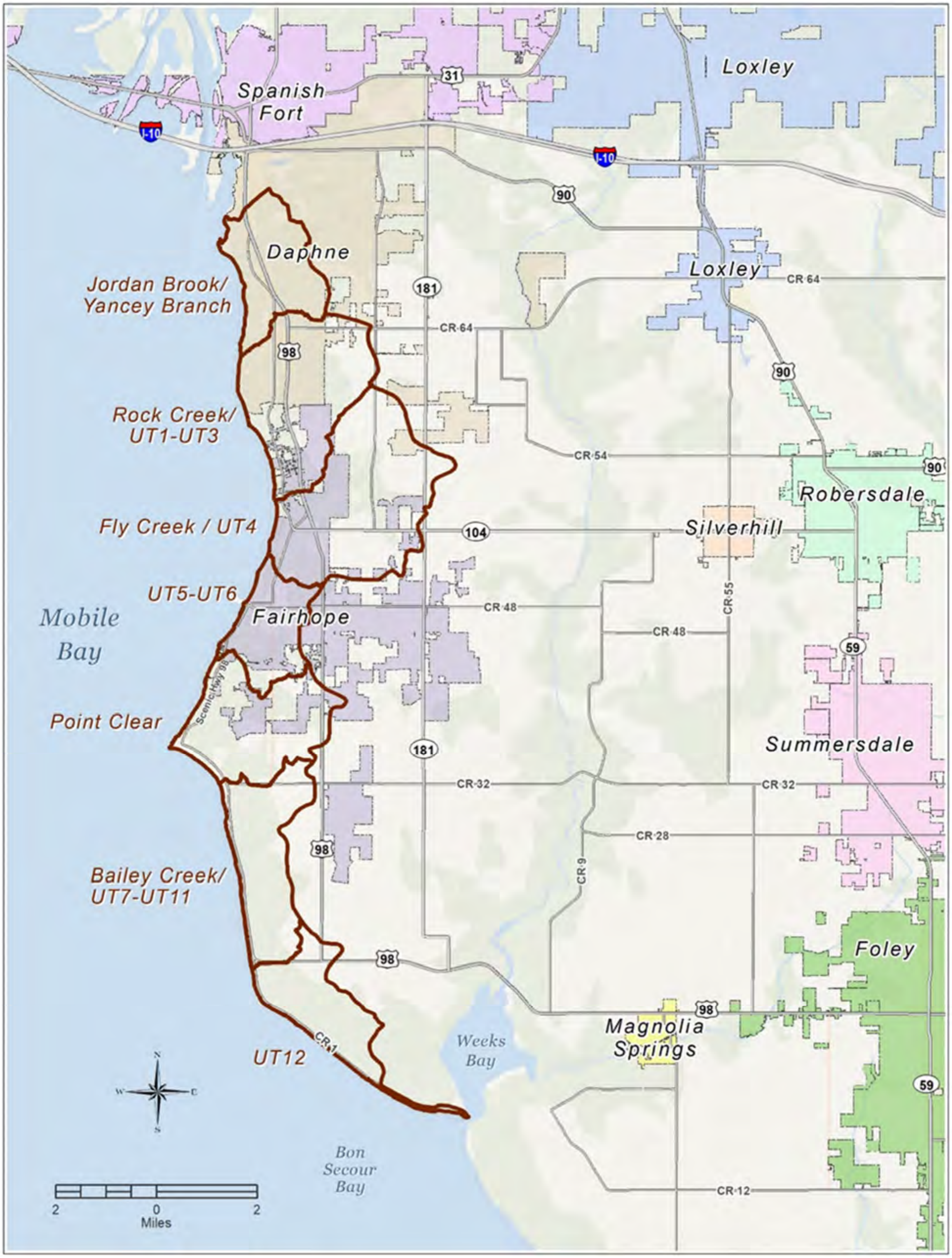


Figure 3.28 Incorporated Areas in Eastern Shore Watershed

Table 3.16 Jurisdictional Acreage in Eastern Shore Subwatersheds

Jurisdictional Acreage in Eastern Shore Subwatersheds			
Jordan Brook/Yancey Branch	Jurisdiction	Area, ac	% of Subwatershed Area Lying within Jurisdiction
	Daphne	2,418.71	100%
	Fairhope	0	0%
	Unincorp. Baldwin County	10.22	0%
Rock Creek/UT-1 – UT3	Jurisdiction	Area, ac	% of Subwatershed Area Lying within Jurisdiction
	Daphne	1875.23	45%
	Fairhope	774.18	19%
	Unincorp. Baldwin County	1,518.65	36%
Fly Creek/UT4	Jurisdiction	Area, ac	% of Subwatershed Area Lying within Jurisdiction
	Daphne	180.15	3%
	Fairhope	1,918.24	35%
	Unincorp. Baldwin County	3,331.11	61%
UT5-UT6	Jurisdiction	Area, ac	% of Subwatershed Area Lying within Jurisdiction
	Daphne	0	0%
	Fairhope	1,513.82	83%
	Unincorp. Baldwin County	317	17%
Point Clear	Jurisdiction	Area, ac	% of Subwatershed Area Lying within Jurisdiction
	Daphne	0	0%
	Fairhope	732.89	22%
	Unincorp. Baldwin County	2646.84	78%
Bailey Creek/ UT7 – UT11	Jurisdiction	Area, ac	% of Subwatershed Area Lying within Jurisdiction
	Daphne	0	0%
	Fairhope	0	0%
	Unincorp, Baldwin County	2845.16	100%
UT12	Jurisdiction	Area, ac	% of Subwatershed Area Lying within Jurisdiction
	Daphne	0	0
	Fairhope	0	0
	Unincorp, Baldwin County	2317.01	100

The Subwatersheds of Jordan Brook/Yancey Branch, Rock Creek/UT1-UT3, and UT5-UT6 have over 50% of their area in the incorporated municipalities of Daphne and Fairhope. However, the planning jurisdictions of these extend beyond their respective boundaries and encompass the entire Eastern Shore Watershed. Per the Extraterritorial Jurisdiction (ETJ) provision of Alabama State Law (Ala. Code §11-52-30), municipalities have the authority to review all planned subdivision developments within their ETJ which can extend to a maximum of five miles outside their corporate limits. Therefore, all developments that occur within the neighboring unincorporated lands of Baldwin County are subject to review by the corresponding jurisdiction. This includes and provides for the remaining unincorporated lands within the Watershed to fall under the ETJ review responsibilities of the City of Daphne and City of Fairhope jurisdictions, as depicted in Figure 3.29. One small area of approximately 248 acres in Montrose within the Rock Creek/UT1-UT3 Subwatershed is excluded from both Daphne and Fairhope ETJs (see Figure 3.30). Inquiries as to why it is excluded have been made with these municipalities, but as of the time of this writing no information has been received.

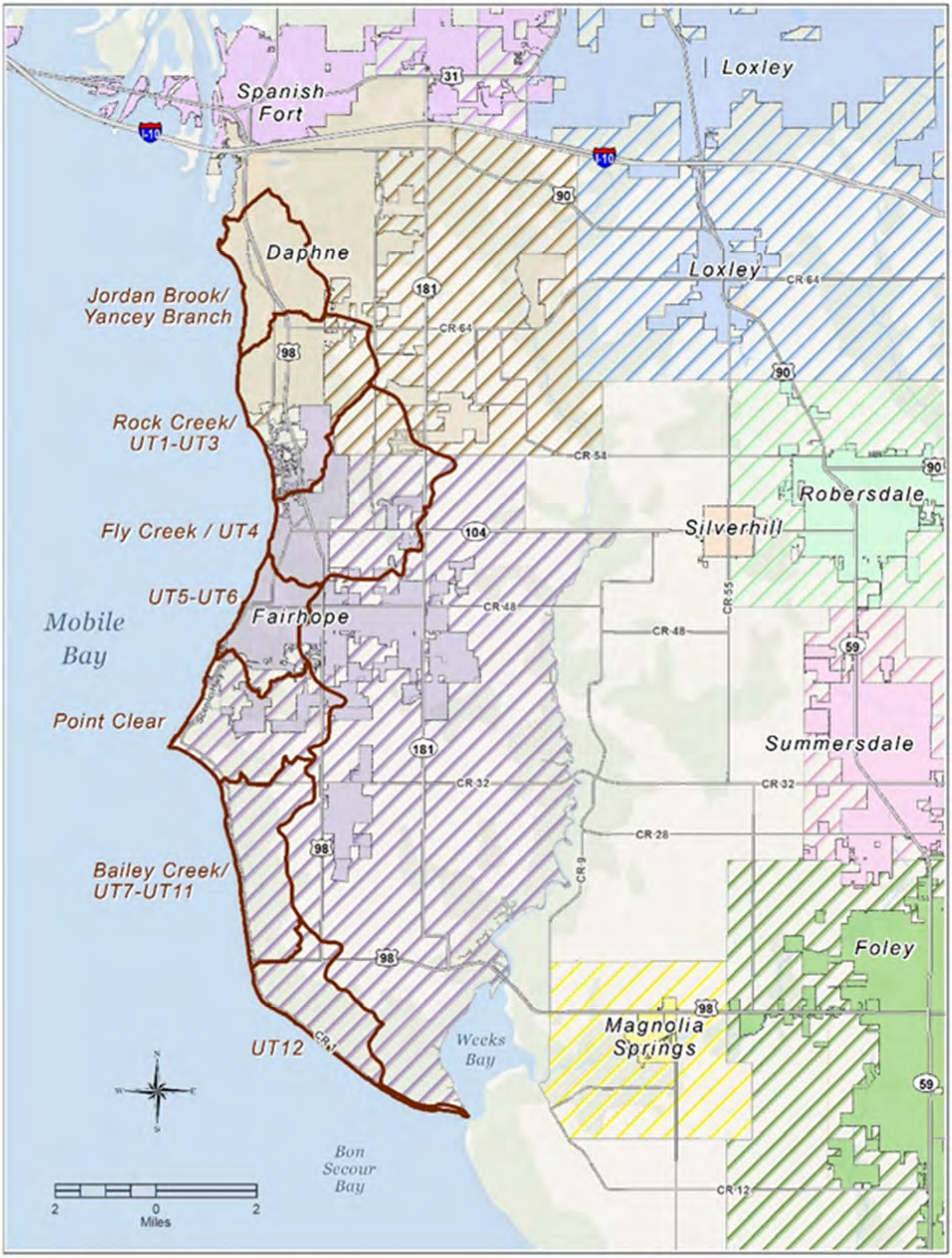


Figure 3.29 Extraterritorial Jurisdictions in Eastern Shore Watershed

In addition to ETJs, Baldwin County divides unincorporated lands into Planning Districts in accordance with ACT No. 91-719 of the Legislature of Alabama as amended. Of the 33 County Planning Districts, the unincorporated lands within the Eastern Shore Watershed are located within Planning Districts 15, 16, 17, 19, and 26 as shown in Figure 3.31. Of these, only District 17 has not adopted zoning provisions consistent with the County's planning and zoning authority to control growth within their portion of the County. The zoned Districts are subject to the planning and zoning authority of the Baldwin County Commission (Article 2, §2.1).

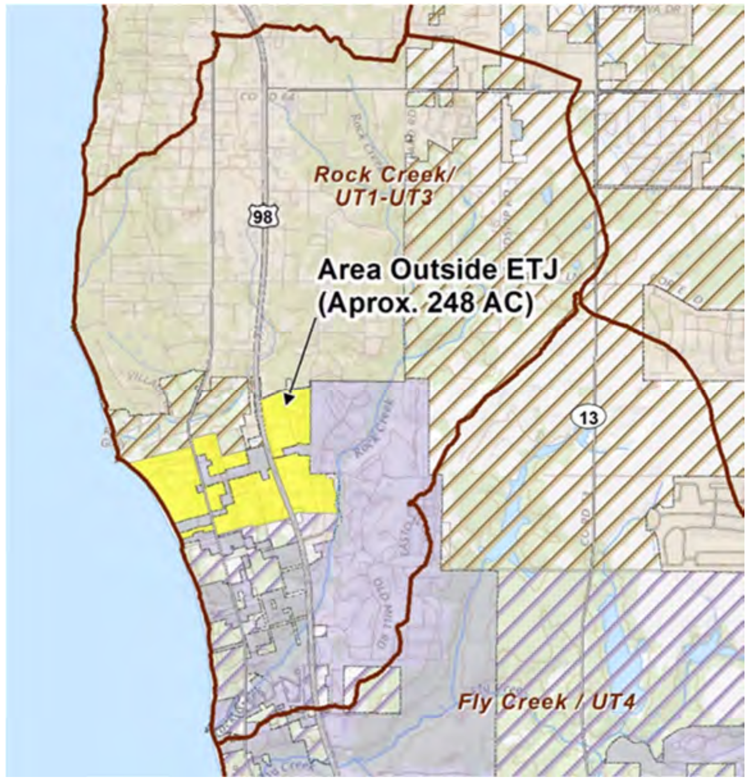


Figure 3.30 Area of Rock Creek/UT1-UT3 Outside ETJ

Therefore, while 58% of the Eastern Shore Watershed is in unincorporated Baldwin County, 37% of that total is within a zoned County Planning District, and only 21% is within unzoned County Planning District 17 (Figure 3.32). As all these unincorporated areas fall within ETJ jurisdictions, the entirety of the Watershed is subject to either city or County planning and zoning provisions. Overlapping ETJ and zoned District areas must meet planning approval of both the County and the city jurisdiction.

ETJs provide valuable development oversight of subdivisions and building permits in adjacent unincorporated areas that are also in unzoned Planning Districts. Recently, State Legislation (*2021 SB107), passed in April of 2021, limits the scope of ETJs thereby and places more oversight responsibility on County Planning Districts (see Note below). In general, County regulations are less rigorous than city regulations, which can affect the manner in which the overall growth and development of the Watershed take place.

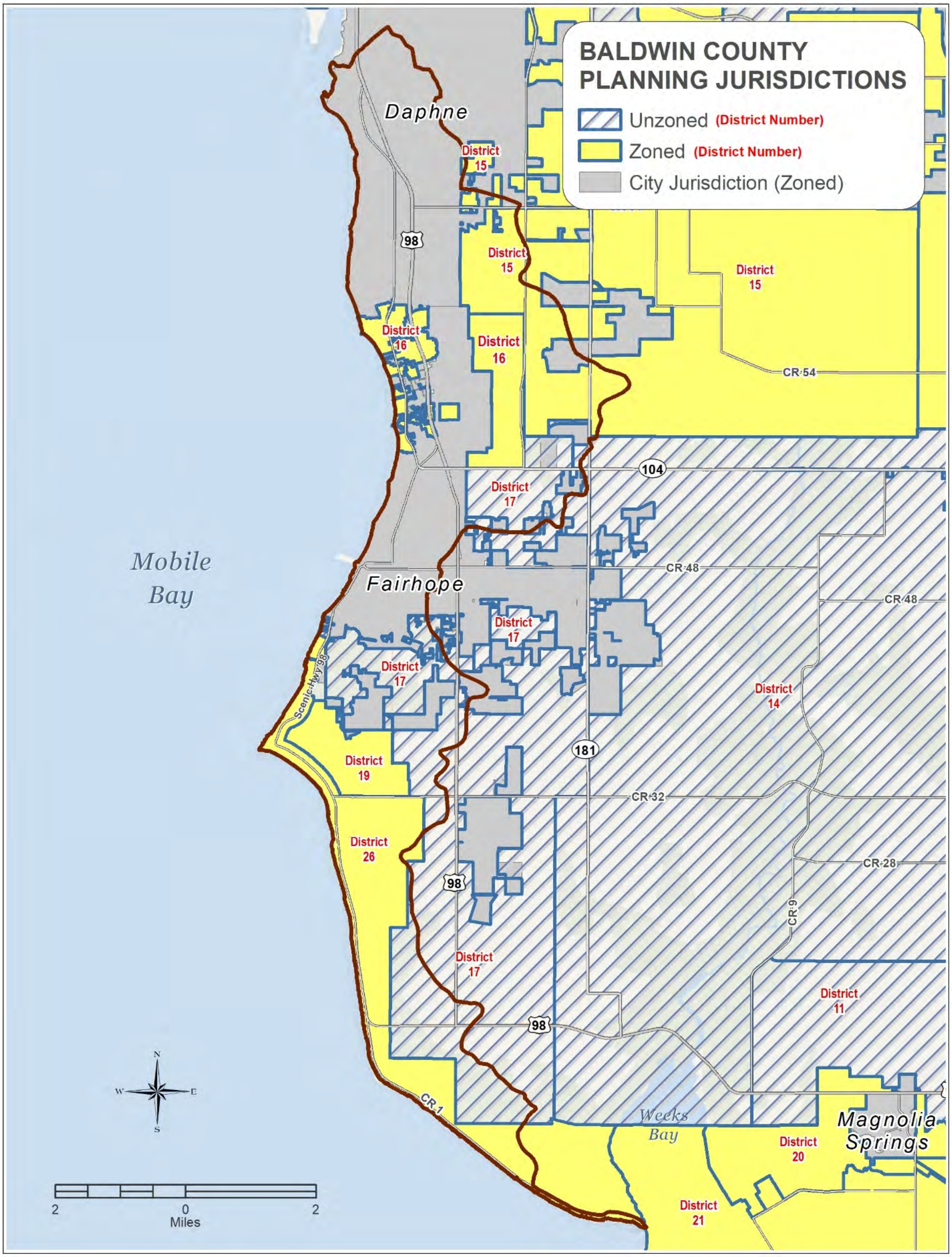


Figure 3.31 County Planning Districts in the Eastern Shore Watershed

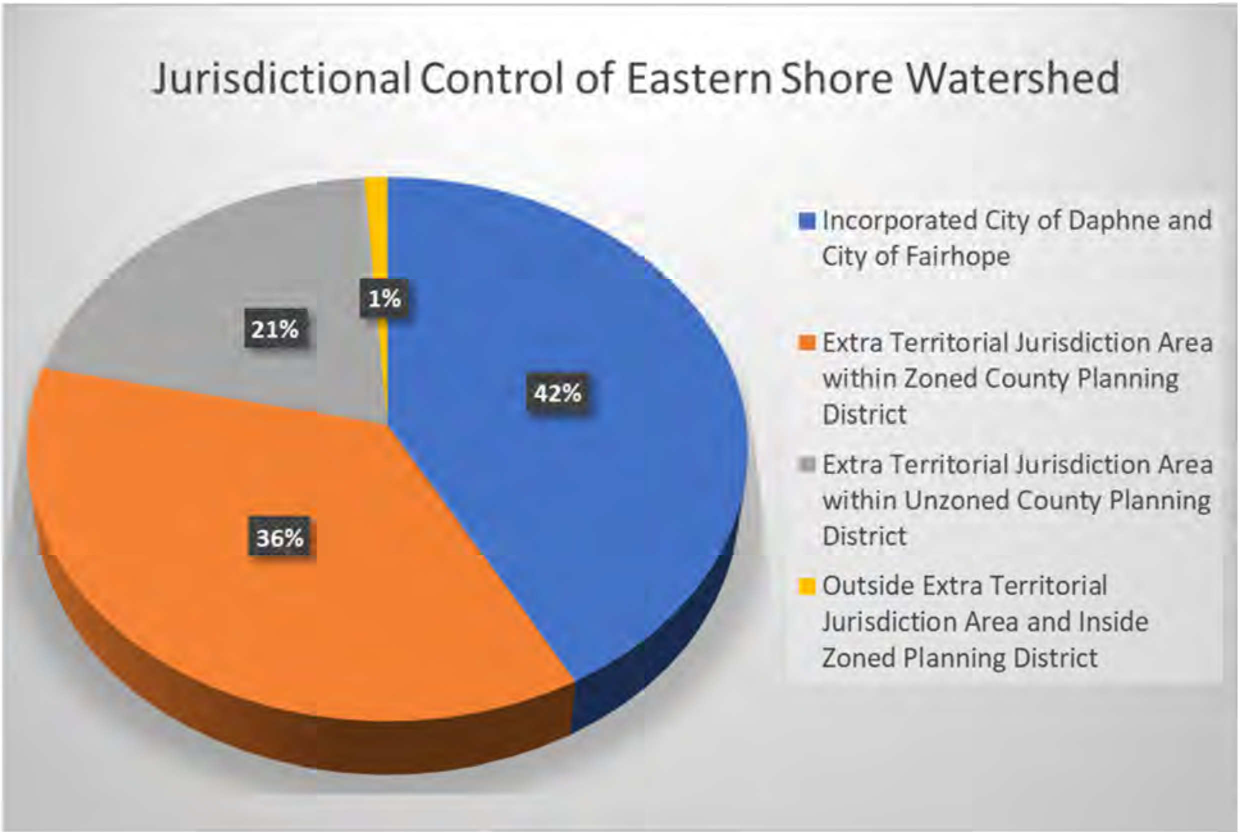


Figure 3.32 Jurisdictional Control of Eastern Shore Watershed

***NOTE:** This Watershed Plan was in development between 2020-2023. During those years, an important bill was introduced to the Alabama State Legislature called Act 2021-297, aka SB107. This new rule amends police jurisdictions and ETJ's. As noted previously in this report, there are a significant number of ETJ's in Baldwin County that would be affected. In July 2021, Act 2021-297 (SB107) was enacted. Pre-act, an ETJ allowed municipalities up to five miles outside of their corporate limits to enforce subdivision regulations. There also existed a "functional" 1.5 to 3 mile police jurisdiction. Post-act the ETJs became obsolete and functional police jurisdictions were frozen. At the time of this Plan writing, the municipalities and County were actively working on the best course of action to implement this new ruling. Because there was no clearly determined plan at the time of this writing of this portion of the WMP, the Team has added Appendix C to show any updates to the maps and calculations above using the most up-to-date information. In addition, two pamphlets developed by Baldwin County officials: 1) Baldwin County Planning and Zoning: Steps to Coming Under the Planning and Zoning Jurisdiction of Baldwin County, and 2) Zoning Frequently Asked Questions (FAQ's) are included in Appendix C.*

3.8 History and Culture of the Watershed

3.8.1 Pre-Settlement and Early Settlement

Documented cultural resources within the Eastern Shore Watershed include prehistoric sites dating from thousands of years ago, up to the colonial period and recent past. Native Americans inhabited the Gulf Coast for many generations before Europeans arrived. Muskogee, Choctaw, and Creek Tribes left evidence of their utilization of Alabama estuaries by the numerous mounds of oyster shells and Indian artifacts on Dauphin Island, the Mobile Tensaw Delta, and areas surrounding Mobile Bay. Prehistoric Indian cultures hunted and fished, and harvested oysters from Mississippi Sound and Mobile Bay over 3,500 years ago (B.C. 1500), during the Archaic Period (May, 1971). During the Woodland Period (B.C. 500 to A.D. 1100), coastal inhabitants led a more sedentary life compared to the Archaic Stage, with horticulture increasing in importance. Mississippian Period (A.D. 1100-1500) inhabitants had an estuary-oriented economy, adapted to the exigencies of deltaic horticulture and seasonal hunting adjusted to delta flooding (Knight, 1984).

The Native Americans who lived in this area as early as 10,000 years ago were Creek Indians (Historic Compilations Comprehensive History, May 2016). The tribes of the Creek Nation in the early 1800s consisted of somewhere between 18,000 and 24,000 people who occupied around 300 square miles (Ft. Mims Massacre, Baldwin County, Alabama 1813, May 2016). After the American Revolution, all of the powerful countries that had land in southern Alabama sought out an alliance with the Creek Indians. The Creek tribes had been using the land since before any of the European settlers arrived and had an unsurpassable knowledge of it as a result. The Creek Indians were mainly hunters and gatherers. They thrived in the presence of the many waterways that encompassed the region as well as the wide range of natural resources. One group of Creeks was called the Shell Mound people because of their love of shellfish and the resulting 25-feet tall historic midden mounds that can still be seen in southern Baldwin County today (Historic Compilations Comprehensive History, May 2016).

Summersell (1957) reported that Alonzo Alvarez de Pineda was the first Spanish explorer to reach Alabama in 1519; however, Owen (1938) reported that the first Europeans to enter what is now Alabama were members of the exploring party of Panfilo de Narvaez, whose expedition visited Mobile Bay in 1528. The Spanish were the first explorers to establish a colony on the Gulf Coast, which they controlled until 1670. The first large group of European settlers to make permanent homes in Alabama was French, with the Le Moyne brothers, Bienville and Iberville, playing important roles in the early years from 1699 to 1711. The French founded Mobile in 1702 as a capital of French Louisiana (Historic Compilations Comprehensive History, May 2016). After the French and Indian Wars ended in 1763, the British gained control of southern Alabama. Then, during the American Revolution, Spain regained control of the area and captured Mobile in 1780. They also expanded to the Eastern Shore and built "Old Spanish Fort." Baldwin County was officially formed on December 21, 1809, which predates the founding of the State of Alabama in 1819 (Historic Compilations Comprehensive History, May 2016). The name of the County comes from the United States Senator Abraham Baldwin (Morton, 2007).

It was during the British reign that many people from other British-held lands of what is now the eastern United States moved to present-day Washington, Baldwin and Mobile counties seeking farmlands offered by the West Florida government. The British performed a hydrographic survey of Mobile Bay in 1771 and published a British Admiralty Chart (Summersell, 1957). The Eastern Shore portion of the chart is presented in Figure 3.33, showing areas north and south of Point Clear, including local stream systems.

During the second Spanish period beginning in 1780, Americans began settling in Spanish West Florida, including Baldwin County, and in the new U.S. territory to the north. The first substantial settlement of the Watershed region occurred as the newly formed U.S. began to acquire the crumbling colony of Spanish West Florida as a territory in the early 1800s.

During the Civil War, on September 4, 1863, the Confederate Commerce raider, *Florida*, successfully ran the federal blockade of Mobile Bay, despite its crew being greatly impacted by yellow fever. Quarantined and with their ship damaged by the federal flagship *Oneida*, they were unable to dock in Mobile. Instead, the ship crossed the Bay, anchoring at Steadman's Landing at Sibley Street. Villagers allowed the burial of Seaman Dunkin and Lt. Stribling in the Montrose Cemetery. These are the only two Confederate seamen known to be buried in Baldwin County (Montrose Cemetery Board).

After the U.S. Civil War, the waters of the Alabama coastal area saw a considerable increase in vessel traffic, and there was increased development of resorts and summer homes on the Eastern Shore. Bay

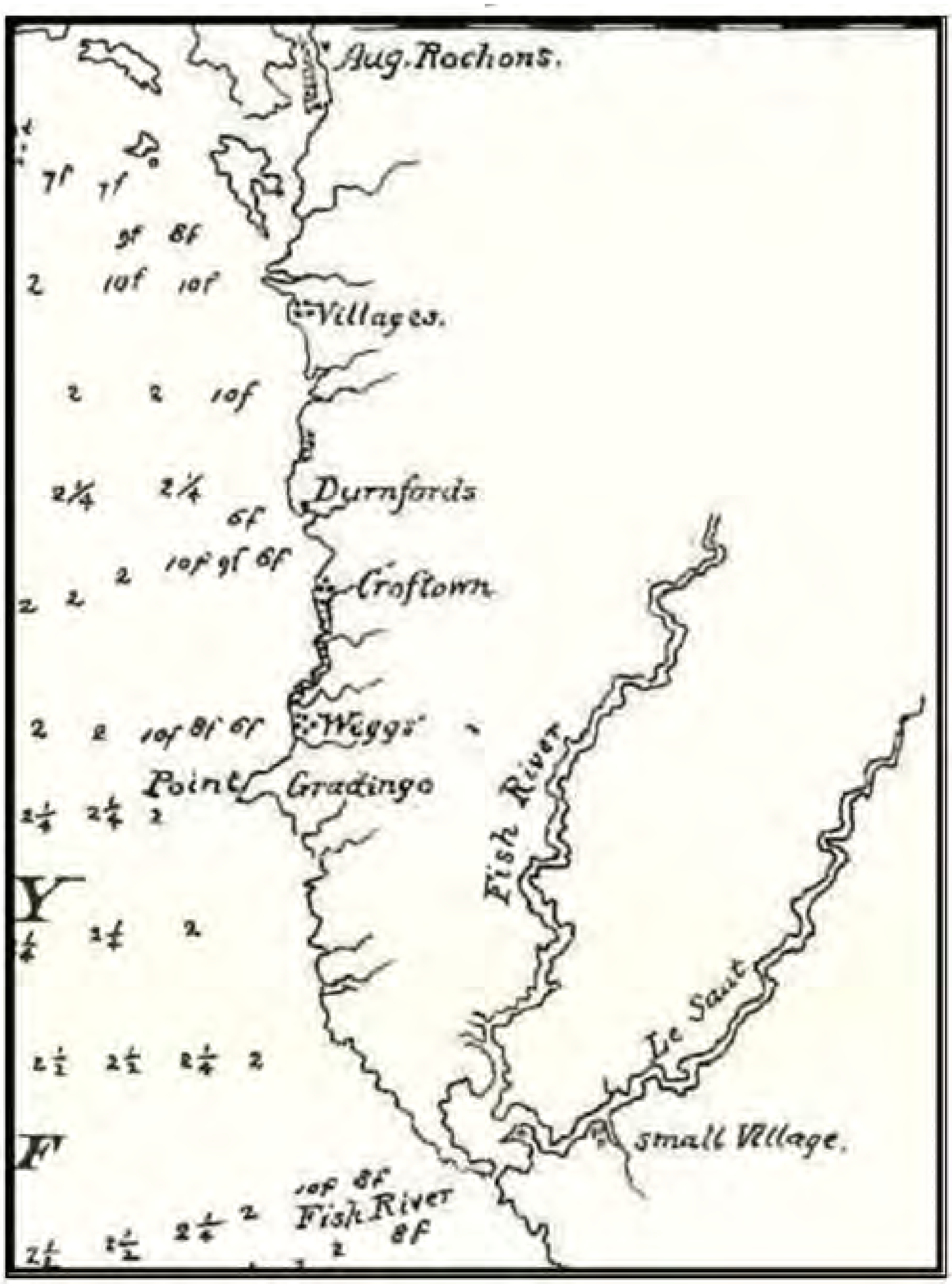


Figure 3.33 Eastern Shore Area of Mobile Bay, as Shown on the British Admiralty Chart of 1771

waters sustained a seafood industry involved in fishing, oystering, and shrimping. By the early twentieth century, substantial fleets of locally built small schooners and sloops were active on coastal Alabama baysand offshore; these vessels were often involved in charter service and transporting farm produce and timber (Mistovich and Knight, 1983).

Before the cities in the Watershed were officially founded, many European immigrants came to the area in and around the Eastern Shore Watershed. Italians migrated to the Daphne area, the Scandinavians to the Silverhill area, the Bohemians (from what is currently known as the Czech Republic) to the Robertsdale, Summerdale, and Silverhill areas, the Poles to the Summerdale area, and the Greeks to the Malbis area. This resulted in a culturally diverse and eclectic county (Causey, 2014).

The Watershed and surrounding southern pine region supported a prosperous lumber industry. After depletion of the native cypress forest of the Mobile-Tensaw Delta, longleaf pine forests became the main timber source at coastal Alabama sawmills (Mohr, 1901). In the early 1900s, cutover pinelands of Baldwin County were increasingly converted to farms **(**Harper, 1913). The naval stores industry (turpentine and rosin) also focused on Gulf coast pine stands. The industry expanded at a rapid rate in the last quarter of the nineteenth century, with the 1880s seeing rapid increase in the purchase of pine forest acreage for timber resources (Outland, 2004). Baldwin County played a key role in this market, with Mobile and Pensacola as the collection points for cargoes from the state's rivers. Around the turn of the 20^{th} century, immigrants from many regions of the United States and from other countries began populating Baldwin County.

Only 2.5% (approximately 555 acres) within the 22,420-acre Eastern Shore Watershed has been formally surveyed for cultural resources. There have been 27 documented cultural resources assessments conducted within the Watershed, primarily regulatory compliance driven studies. There have been additional reconnaissance level studies of varying intensity, including the work of Clarence B. Moore in the early 20^{th} century (Sheldon, 2001), and Walter B. Jones of the Alabama Museum of Natural History, primarily in the 1930s. The University of South Alabama and various volunteers have also contributed information about sites to the state site files outside of formal survey circumstances.

During cultural resources surveys, 57 archaeological sites have been recorded in the Watershed (Figure 3.34). Of these sites, 37 have prehistoric occupations dating pre-1700 or the time of initial European colonization of the area. Many of the sites have multiple episodes of occupation. Seventeen sites have components that could not be assigned to a known cultural period, one was dated to the Archaic Period, eleven dated to the Woodland Period, and seven dated to the Mississippi Period.

Not surprisingly the documented archaeological sites are largely the remains of shellfish gathering and feasting events that took place throughout history along the shores and bluffs of Mobile Bay. Fourteen were noted clam or oyster middens, one earthen mound was documented, and 26 were primarily scatters of artifacts not directly associated with an observable midden or mound feature. One of the sites was a large boulder of locally available ferruginous sandstone with a large spiral carved into its surface, thought to represent the sun or perhaps a hurricane (Figure 3.35).

Thirty-six of the documented archaeological sites in Figure 3.34 have historic components that date from the French period of colonization, and throughout the 18^{th}, 19^{th}, and 20^{th} centuries. Thirteen of these sites are the remains of historic pottery kilns and their associated waste dumps that were located along the Eastern Shore, primarily dating to the late 19^{th} and early 20^{th} centuries (Gums, 2001).

Eleven of these sites are associated with what is known as "The Village" (present-day Daphne), including the remains of several early plantations as well as a cemetery near Village Point. Village Point also includes Jackson's Oak (Figure 3.36), from which Andrew Jackson addressed his soldiers from a massive limb while on his way to Pensacola during the War of 1812.

Three additional sites with historic components include a steamboat landing (Steadman's Landing), an early 20^{th} century dairy, and the remains of a wooden boat or pier embedded in the bay shoreline, at Ecor Rouge, Montrose (Figure 3.37).

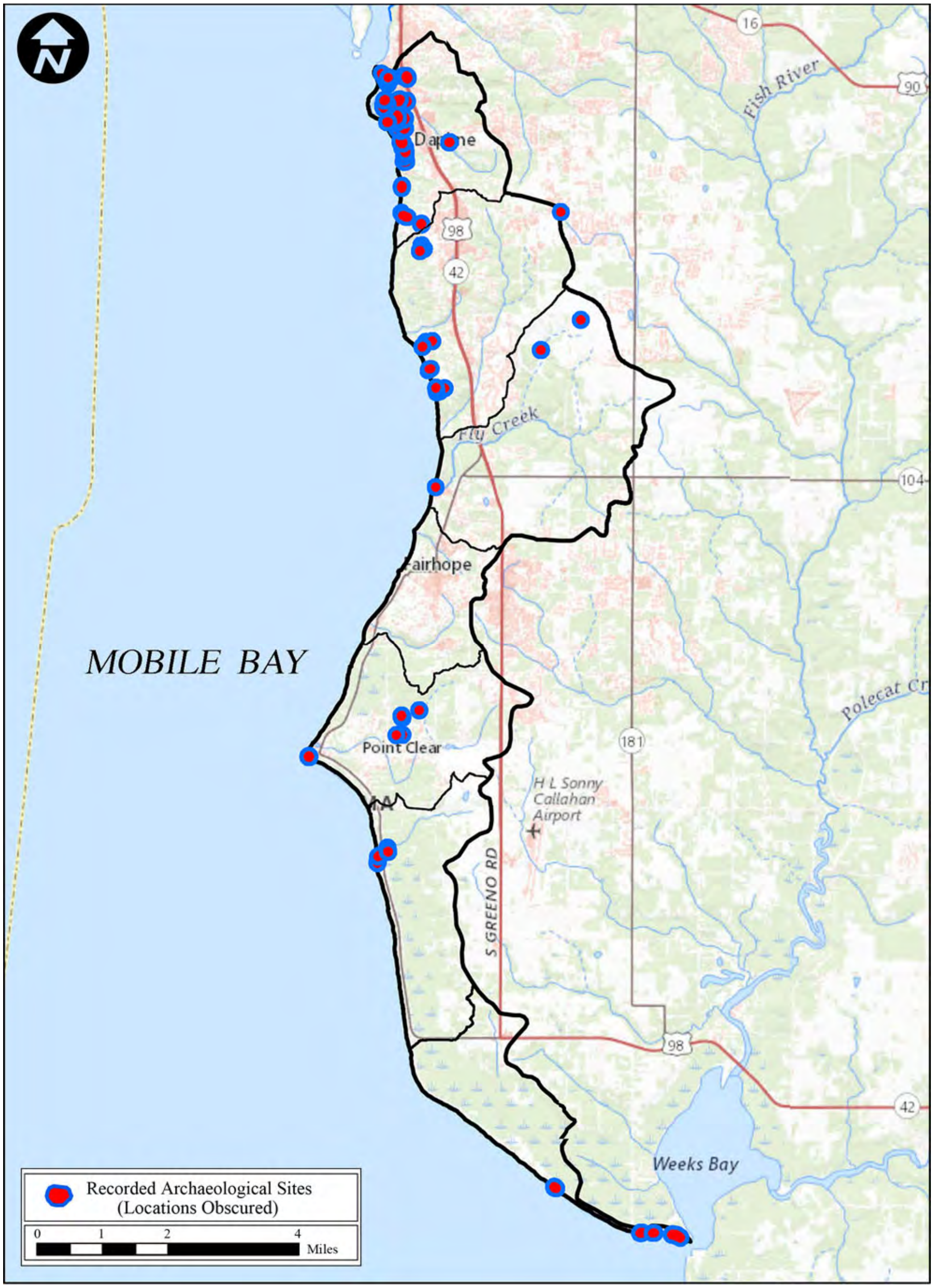


Figure 3.34 Archaeological Sites Recorded in the Eastern Shore Watershed
NOTE: Approximate locations

Figure 3.35 Prehistoric Petroglyph
Photograph Courtesy of Gulf South Past Recovery

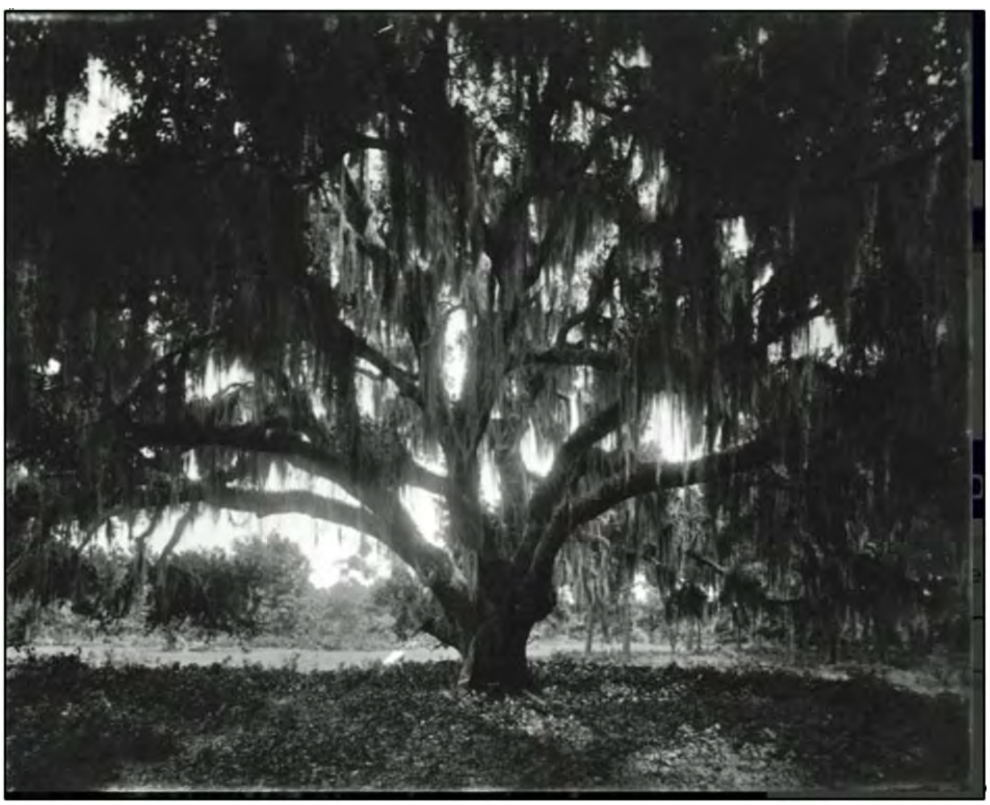


Figure 3.36 Jackson's Oak
Photograph Courtesy of Overby Collection, Doy Leale McCall Rare Book and Manuscript Library, University of South Alabama

Figure 3.37 Remains of a Wooden Boat or Pier Embedded in the Bay Shoreline at Ecor Rouge, Montrose
Photograph Courtesy of Gulf Coast Past Recovery

3.8.2 Settlement/History of Towns

Fairhope, which has grown exponentially in recent years and is located toward the middle of the Eastern Shore Watershed, was founded in November 1894 as a single tax colony. Henry George along with 28 followers from Des Moines, Iowa, moved to Fairhope and settled, hoping to "be free from all forms of private monopoly." Their settlement was meant to secure its members "equality of opportunity, the full reward of individual efforts, and the benefits of co-operation in matters of general concern" (Fairhope, AL, 2016). The members chose the name for the town because they believe they had a "fair hope" of success (Gaston, 2007).

The Daphne area, located in the northern portion of the Eastern Shore Watershed, was first settled by Spanish immigrants in 1557, but in 1710, the French took over the area. In 1763, the city that would one day be known as Daphne had come under British control. In November 1814, General Andrew Jackson and his army defeated the British and gained control of southern Alabama, including the City of Daphne. Daphne was named and established on April 9, 1874. William Howard, a wealthy hotel owner, eventually became the postmaster of the City and supposedly named it after a bush that his wife loved (Thompson-Messina, 2009). Italian immigrants came to Daphne beginning around 1888. Greek immigrants settled in the Malbis community. The City of Daphne was incorporated on July 8, 1927 (City of Daphne, 2016).

As early as the 1800s, families along the Gulf Coast would vacation in Point Clear, believing the daily breeze from Mobile Bay warded off yellow fever. Most folks arrived by ferryboat in Point Clear at Zundel's Wharf. In 1944, Point Clear's Grand Hotel served as the base for a secret operation known as Operation Ivory Soap in World War II all for the price of "$1 per year for the duration of the war". Lt. Col. Matthew Thompson ran the secret military operation that played a vital part in World War II's final push. Allied forces used a tactic called "island hopping" where they would capture Japanese-held islands of strategic important while "hopping" ineffectual islands and then leaving them. This tactic allowed the Allies to move through the Pacific quickly, it prevented them from wasting supplies and manpower on capturing inconsequential territory and it provided them with the all-important element of surprise. However, the tactic also started to present a major problem. American bombers and fighter planes returning from long-range missions needed to be repaired and rearmed for the next mission, but building repair facilities on each island was taking too much time. General Henry H. Arnold, commander of the Army Fair Forces, recognized the need for floating repair facilities and determined that six Liberty ships could be modified into Aircraft Repair Units and smaller vessels turned into Aircraft Maintenance Units. The problem with this idea was who would man these repair ships? The mechanics from the Army and Air Force had never been trained to live and operate at sea. When Lt. Col. Thompson heard that the Grand Hotel, a historic waterfront establishment, would be closing he contacted Ed Roberts, head of Waterman Steamship Co. and owner of the Grand Hotel. Roberts chose to donate the use of the hotel for this strategy but Thompson that using the hotel of free of charge didn't feel right and therefore where the $1/year was drafted. Once the agreement had been made the nineteenth-century Alabama hotel was transformed to mimic nautical conditions while it housed soldiers and served as a maritime training facility. In just about five months, the men were trained in skills such as swimming, special calisthenics, marching, drill, navigation, ship identification, signaling, cargo handling, ship orientation, sail making and amphibious operations. The school produced 5,000-trained Army seamen who took part in operations in the Philippines, Iwo Jima, and Guam. The training these troops received thanks to Operation Ivory Soap allowed the soldiers to help save countless lives and aircraft. The name "Ivory Soap," according to Col. Thompson, was derived from the fact that like the experimental aircraft repair units the military wanted to deploy, ivory soap floats (Mobile Bay Magazine 2016). The Grand Hotel is still in operation on the eastern shore of Mobile Bay today (Congressional Record, Volume 146, 2000).

Figure 3.38 Historic Photograph of the Grand Hotel, Point Clear, Alabama
Source: Mobile Bay Magazine 2016

Montrose is a non-incorporated community originally known as Sibley City, in honor of Cyrus Sibley, an early landowner in the area. In 1839, Cyrus Sibley, of Massachusetts, acquired land on the eastern shore of Mobile Bay. Eight years later, a village was formally platted and surveyed. In 1852, it was renamed Montrose as a tribute to the Scottish Duke of Montrose.

The National Register of Historic Places provides a listing of the Nation's historic places recognized as worthy of preservation, as authorized by the National Historic Preservation Act of 1956. The list is maintained by the National Park Service, U.S. Department of the Interior. Currently there are 24 sites within the Eastern Shore Watershed, shown on Table 3.14.

Table 3.17 National Register of Historic Sites within Eastern Shore Watershed

Name of Site	Lat/Long	Date Added	Subwatershed	Significance	Address
Montrose Historic District	30°34'7" N, 87°54'2" W	1976	Rock Creek	Mostly residential, many of the houses were built as summer homes for residents of Mobile.	Main (AL 42) and 2nd Streets Montrose, AL
Tolstoy Park	30°33'23" N, 87°53'38" W	2006	Rock Creek	Also known as the Henry Stuart House, the hand built hut was completed in 1926 by its namesake.	22787 AL 98, Montrose, AL
Lewis Starke House	30°36'26" N, 87°54'39" W	1990	Jordan Brook/Yancey Branch	This home was built in 1850 in the Greek Revival architecture style.	2103 Old County Rd., Daphne, AL
George W. Cullum House	30°36'19"N, 87°454'39"W	1990	Jordan Brook/Yancey Branch	This home was built in 1846 in the Greek Revival architecture style.	1915 Old County Road, Daphne, AL
The Texas	30°36'02" N, 87°54'37" W	1988	Jordan Brook/Yancey Branch	It was built as a hotel by William L. Howard in 1835.	306 Dryer Avenue, Daphne, AL
McMillan House	30°35'52"N, 87°54'42"W	1988	Jordan Brook/Yancey Branch	This home was built in 1835 in the Greek Revival Creole and Gulf Coast Cottage style.	1404 Captain O'Neal Avenue, Daphne, AL
Captain Adams House	30°35'25 N, 87°54'51" W	1988	Rock Creek/UT1-UT3	This home was built around 1850 in the Greek Revival architecture style.	901 Captain O'Neal Drive Daphne, AL
Walker House	30°35'23" N, 87°54'51" W	1988	Rock Creek/UT1-UT3	This home was built around 1850 in the Greek Revival architecture style.	905 Captain O'Neil Drive Daphne, AL
Manly-Strong House	30°35'23" N, 87°54'51 W	2019	Rock Creek/UT1-UT3	This home was built around 1850 in the Greek Revival architecture style.	100 Deer Court, Daphne, AL
Axil Johnson House	30°31′39″N 87°53′24″W	1997	UT5/UT6	This home was built around 1850 in the Greek Revival architecture style.	751 Edwards Street Fairhope, AL

Name of Site	Lat/Long	Date Added	Subwatershed	Significance	Address
Golf, Gun, & Country Club	30°31′22″N 87°53′41″W	1988	UT5/UT6	Significant as an architectural reflection of the entertainment/recreation values prevalent in Fairhope during the 1920s.	651 Johnson Avenue Fairhope, AL
Fairhope Bayfront District	30°31′28″N 87°54′32″W	1988	UT5/UT6	Late 19th and early 20th century American movements and revivals.	Roughly bounded by Blakeney, N. and S. Summit Sts., Fels Avenue, and Mobile Bay
Fairhope Downtown District	30°31′21″N 87°54′11″W	2006	UT5/UT6	Late 19th and early 20th century American movements and revivals.	Roughly bounded by Equality St., Fairhope Avenue, Morphy Avenue, School St., and Summit St.
White Avenue Historic District	30°31′10″N 87°54′04″W	1988	UT/UT6	Bungalow/craftsman architecture. A significant collection of residential buildings, which respond to Fairhope's egalitarian building tradition through the use of modest materials.	White Avenue Fairhope, AL
Whittier Hall	30°31′29″N 87°53′45″W	1985	UT/UT6	Built in 1905.	201 Magnolia Avenue Fairhope, AL
U.S. Post Office	30°31′23″N 87°54′15″W	1988	UT5/UT6	This historic U.S. Post Office was built in 1932 in the Italian Renaissance Revival architecture style.	325 Fairhope Avenue Fairhope, AL
Carl L. Bloxham Building	30°31′23″N 87°54′15″W	1988	UT5/UT6	Significant as a rare Baldwin County example of the Art Deco style of architecture constructed by M. Dyson and company in 1932.	327 Fairhope Avenue Fairhope, AL

Name of Site	Lat/Long	Date Added	Subwatershed	Significance	Address
Gaston Building	30°31′22″N 87°54′14″W	1988	UT5/UT6	Significant as the headquarters of the Fairhope Single-Tax Corporation from 1924 to 1938.	336 Fairhope Avenue Fairhope, AL
Bank of Fairhope	30°30′48″N 87°55′06″W	2018	UT5/UT6	The bank was built in 1927.	S Mobile Street Fairhope, AL
Beckner House	30°31′15″N 87°54′17″W	1988	UT5/UT6	This structure was built in 1906 and is significant as an exceptional early example of a Fairhope house built for year round living where summer resort house were the norm.	63 S. Church Street, Fairhope, AL
Zurhorst House	30°31′16″N 87°54′23″W	1988	UT5/UT6	It is significant as the finest concrete block construction in Baldwin County, a method of construction popular in Fairhope from 1905 to 1930.	200 Fells Avenue Fairhope, AL
American Legion Post 199	30°30′48″N 87°55′06″W	2016	UT5/UT6		700 S. Mobile Street, Fairhope, AL
Twin Beach AME Church	30°30′04″N 87°54′34″W	1988	UT5/UT6	A historic African Methodist Episcopal Church built in 1925.	Southern Side of County Road 44
Street House	30°27′52″N 87°53′54″W	1988	Bailey Creek/UT7-UT11	It was built in 1906 by William Street, and has remained in the family.	Wood Acres Road, County Road 3 Point Clear, AL

3.8.2.1 Forestry Practices

Prior to European influence, the Eastern Shore Watershed was covered in part by old growth longleaf pine forests and forested wetlands. As the timber industry grew, timbermen clearcut the longleaf pines forests. Over time, clearcut areas were settled by farmers who removed residual stumps and cultivated the soil for agricultural crops. Nearly every lumber mill in the area used longleaf pine as their source of lumber (Harper, 1913). John Loxley established a lumber camp with a sawmill and a small, temporary railroad system. Many of the towns in Baldwin County harvested trees for lumber. Some areas created their own temporary railroad system to make hauling lumber easier and more efficient. According to Roland Harper's book published in 1913, lumber was the leading wood product in the area, and it was also used for fuel for locomotives (Harper, 1913).

3.8.2.2 Farming

Until the mid-1860s, the rest of the country recognized Alabama as the "Cotton State" because cotton was its primary crop, and it covered almost four million acres across the State. Cotton dominated southern Alabama's farmland until after the end of WWII, when a larger diversity of crops was introduced to the area. Some of the most common crops grown in Alabama in the 1920s were peanuts, cotton, soybeans, grain, peaches, and pecans. Around this time, farmers started using nitrate, superphosphate, and potassium minerals as fertilizers to reintroduce nutrients into the depleted soil. To correct for more acidic soils, the farmers would use ground limestone and slag (Mitchell, 2007).

Until the 20th century, agriculture was the main source of revenue for Baldwin County. At this point, the most lucrative industry in the area became timber as the economy shifted to industry. By the 1960s, farmers had replaced workers with machinery, which resulted in workers relocating to other industries such as timber and turpentine. Today the most common crops grown in Baldwin County are wheat and other grains, cotton, potatoes, corn, peas, butterbeans, soybeans, tomatoes, squash, okra, peanuts, eggplant, turnip and collard greens (Baldwin County, Alabama, 2016a).

The Europeans were the first to introduce cattle to Baldwin County during the colonial era (Mitchell, 2007). In the early 1900s, farmers used the practice of open range cattle grazing, which allowed cattle to have free range of the land (Harper, 1913). Farmers would let their cattle wonder wherever they pleased. Branding your cattle was the way to tell them apart from others. The only fences in the early 1900s were to keep cattle off gardens or yards. However, due to the increase in population and major highways in Baldwin County, livestock laws were passed in the 1940s making it mandatory for livestock to be confined within fences.

3.8.2.3 Transportation

The major railroad in Baldwin County was the Louisville and Nashville Railroad, more commonly known as the L&N Railroad. Having the railroad route enabled significant economic and population growth for Baldwin County. It carried passengers as well as goods. The railroad was one of the most prominent railroads in the Southeast and earned the nickname "Old Reliable" because of its durability. It allowed the County to bring supplies that could not otherwise have been transported to southern Alabama (Louisville and Nashville Railroad, 2016). The L&N ran from Bay Minette to Foley, a route that would run closely along the present-day Highway 59 (Lee, 2009).

Today, the major highways within or close to the Watershed are Interstate 10, U.S. Highway 31, U.S. Highway 90, U.S. Highway 98, Alabama Highway 59, Alabama Highway 104, and Alabama Highway 181. These are supplemented with a dense network of paved and unpaved County roads. During the times of settlement in the 1800s, roads were little more than wagon trails that tended to follow natural high ground at major Watershed boundaries. As more settlers moved in, and as the forest and agriculture produced materials, goods were transported to larger markets like Mobile, Pensacola, and beyond, as needed.

In 1941, U.S. Highways 31, 90, and 98, along with Alabama Highway 59, were operational (Baldwin County, Alabama, 2016b). In 1978, the I-10 Bridge over Mobile Bay was completed.

3.9 Public Access in Eastern Shore Watershed

The public access sites in the Eastern Shore Watershed play an integral role in community health by providing outdoor recreation. In addition, these sites provide education about coastal ecosystems and add a sense of ownership to the public. There are 25 public access sites located within the Watershed. These sites, listed in Table 3.18, include water-based and land-based parks that allow public access to waterbodies. These sites do not include the many privately owned boat ramps and access sites, County/municipal parks, or recreation sports fields. Figure 3.39 shows the location of these public access facilities within the Watershed.

Table 3.18 Public Access in Eastern Shore Watershed

Name	Boat Launch	Address	Bay Access
Alfonse Memorial Veteran's Park	No	7281 Park Dr	No
Battles Rd Access	No	Battles Rd & Scenic 98	Yes
Bayfront Park	No	6200 Bayfront Park Dr	Yes
Belrose Park	No	90 Belrose Ave	Yes
Cypress Ave Beach & Water Access	No	12495 CR 1	Yes
Daphne Sports Complex	No	7060 Park Dr	No
Dryer Ave Bay Access	No	Dryer Ave & Captain O'Neal Dr	Yes
Volanta Park	No	701 Volanta Ave	No
Fairhope Municipal Pier	No	S. Mobile St & Fairhope Ave	Yes
Holly Ave Water Access	No	Holly Ave & Scenic 98	Yes
Live Oak Water Access	No	Live Oak & Scenic 98	Yes
Mary Ann Nelson Park	No	10646 CR 1	Yes
May Day Park	Yes	100 College Ave	Yes
McMillan Bluff	No	McMillan Ave & Lovette Ln	Yes
Mullet Point Park	Yes	13202 CR 1	Yes
North Beach Park	No	4 N Beach Rd	Yes
Orange St Pier-Beach	No	S. Mobile St & Orange Ave	Yes
Palmetto Ave Water Access	No	Palmetto Ave & Scenic 98	Yes
Pelican Point	Yes	10321 CR 1	Yes
Perdido Ave Public Beach Access	No	Perdido Ave & N Mobile St	Yes
Pier St Launch	Yes	Pier St & S Mobile St	Yes
Sea Cliff Dr	No	End of Sea Cliff Drive (off Main St)	Yes
Stedman's Landing	No	Sibley St & Main St	Yes
Sunset Ln Water Access	No	Sunset Ln & Scenic 98	Yes
Village Point Park Preserve	No	27710 Main St	Yes
Volanta Ave Water Access	No	Volanta Ave End (off Scenic 98)	Yes
White Ave Park	No	White Aven& Scenic 98	Yes
W.O. Lott Park	No	2000 Main St	No
Yupon Ave Water Access	No	Yupon Ave & Scenic 98	Yes
Zundel Rd Water Access	No	Zundel Rd& Scenic 98	Yes

Sources: TE, MBNEP's Alabama Coastal Resources Comprehensive Inventory 2021

Figure 3.39 Public Access Locations within Eastern Shore Watershed

3.9.1 Eastern Shore Jubilee Phenomenon

The phenomenon of jubilee has been observed at least as early as 1821 according to newspapers in files of the Fairhope Single Tax Corporation (Mobile Bay Symposium 1979). The jubilee events occur during summer months (most often in August) typically during predawn hours as fish, shrimp, and crabs crowd onto the shallow waters along the shoreline. Scientific documentation on jubilees have been published by Harold Loesch (1960) and Edwin May (1973). Generally accepted conditions that are associated with jubilees include an incoming tide and easterly wind. The most common location within Mobile Bay is the upper eastern shore (Point Clear to Daphne). The jubilee results as easterly winds push the well oxygenated shallow waters offshore and the incoming tide pushes a mass of low dissolved oxygen bottom water eastward toward the shore "trapping" the bottom-dwelling species against the shoreline. Figure 3.40 shows a typical jubilee event.

Figure 3.40 Jubilee Phenomenon

3.10 Population

In assessing the population of the Eastern Shore Watershed, historic and projected population data have been evaluated to gain an appreciation of population characteristics. Data from the 2010 Census and the latest 2020 Census were analyzed, along with projections made by the Eastern Shore Metropolitan Planning Organization (ESMPO or MPO) to understand population trends in the Watershed. The U.S. Census uses various geographic areas (or units) to aggregate and organize the information it collects. Aside from legal/administrative areas (e.g., states, counties, cities), it supplements these by aggregating data for statistical areas that are created in cooperation with state and local agencies. Most notably, counties are divided into census tracts, block groups, and blocks. The block is the smallest and most detailed geographic unit that the Census Bureau uses to tabulate decennial census data.

3.10.1 Demographics

In 2020, the total population of Baldwin County in 2020 was 227,131 with approximately 21.5% (48,913) of those people residing in the cities of Daphne (total population = 27,088) and Fairhope (total population = 21,825) which are within the Eastern Shore watershed. Based on American Community Survey data, approximately 21% (46,805) of Baldwin County's resident population is aged 65 or over in comparison to 17.6% (4,778) in Daphne and 22.9% (5,009) in Fairhope (Table 3.19).

Table 3.19 U.S. Census Bureau American Community Survey Demographic numbers for 2020

Geographic Area	2020
Total Population	
Baldwin County	227,131
City of Daphne	27,088
City of Fairhope	21,825
Age 65+	
Baldwin County	21.00%
City of Daphne	17.60%
City of Fairhope	22.95%

Source: U.S. Census Bureau 2020

Census data show that the population of the Eastern Shore WMP is not racially diverse with 87.7% (199,259) of the population of Baldwin County identifying as white, 9.3% (21,232) identifying as African American, 4.7% (10,634) identifying as Hispanic or Latino, and less than 10% identifying as Native American, Asian, Native Hawaiian, and all other races combined. The cities of Daphne and Fairhope are similar in ethnic diversity, see the table below for those comparisons (Table 3.17).

Table 3.20 Ethnic Diversity of Eastern Shore WMP

	White	Black and African American	Hispanic or Latino	Asian	Native Hawaiian and other Pacific Islander	Other race
Baldwin County	87.70%	9.30%	4.70%	1.50%	0.30%	3.10%
City of Daphne	81.10%	16.10%	2.90%	3.90%	0.10%	1.40%
City of Fairhope	90.50%	5.40%	4.7	1.80%	0%	2.50%

Source: U.S. Census Bureau 2020

3.10.2 Historic Population Trends

Baldwin County is, by area, the largest county in the State of Alabama, covering approximately 2,027 square miles (U.S. Census Bureau). Established in 1809, it has been the fastest growing county in Alabama by total population increase since 2005. It is now the fourth most populous county in Alabama, surpassing Montgomery County by 2,800 according to the 2020 Census. Additionally, the 2020 U.S. Census data ranks Baldwin County as the seventh fastest-growing metropolitan area in the country, with a 27.2% population increase from 2010, and a 65% increase since 2000. It currently has the largest projected growth among all Alabama Metropolitan Statistical Areas (MSAs).

Located across Mobile Bay from the City of Mobile, Baldwin County shorelines border Mobile Bay, Bon Secour Bay, Weeks Bay, Wolf Bay, Perdido Bay, and the Gulf of Mexico, encompassing approximately 250 miles.

Figure 3.41 summarizes population growth in Baldwin County since the first U.S. Census enumeration of 1820 for the State of Alabama. The figure includes population historical data from 1810 after the establishment of the county in 1809.

The overall historic average growth per decade of the county has been around 28%. As a side note, this historical perspective shows an interesting decline in population (by 22%) during the Civil War period, between the years of 1860 and 1870.

From the 1990 Census to the 2020 Census, the population of Baldwin County grew 136%. Historically, the county's population has been concentrated in its major municipalities in the central portion of the county. However, more recently, the growth patterns have extended to the southern portions of the county. The fastest growing city in Alabama is Gulf Shores followed by Spanish Fort, with Fairhope fourth, Foley seventh, and Daphne ranked eleventh in municipal population growth. While three of these cities lie outside of the Watershed and are experiencing growth along their peripheries, this "urban sprawl" is primarily due to development of new subdivisions, but also commercial development and annexations. While urban sprawl means outward development pressures, it has also placed development pressures in the urban cores of both Daphne and Fairhope. These "bedroom" communities are particularly appealing for their locations along the shores of Mobile Bay, small town appeal, and relative proximity to major transportation corridors and various amenities along the Eastern Shore, and City of Mobile. This development pressure is particularly true for the City Fairhope where urban infill has been notable in its urban core with both residential and commercial development.

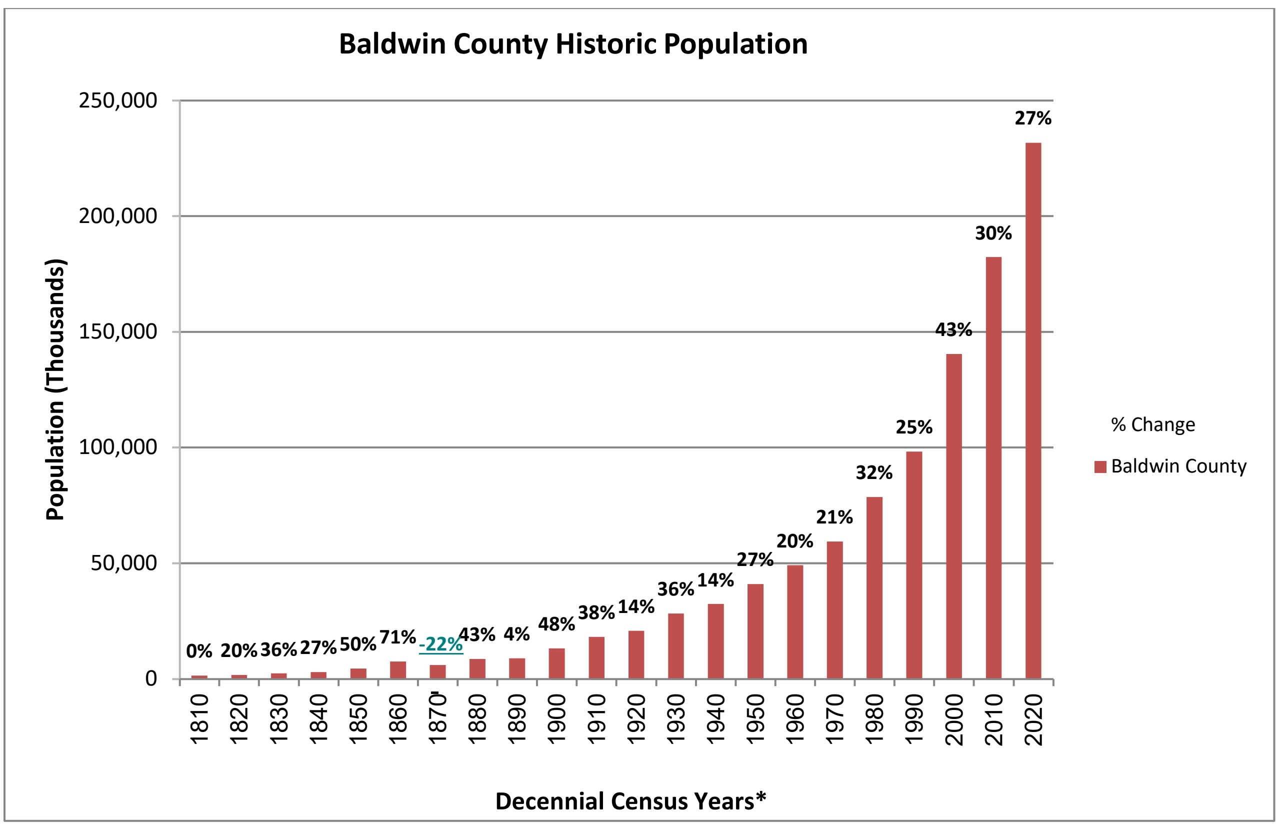


Figure 3.41 Baldwin County Historic Population

Source: U.S. Census Population Estimates

Figure 3.42 shows population growth for the cities of Daphne and Fairhope since 1980. As previously noted in Chapter 3.7, a little over half (58%) of the Watershed lies in unincorporated areas of Baldwin County.

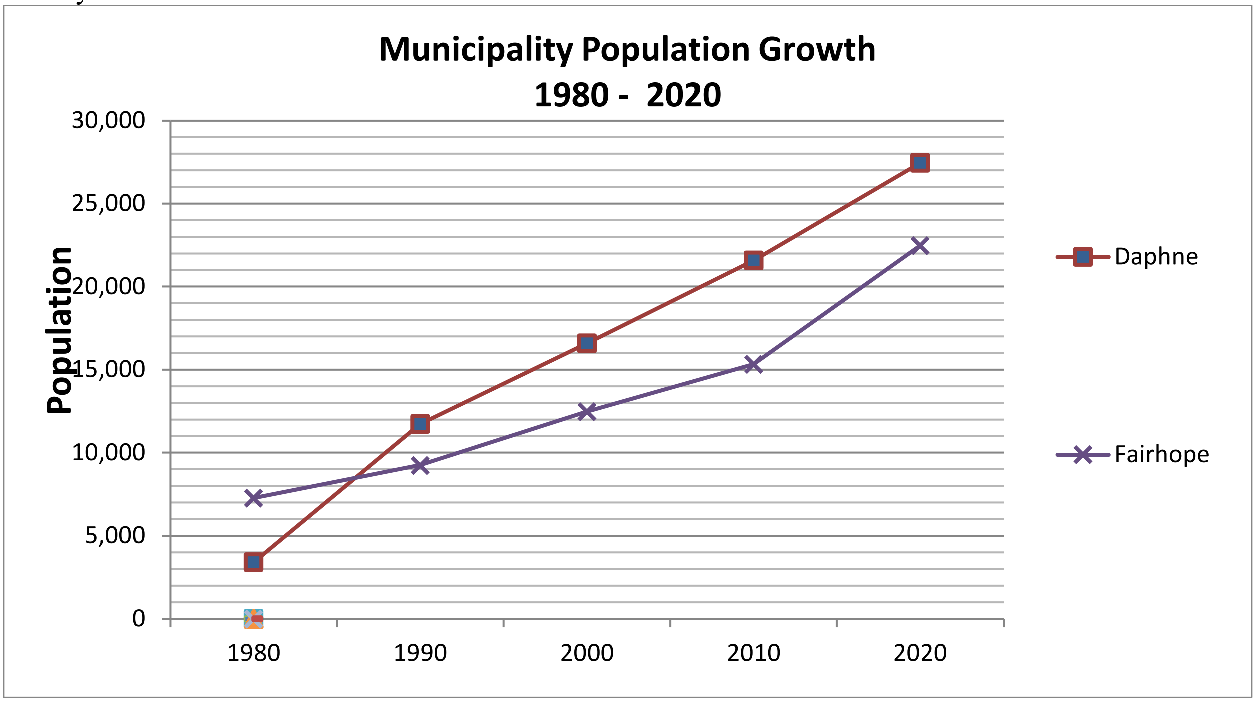


Figure 3.42 Municipality Population Growth 1980 - 2020
Source: U.S. Census 2020

3.10.3 Current and Projected Future Population Growth

Eastern Shore Watershed populations were evaluated using 2010 and 2020 U.S. Census data at the block level for each Subwatershed. For population growth projections, the Eastern Shore Metropolitan Planning Organization's (ESMPO) 2045 Long Range Transportation Plan (LRTP) projections were utilized.

As Figure 3.43 shows, the ESMPO Study Area encompasses all of the Eastern Shore Watershed, with the exception of a small portion from Mullet Point to Pelican Point; therefore, their projections were applied to our study area Subwatersheds.

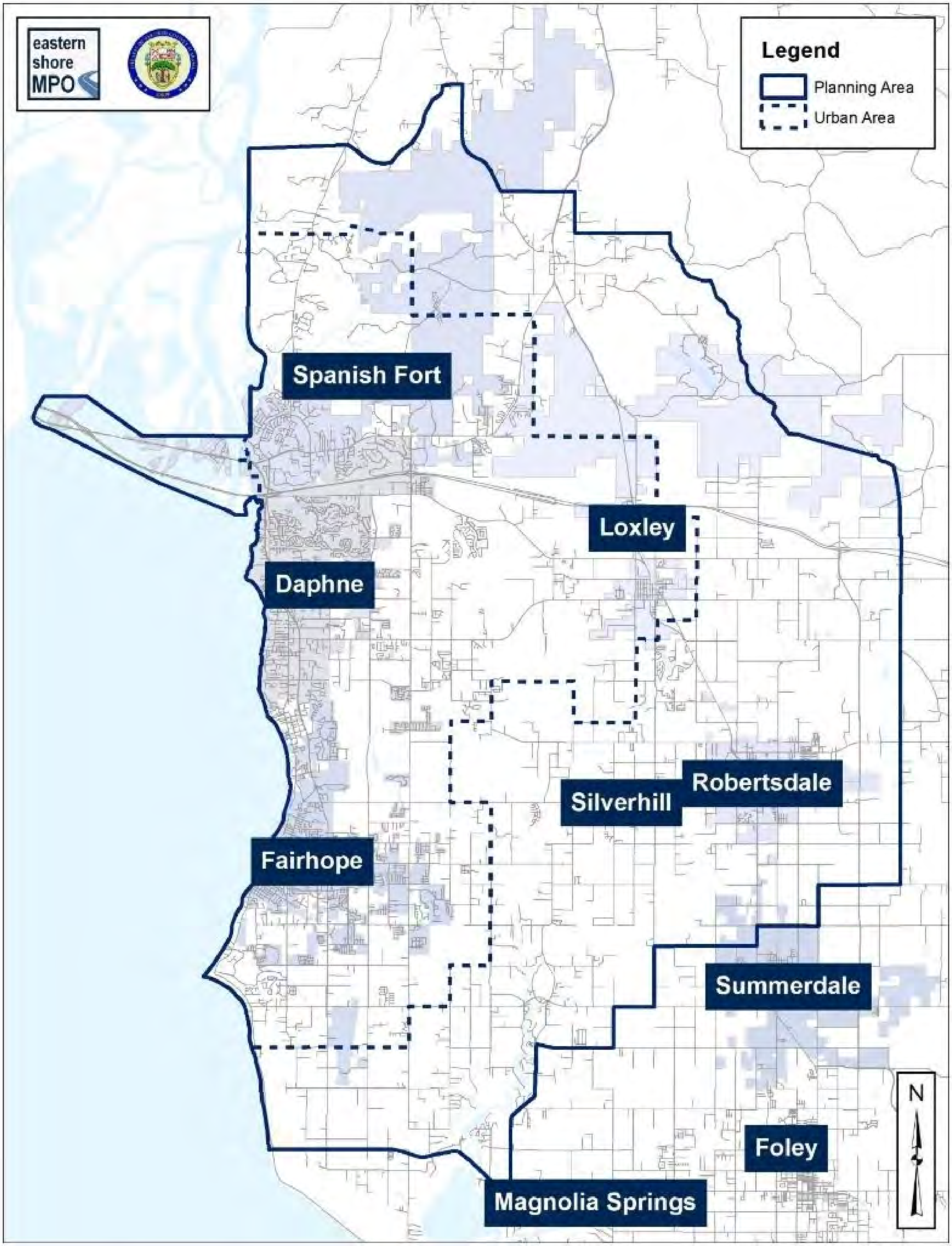


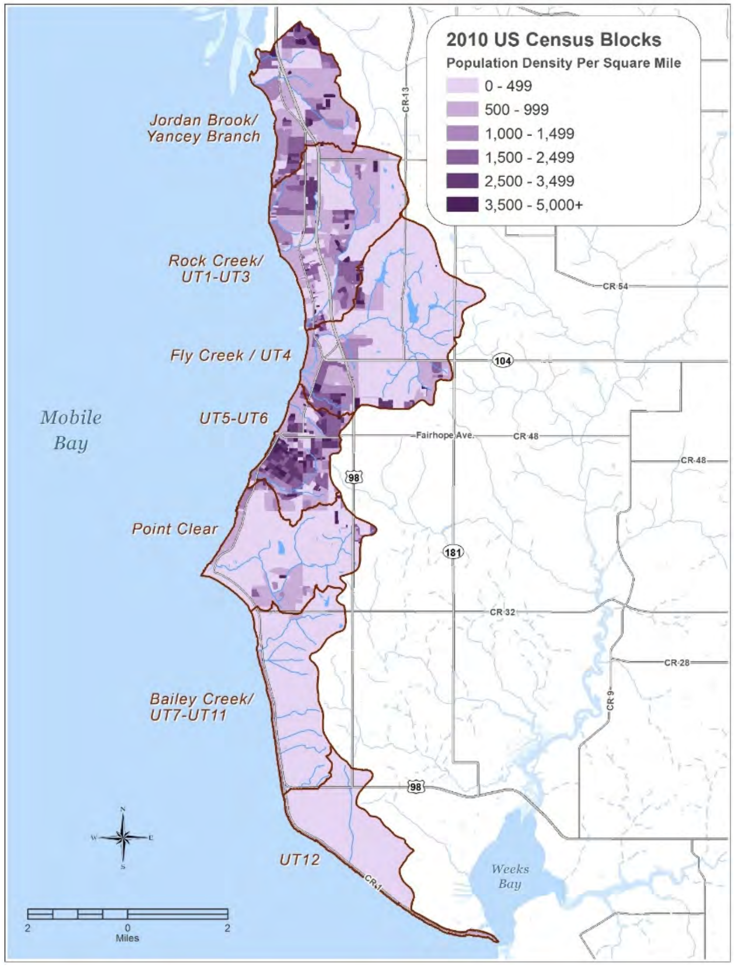
Figure 3.43 ESMPO Planning Areas

The U.S. Census uses various geographic areas (or units) to aggregate and organize the information it collects as noted earlier. Aside from legal/administrative areas (e.g., states, counties, cities), it supplements these by aggregating data for statistical areas created in cooperation with state and local agencies. Most notably, counties are divided into census tracts, block groups, and blocks.

A block is the smallest and most detailed geographic unit the Census Bureau uses to tabulate decennial census data, thus blocks were utilized to estimate population within the Watershed for both 2010 and 2020 censuses. Blocks, however, usually correspond to city blocks and in rural areas may include many square miles bound by streets, streams, and political or other features that do not coincide with watershed boundaries. About 84% of the 2010 census blocks and 67% of the 2020 census blocks overlapped watershed boundaries in our study area. In these, population numbers were apportioned based on an examination of parcel data, land uses, zoning, presence and type of structures, vacant lots, Google Earth street view, and period imagery (2010 and 2019 imagery) to derive the most accurate population counts for each block section within the Watershed. Figure 3.44 and Figure 3.45 show the 2010 and 2020 population densities for the Watershed by census block.

Additionally, there are Traffic Analysis Zones (TAZs) which are special areas delineated for state and/or local transportation officials to tabulate traffic-related data and are used by the ESMPO to analyze population and generate projections. These TAZs can comprise numerous census blocks (i.e., they are larger than blocks) but are usually smaller than block groups.

The ESMPO 2040 LRTP published in 2015 provided population projections for 2040 prepared by the University of Alabama Center for Business and Economic Research for Baldwin County. Figure 3.46 shows the ESMPO 2040 LRTP's population density per square mile (by TAZ) for the Eastern Shore in relation to the Eastern Shore Watershed boundary.



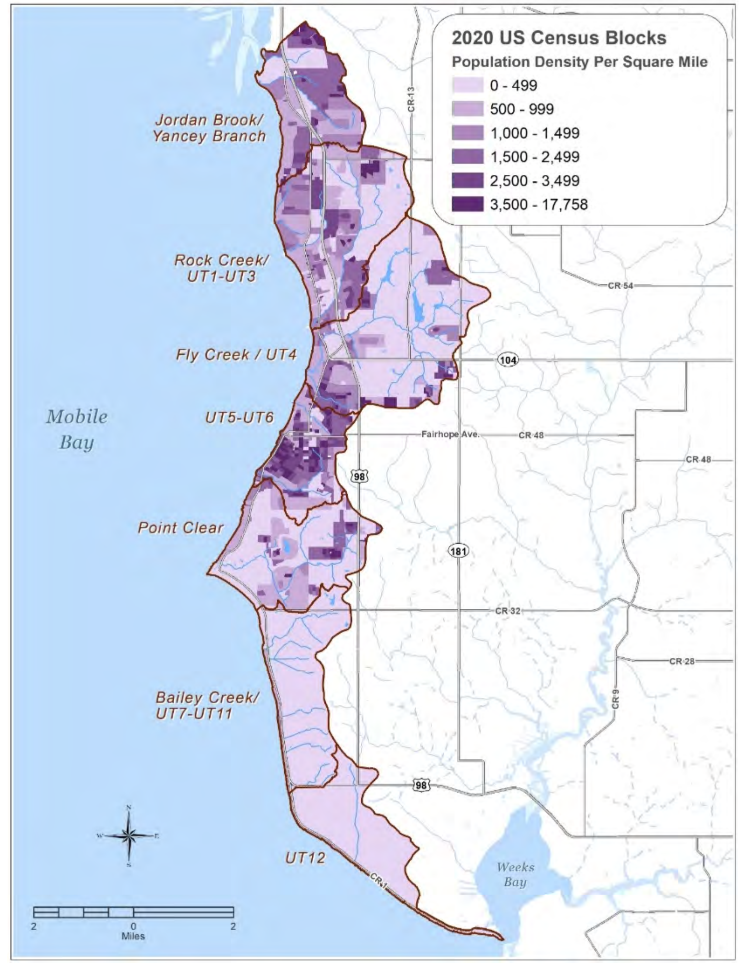


Figure 3.44 2010 U.S. Census Blocks Apportioned Population Density

Figure 3.45 2020 U.S. Census Blocks Apportioned Population Density

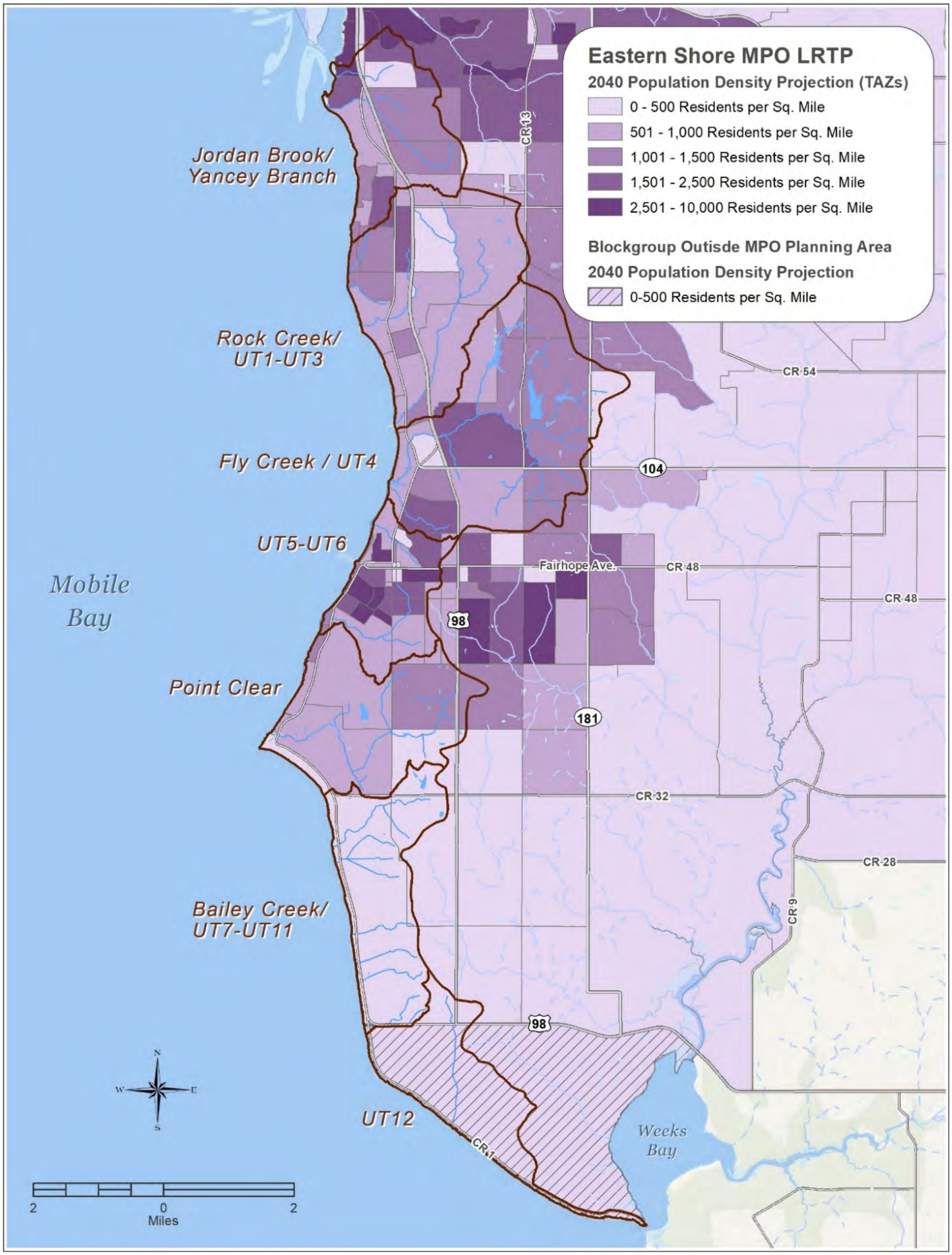


Figure 3.46 ESMPO 2040 LRTP's Population Density Per Square Mile by TAZ

The 2045 LRTP update, published in January 2021, provided 2045 population projections conducted using a linear regression forecast using the 2010 and 2015 populations for the MPO study area, and the 2040 assumed population from the previous 2040 LRTP update (Eastern Shore MPO 2045 Long Range Transportation Plan). These projections forecast for a 6.7% population increase over the entire in the MPO Area.

As the MPO 2045 projections are a net percentage growth projection above their base 2040 projections, the 2040 projections were apportioned to the block level. Naturally, populations are not distributed equally geographically, thus a higher level of detail and examination was required to accurately apportion the projected TAZ population to the block areas within each TAZ but also within the Watershed, since TAZes overlap and extend beyond the Watershed boundaries. As with the Census data, apportionment was based on the examination of parcel data, land use, zoning, presence of and type of structures, vacant lots, Google Earth street view, and imagery.

Figure 3.47 shows the resulting apportionment of the MPO's 2040 population projections, displayed by block group. This smaller geography provides a more detailed comprehension of population distribution within each Subwatershed than from the larger TAZs shown in Figure 3.46.

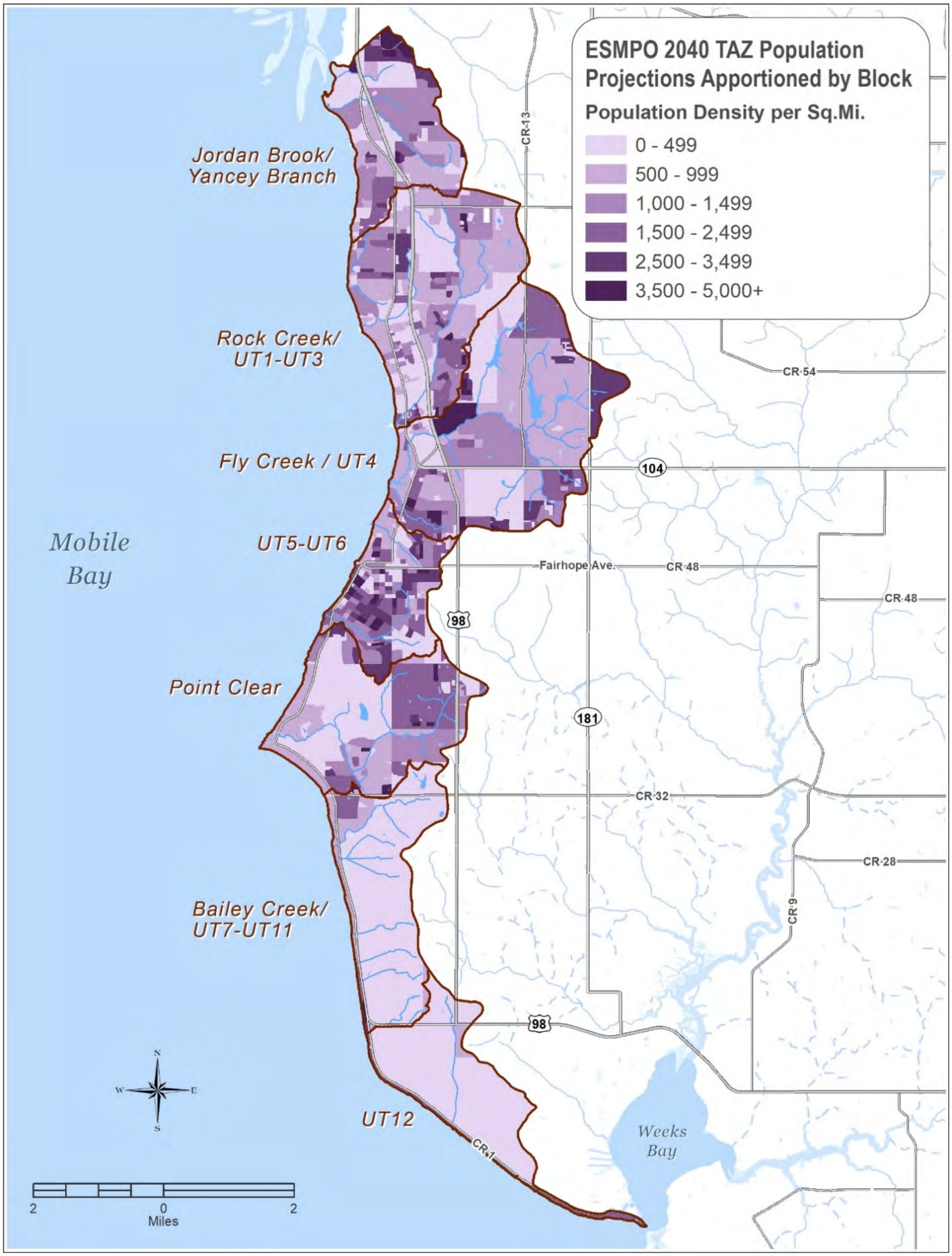


Figure 3.47 ESMPO 2040 Population Projections Apportioned by Block

Once the 2040 base population projections were apportioned, the ESMPO 2045 projected 6.7 percent growth rate was applied equally throughout the study area. Coupled with the detailed apportionment of the 2040 population shown in Figure 3.47, the resulting estimates shown in Table 3.21 provide a good understanding of the general population distribution and growth within each Subwatershed.

Table 3.21 shows the population estimates by Subwatershed for the 2010 and 2020 censuses, as well as the apportioned 2040 population estimates with 2045 projections.

Table 3.21 Census Block Information by Subwatershed

2010 and 2020 Census Block Population Apportionment by Subwatershed & 2040 ESMPO Population Estimates Apportionment by 2010 Census Block by Subwatershed				
Subwatershed	2010 Population Estimate*	2020 Population Estimate*	2040 Population Estimate*	2045 ESMPO LRTP Population Estimate (2040-2045 Pop Growth Rate of 6.7%)
Jordan Brook / Yancey Branch	4,971	5,399	5,138	5,482
Rock Creek / UT1-UT3	5,777	7,144	6,489	6,924
Fly Creek / UT4	3,768	4,545	9,862	10,523
UT5-UT6	4,627	5,494	5,146	5,491
Point Clear	2,130	3,265	4,963	5,296
Bailey Creek / UT7-UT11	722	825	1,241	1,324
UT12	621	789	933	996
Eastern Shore Watershed Total* Population	22,616	27,461	33,772	36,035
Baldwin County U.S. Census April 1, 2010 Total Population		182,265		
Baldwin County U.S. Census April 1, 2020 Total Population		231,767		
**Apportioned population.*				

Source: U.S. Census Bureau 2010

The Eastern Shore Watershed has been a very desirable area in which to live with relatively short commute times to Mobile jobs, Gulf of Mexico beaches, and easy access via Intersate-10 and the Hwy 98 corridor. Areas along the Eastern Shore between Mobile Bay and U.S. Hwy 98 are largely developed and populated, particularly in the northern part of the Watershed. Development pressures are shown to be primarily along jurisdictional boundaries with growth patterns moving east, a trend that the MPO study forecasts to continue.

As Table 3.21 shows, the Eastern Shore Watershed population for 2010 is estimated at a total of 22,616 residents. This is approximately 646 residents per square mile if distributed equally across the Watershed. Based on the 2020 Census population apportionment, the Watershed population increased by 4,845 people, or 21% (an additional 138 per square mile). The ESMPO 2045 projections provide for an additional 31% population growth in the Watershed, placing the total population at 36,035 and the population density at 1,029 people per square mile. Examining each Subwatershed individually, we can anticipate which areas may be impacted by the expected growth and plan accordingly.

The Jordan Brook/Yancey Branch Subwatershed showed a relatively low population increase of 9% between 2010 and 2020. The Subwatershed lies almost completely within the City of Daphne (with the exception of 10 acres) and is largely residential with numerous business and commercial uses along the north-south corridor of Hwy 98 which bisects it. Remaining forested and agricultural lands east of Hwy 98 along its east-west corridors of Park Drive, Whispering Pines, and Wilson Avenue have seen development in the last 20 years with potential for more. Its current 2020 population density is approximately 1,420 residents per square mile with projections for 2045 showing only a 1.5% population increase. However, both residential and commercial development is likely to continue due to the proximity to Interstate 10, schools, shopping/retail centers, and parks.

The Rock Creek/ UT1-UT3 Subwatershed had the third-largest population increase of 24% between 2010 and 2020 by 1,367 people. This Subwatershed, which encompasses the Daphne City Center, has a current population density of approximately 1,099 people per square mile. About 36% of the Subwatershed is unincorporated and experiences both residential and commercial development pressures due to its proximity to downtown Daphne and the Scenic Hwy 98, CR 13, and CR 64 corridors. Although the projected 2045 population is 6,924, which is just lower than the 2020 Census apportionment, agricultural areas on the eastern side of the Subwatershed will likely transition to residential and commercial uses over the next 20 years. While Daphne is not yet experiencing infill; development and refurbishment of residential and business properties around the City core have increased in the last five or so years (perhaps starting with the construction of the new City Hall in 2010) and will likely continue along and west of Main Street/Scenic 98.

The Fly Creek/UT-4 Subwatershed is the largest (8.5 sq. mi.) in the Eastern Shore Watershed and has had the fourth largest population increase between 2010 and 2020 with an additional 777 people. Largely agricultural on its east side, residential uses are mostly west of and along Hwy 98/Greeno Road, and south of Hwy 104, providing a population density of 535 people per square mile. About 61% of its area is in unincorporated Baldwin County on the east, with the majority in zoned County Planning Districts 15 and 16, and a smaller portion in unzoned District 17 (now zoned District 37 – see Appendix C). A significant portion of land along Hwy 104 and between Hwy 98 and CR 13 is owned by the Gulf Coast Research and Extension Center, which will likely retain this land as agricultural. Commercial development in this Subwatershed has largely occurred along Greeno Road, the primary north-south corridor. Recent improvements to CR 13 and the expansion of Hwy 181 provide added development pressure for current agricultural lands. This is most notable with the residential subdivisions along Hwy181 that have spilled into the Subwatershed on its eastern side moving west toward CR 13. There are also new residential subdivisions and a new shopping center along Hwy 104 between these two north-south corridors and a future school development on CR 13. The 2045 population projections add 5,978 new residents to the Fly Creek Subwatershed. This is the largest projected growth for the Eastern Shore Watershed at 131.5%, projecting well over 2,000 new households.

The UT5-UT6 Subwatershed experienced a population increase between 2010 and 2020 of 19% with 867 additional residents and a density of 1,921 people per square mile. The smallest of the Subwatersheds at 2.86 square miles, it contains the entire Fairhope city center and a large portion of its business district. It is intersected by Fairhope Avenue (CR 48) and Section Street, where commercial and business use is predominant, and some light industrial uses along the southern end of Section Street. Otherwise, the Subwatershed is largely residential use. There are only 317 acres (17%) of unincorporated lands along the south part of the Subwatershed in unzoned County Planning District 17 (now zone District 8 – see Appendix C) which are largely undeveloped. Projections for 2045 have the population for this Subwatershed at the current 2020 total (5,491). Being the heart and established residential and commercial center of Fairhope since 1908, perhaps population projections were under-estimated for this area, and only continued outward urban sprawl of the City was expected. While this urban expansion has occurred, over the last ten to fifteen years Fairhope has been experiencing increasing urban infill with people wanting to reside closer to its city center. Fairhope is a unique town with a planned grid pattern and commercial district making it a walkable, pedestrian-friendly community where amenities are readily accessible. Redevelopment and new development of both residential and commercial/businesses and properties has been rapid and are expected to continue. A current building permit moratorium is in place to allow the City to develop a plan to manage the increased growth and traffic in and around the City center.

The Point Clear Subwatershed has had the largest population increase between 2010 and 2020, with 1,135 additional people – a 53% increase. As the third largest Subwatershed in the study area (after Fly Creek and Rock Creek), this increase places its 2020 population density at only 618 people per square mile. Largely unincorporated (78%), it lies west of Hwy 98 and includes large agricultural areas east of Section Street, high-end residential developments, private clubs and golf courses west of Section Street. Its western edge along Mobile Bay is almost entirely developed with single-family residences. The Subwatershed has very little commercial or business development, primarily found along the Hwy 98 corridor on the east. The projected 2045 population for the Point Clear Subwatershed is 5,296 – an increase of 62% from the 2020 population. With 2,646 acres (78%) of unincorporated lands in unzoned Planning District 17 (900 acres now part of zoned Planning District 8 – see Appendix C), expected development for this area is largely residential.

The Bailey Creek/UT7–UT11 Subwatershed had a 14% population increase of 103 additional people between 2010 and 2020 for a total of 825 residents. This Subwatershed is primarily agricultural with residential use limited to the shoreline west of Scenic 98 and some scattered along its east side. The entire Subwatershed is in unincorporated Baldwin County and roughly one third of it lies in zoned Planning District 26 with portions in unzoned District 17. The 2045 population projections show a 60% increase to a total of 1,324 residents. Future development of this Subwatershed will likely be along CR 3, where large agricultural lands remain. Large portions of land east of Scenic 98 are wetlands, where development is unlikely. The shoreline along Scenic 98 is almost fully developed with residential houses. However, additional development can be expected to occur with new construction on old home sites and either subdivided or consolidated lots in the future. Very little commercial or business uses exist in this Subwatershed.

UT12 is the southern-most Subwatershed in the study area and is largely all forested/shrub wetlands. It had a population increase of 27% between 2010 and 2020 with a total of 789 residents, and a population density of 218 people per square mile. Like Bailey Creek, UT12 is fully developed residential along the shoreline west of CR 1 all the way south to Pelican Point; this area and most wetlands lie in zoned Planning District 26. A mixture of agricultural, residential, and some commercial uses exist on the northeast portion of this Subwatershed along Alt Hwy 98 (which runs east-west at this location) and Greeno Road (north-south corridor). These areas are in unzoned District 17 (a small portion of which is now partially in District 39 – see Appendix C). The 2045 population estimates provide for an added 26% growth to 996 people. Development along the shoreline can be expected to be the same as for Bailey Creek, with any significant changes occurring in the agricultural areas where residential and commercial development would be expected.

3.11 Economics

Information from U.S. Census Bureau (2020) regarding economics within the Eastern Shore Watershed are summarized in this section. The median household income for Baldwin County is $64,346 which is slightly higher than the State of Alabama ($54,943). Whereas the local municipalities within the Eastern Shore show significantly higher median household incomes with Fairhope having the highest at $83,258 and Daphne at $74,701. In 2020, according to the Department of Health and Human Services the national poverty level for a family of four was $30,000 (USDHHS, 2020). The percentage of people in poverty is lower on the Eastern Shore than in the State (Alabama = 16%, Baldwin County = 11%, Daphne = 8.5%, and Fairhope 8.9%).

3.12 Education

Table 3.22 demonstrates the estimated number of individuals on the Eastern Shore that do not have a high school diploma, have a high school diploma or higher, or have a bachelor's degree or higher (U.S. Census Bureau, 2020). The value in parentheses is the percentage of individuals within the estimated population at each education level and age group. The majority of citizens in both municipalities, as well as, Baldwin County have at least a high school education or higher. The City of Fairhope consistently has the highest percentage of people with a Bachelor's degree or higher with the exception of those in the 18-24 year age group where the City of Daphne has a slightly higher number (Table 3.22).

Table 3.22 Educational Attainment in the Eastern Shore Watershed by Age Group

Eastern Shore Watershed	Baldwin County	City of Daphne	City of Fairhope
Population 18 to 24 years			
Less than high school graduate	2,333 (14.8%)	338 (16.6%)	19 (1.9%)
High school graduate or higher	12,040 (76.5%)	1,405 (68.9)	844 (85.4%)
Bachelor's degree or higher	1,360 (8.6%)	296 (14.5%)	125 (12.7%)
Population 25 to 34 years			
High school graduate or higher	22,099 (90.6%)	3,270 (97.3%)	1,633 (89.4)
Bachelor's degree or higher	7,749 (31.8%)	1,555 (46.3%)	950 (52.0%)
Population 35 to 44 years			
High school graduate or higher	23,680 (89.7%)	3,161 (96.5%)	2,662 (95.9%)
Bachelor's degree or higher	9,404 (35.6%)	1,365 (41.7%)	1,878 (67.7%)
Population 45 to 64 years			
High school graduate or higher	54,818 (91.3%)	6,568 (97.8%)	5,197 (98%)
Bachelor's degree or higher	19,360 (32.2%)	2,570 (38.3%)	3,022 (57.0%)
Population 65 years and over			
High school graduate or higher	40,143 (89.8%)	4,522 (91.1%)	5,105 (95.7%)
Bachelor's degree or higher	13,123 (29.3%)	1,717 (34.6%)	2,241 (42.0%)

Source: U.S. Census Bureau 2016-2020

3.13 Land Use and Land Cover

Land use and land cover (LULC) significantly influences stormwater runoff velocities, volumes, and timing within watersheds. The following summarizes historic, existing, and future land uses for the Eastern Shore Watershed through 2040.

3.13.1 Roads and Their Influence on Development Patterns

Highways greatly influence the location, type, and pattern of land use. Major roads and arterials become traffic routes next to which development takes root; from residential areas, to high intensity development such as shopping areas, businesses, and the like emerge. The major roads influencing development in the Eastern Shore Watershed are Interstate 10, US Highway 98, and numerous County Roads (see Figure 3.48).

In the early part of the 20th Century, US Highway 90 (locally called Old Spanish Trail) and US Highway 98 crossed the lower Mobile-Tensaw Delta by way of the low elevation, two-lane "Causeway" that was completed in 1927. US Highway 31's southern terminus is a Spanish Fort. Before the Causeway was built, boats were the only direct means of travel between Mobile and Baldwin County's Eastern Shore. In February 1941, opening of the two-lane Bankhead Tunnel underneath the Mobile River enhanced the travel corridor between the two counties. Despite this connectivity, extensive development of the Eastern Shore of Baldwin County did not occur until the 1960s. Periodic flooding of the Causeway and the general tendency for most people to live near their jobs probably discouraged this.

The small, unincorporated community of Spanish Fort was essentially associated with US Highways 31 and 90, while the Eastern Shore Watershed municipalities of Daphne and Fairhope demonstrated a similar affiliation with US Highway 98 that traversed the area near the Mobile Bay shoreline from Bridgehead/Spanish Fort southward to Mullet Point, after a small jog through the City of Fairhope. The "heart" of Daphne was at the intersection of Highway 98 and Belforest Road (CR 64), while Fairhope - being a planned community from inception and having the ferry dock landing - had a few more corridors associated with its enterprising community. Greeno Road was an existing route between Morphy Avenue south to Barnwell in the 1920s, and would later be tied in with US Highway 98 as we know it today. The old two-lane US Highway 98 was locally renamed "Scenic 98" after the main US Highway 98 was moved east of the original Scenic 98 alignment to facilitate the four-lane highway from Spanish Fort to just south of Fairhope. The land along U.S. Highway 90, north of the Eastern Shore Watershed, was essentially undeveloped.

In 1967, the completed eastern portion of Interstate 10 terminated at Alabama Highway 59 and US Hwy 98 was still under construction the same year. By 1971, Interstate 10 reached westward to the intersection with US Highway 98, and the George Wallace Tunnels opened in 1973. However, the I-10 Bayway Bridge did not reach completion until 1979. The improved transportation links made it easier for people to live in Baldwin County and work in Mobile County. In the 1980s, people began to move to the Eastern Shore mostly for quality of life.

What originally began as the development and expansion to serve individuals who worked in Mobile has gradually transformed the Baldwin County communities into an area where now people work, reside, shop, and play without traveling to Mobile. This development has stimulated increased traffic and development of county roads and arterials over the entire County. US Highway 98 is now the primary corridor for the waterfront communities of the Watershed and improvements to other corridors such as CR 64, CR 104 and CR 48 have aided to the east-west mobility of residents and added to the growth and expansion in the area. (Figure 3.48).

Figure 3.48 Major Roads of Eastern Shore Watershed

3.13.2 Historic Land Use Trends

Historic LULC within the Eastern Shore Watershed area has been evaluated by both NASA and the USGS NLCD, in some areas, covering the period from 1974 to 2019 (https://www.mrlc.gov/). Both LULC datasets utilize Landsat derived land cover with 60- meter and 30-meter resolutions and are discussed in the following paragraphs.

3.13.2.1 NASA Land Use/Land Cover

Under the direction of the MBNEP, NASA (Ellis et al., 2008) used remote sensing imagery to investigate historic LULC changes in selected areas bordering Mobile Bay. This study focused on a regional analysis of urban expansion at the watershed level using Landsat data for the following years: 1974, 1979, 1984, 1988, 1991, 1996, 2001, 2005, and 2008. The “Northern Mobile Bay” area of study coincides with the following Subwatersheds of the Eastern Shore Watershed Management Plan: Yancey Branch/Jordan Brook, Rock Creek/UT1-UT3, Fly Creek/UT4, and portions of UT5/UT6. A 60-meter resolution was used for 1974 through 1984, and a 30-meter resolution for subsequent years. The LULC change analysis considered upland herbaceous, barren, open water, urban, upland forest, woody wetland, and non-woody wetland-dominated land cover types. In order to represent approximate decadal changes, the analysis was presented for the years 1974, 1984, 1996, and 2008 for several watersheds in Mobile and Baldwin counties draining into Mobile Bay. The NASA study clearly shows an increase in urbanization from the 1970s to 2008 along much of the Eastern Shore Watershed study area (Figure 3.49).

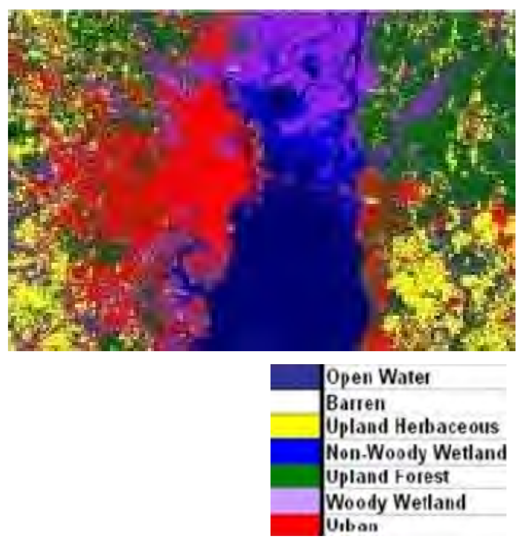


Figure 3.49 1974 and 2008 Land-Use, Land-Cover Classification Comparison
Source: Ellis, et. al., 2008

3.13.2.2 USGS NLCD Analysis

An analysis of the USGS NLCD was conducted to evaluate previous growth and urbanization and to estimate future growth and urbanization patterns within the entire Eastern Shore Watershed. While current land uses provide for the evaluation of existing conditions in the Watershed, future growth estimates and LULC change projections are necessary to provide direction for future management methods and strategies.

The NLCD analysis covers the years 1992, 2001, 2006, and 2011. The land cover classification system changed from the 1992 NLCD to the consistent system used for 2001, 2006, 2011, and 2016 (2019 dataset is currently provisional at the time of this writing). Figure 3.50 through Figure 3.54 depict land cover for the years 2001, 2006, 2011, 2016, and 2019. Figure 3.55 presents a cover change index for the period 2001-2019. Therefore, statistical comparisons between the 1992 NLCD and the more recent datasets may not be dependably accurate. A summary comparison of the past LULC data for these years is presented in Table 3.23.

The Subwatersheds least affected by urbanization and development are those in the southern portion of the Eastern Shore Watershed: Bailey Creek/UT7-UT11 and UT12. Not surprisingly, the Subwatersheds most affected by urbanization and development are those closest to I-10 in the northern portions of the Eastern Shore Watershed: Jordan Brook/Yancey Branch and Rock Creek/UT10UT3.

Table 3.23 National Land Cover Database, Eastern Shore Subwatershed, 2001-2019

National Land Cover Datasets 2001 - 2019										
Jordan Brook / Yancey Branch	2001		2006		2011		2016		2019*	
Land Cover	Area (ac)	%	Area (ac)	%	Area (ac)	%	Area (ac)	%	Area (ac)	%
Open Water	6	0%	6	0%	5	0%	9	0%	10	0%
Developed Open Space	547	23%	569	23%	578	24%	644	27%	640	26%
Developed Low Intensity	253	10%	271	11%	288	12%	307	13%	408	17%
Developed Medium Intensity	104	4%	129	5%	164	7%	164	7%	227	9%
Developed High Intensity	50	2%	58	2%	54	2%	63	3%	92	4%
Barren Land	34	1%	24	1%	24	1%	26	1%	19	1%
Deciduous Forest	3	0%	3	0%	1	0%	0	0%	0	0%
Evergreen Forest	875	36%	826	34%	779	32%	778	32%	633	26%
Mixed Forest	64	3%	60	2%	57	2%	12	0%	11	0%
Shrub/Scrub	32	1%	41	2%	39	2%	13	1%	8	0%
Grassland/Herbaceous	7	0%	15	1%	26	1%	43	2%	17	1%
Hay/Pasture	112	5%	103	4%	96	4%	77	3%	70	3%
Cultivated Crops	30	1%	27	1%	24	1%	24	1%	23	1%
Woody Wetlands	280	12%	265	11%	259	11%	238	10%	240	10%
Emergent Herbaceous Wetlands	22	1%	23	1%	23	1%	20	1%	20	1%

Rock Creek / UT1 - UT3	2001		2006		2011		2016		2019*	
Land Cover	Area (ac)	%	Area (ac)	%	Area (ac)	%	Area (ac)	%	Area (ac)	%
Open Water	3	0%	3	0%	2	0%	6	0%	7	0%
Developed Open Space	1069	26%	1064	26%	1115	27%	1158	28%	1122	27%
Developed Low Intensity	411	10%	416	10%	449	11%	493	12%	606	15%
Developed Medium Intensity	156	4%	195	5%	252	6%	259	6%	366	9%
Developed High Intensity	49	1%	57	1%	48	1%	75	2%	97	2%
Barren Land	23	1%	14	0%	9	0%	9	0%	8	0%
Deciduous Forest	22	1%	19	0%	17	0%	1	0%	0	0%
Evergreen Forest	1129	27%	1094	26%	1052	25%	1130	27%	951	23%
Mixed Forest	79	2%	78	2%	73	2%	21	1%	19	0%
Shrub/Scrub	117	3%	133	3%	113	3%	46	1%	24	1%
Grassland/Herbaceous	80	2%	91	2%	82	2%	45	1%	70	2%
Hay/Pasture	325	8%	315	8%	285	7%	216	5%	198	5%
Cultivated Crops	255	6%	241	6%	235	6%	309	7%	305	7%
Woody Wetlands	407	10%	408	10%	392	9%	378	9%	374	9%
Emergent Herbaceous Wetlands	33	1%	32	1%	36	1%	14	0%	15	0%
Fly Creek / UT4	2001		2006		2011		2016		2019*	
Land Cover	Area (ac)	%	Area (ac)	%	Area (ac)	%	Area (ac)	%	Area (ac)	%
Open Water	31	1%	31	1%	37	1%	118	2%	119	2%
Developed Open Space	527	10%	607	11%	709	13%	687	13%	692	13%
Developed Low Intensity	197	4%	249	5%	295	5%	343	6%	453	8%
Developed Medium Intensity	39	1%	52	1%	62	1%	82	2%	159	3%
Developed High Intensity	3	0%	7	0%	21	0%	19	0%	26	0%
Barren Land	16	0%	14	0%	9	0%	8	0%	6	0%
Deciduous Forest	18	0%	11	0%	11	0%	2	0%	1	0%
Evergreen Forest	1505	28%	1331	25%	1207	22%	1577	29%	1456	27%
Mixed Forest	57	1%	52	1%	49	1%	28	1%	19	0%
Shrub/Scrub	278	5%	376	7%	318	6%	50	1%	38	1%
Grassland/Herbaceous	104	2%	134	2%	189	3%	102	2%	88	2%
Hay/Pasture	77	14%	740	14%	722	13%	647	12%	604	11%
Cultivated Crops	1308	24%	1291	24%	1292	24%	1382	25%	1363	25%
Woody Wetlands	405	7%	377	7%	351	6%	336	6%	356	7%
Emergent Herbaceous Wetlands	150	3%	145	3%	145	3%	37	1%	37	1%

UT5 - UT6	2001		2006		2011		2016		2019*	
Land Cover	Area (ac)	%	Area (ac)	%	Area (ac)	%	Area (ac)	%	Area (ac)	%
Open Water	10	1%	10	1%	10	1%	10	1%	10	1%
Developed Open Space	720	39%	696	38%	737	40%	705	39%	623	34%
Developed Low Intensity	264	14%	260	14%	237	13%	278	15%	381	21%
Developed Medium Intensity	90	5%	112	6%	118	6%	140	8%	208	11%
Developed High Intensity	36	2%	44	2%	39	2%	48	3%	67	4%
Barren Land	24	1%	21	1%	20	1%	24	1%	11	1%
Deciduous Forest	6	0%	4	0%	4	0%	1	0%	0	0%
Evergreen Forest	497	27%	497	27%	477	26%	487	27%	395	22%
Mixed Forest	14	1%	14	1%	14	1%	2	0%	1	0%
Shrub/Scrub	4	0%	5	0%	25	1%	3	0%	7	0%
Grassland/Herbaceous	6	0%	11	1%	10	1%	4	0%	5	0%
Hay/Pasture	32	2%	32	2%	16	1%	22	1%	16	1%
Cultivated Crops	-	0%	0	0%	0	0%	0	0%	0	0%
Woody Wetlands	115	6%	113	6%	111	6%	95	5%	96	5%
Emergent Herbaceous Wetlands	7	0%	7	0%	6	0%	5	0%	4	0%

Point Clear	2001		2006		2011		2016		2019*	
Land Cover	Area (ac)	%	Area (ac)	%	Area (ac)	%	Area (ac)	%	Area (ac)	%
Open Water	22	1%	22	1%	22	1%	34	1%	30	1%
Developed Open Space	747	22%	731	22%	801	24%	800	24%	801	24%
Developed Low Intensity	127	4%	159	5%	166	5%	218	6%	323	10%
Developed Medium Intensity	22	1%	49	1%	93	3%	103	3%	218	6%
Developed High Intensity	2	0%	4	0%	9	0%	11	0%	34	1%
Barren Land	44	1%	36	1%	34	1%	50	1%	40	1%
Deciduous Forest	4	0%	8	0%	8	0%	0	0%	0	0%
Evergreen Forest	721	21%	680	20%	675	20%	704	21%	561	17%
Mixed Forest	9	0%	9	0%	8	0%	9	0%	8	0%
Shrub/Scrub	44	1%	65	2%	52	2%	19	1%	16	0%
Grassland/Herbaceous	89	3%	108	3%	73	2%	40	1%	55	2%
Hay/Pasture	531	16%	506	15%	446	13%	273	8%	234	7%
Cultivated Crops	283	8%	283	8%	281	8%	434	13%	415	12%
Woody Wetlands	688	20%	672	20%	661	20%	630	19%	598	18%
Emergent Herbaceous Wetlands	36	1%	39	1%	40	1%	45	1%	38	1%

Bailey Creek / UT7 - U11	2001		2006		2011		2016		2019*	
Land Cover	Area (ac)	%	Area (ac)	%	Area (ac)	%	Area (ac)	%	Area (ac)	%
Open Water	18	1%	17	1%	17	1%	21	1%	23	1%
Developed Open Space	284	10%	284	10%	293	10%	186	7%	220	8%
Developed Low Intensity	23	1%	23	1%	14	1%	21	1%	62	2%
Developed Medium Intensity	2	0%	3	0%	3	0%	3	0%	24	1%
Developed High Intensity	-	0%	0	0%	0	0%	0	0%	1	0%
Barren Land	8	0%	11	0%	10	0%	31	1%	17	1%
Deciduous Forest	-	0%	0	0%	0	0%	1	0%	0	0%
Evergreen Forest	572	20%	536	19%	532	19%	621	22%	583	21%
Mixed Forest	5	0%	2	0%	2	0%	5	0%	4	0%
Shrub/Scrub	31	1%	68	2%	115	4%	11	0%	13	0%
Grassland/Herbaceous	136	5%	130	5%	85	3%	72	3%	67	2%
Hay/Pasture	590	21%	602	21%	602	21%	545	19%	516	18%
Cultivated Crops	129	5%	128	4%	128	4%	238	8%	233	8%
Woody Wetlands	1008	35%	1003	35%	986	35%	1046	37%	1042	37%
Emergent Herbaceous Wetlands	27	1%	26	1%	45	2%	34	1%	29	1%

UT12	2001		2006		2011		2016		2019*	
Land Cover	Area (ac)	%	Area (ac)	%	Area (ac)	%	Area (ac)	%	Area (ac)	%
Open Water	11	0%	13	1%	14	1%	6	0%	6	0%
Developed Open Space	166	7%	165	7%	169	7%	121	5%	127	5%
Developed Low Intensity	48	2%	48	2%	42	2%	44	2%	84	4%
Developed Medium Intensity	4	0%	5	0%	7	0%	7	0%	30	1%
Developed High Intensity	1	0%	1	0%	0	0%	4	0%	6	0%
Barren Land	12	1%	11	0%	13	1%	38	2%	20	1%
Deciduous Forest	-	0%	0	0%	0	0%	0	0%	0	0%
Evergreen Forest	139	6%	136	6%	141	6%	152	7%	143	6%
Mixed Forest	-	0%	0	0%	0	0%	0	0%	0	0%
Shrub/Scrub	17	1%	34	1%	42	2%	6	0%	7	0%
Grassland/Herbaceous	63	3%	49	2%	38	2%	33	1%	31	1%
Hay/Pasture	242	10%	243	10%	242	10%	169	7%	151	7%
Cultivated Crops	47	2%	47	2%	47	2%	159	7%	141	6%
Woody Wetlands	1363	59%	1358	59%	1246	54%	1416	61%	1402	60%
Emergent Herbaceous Wetlands	185	8%	187	8%	300	13%	146	6%	150	6%

***** *Source: Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database (NLCD)*

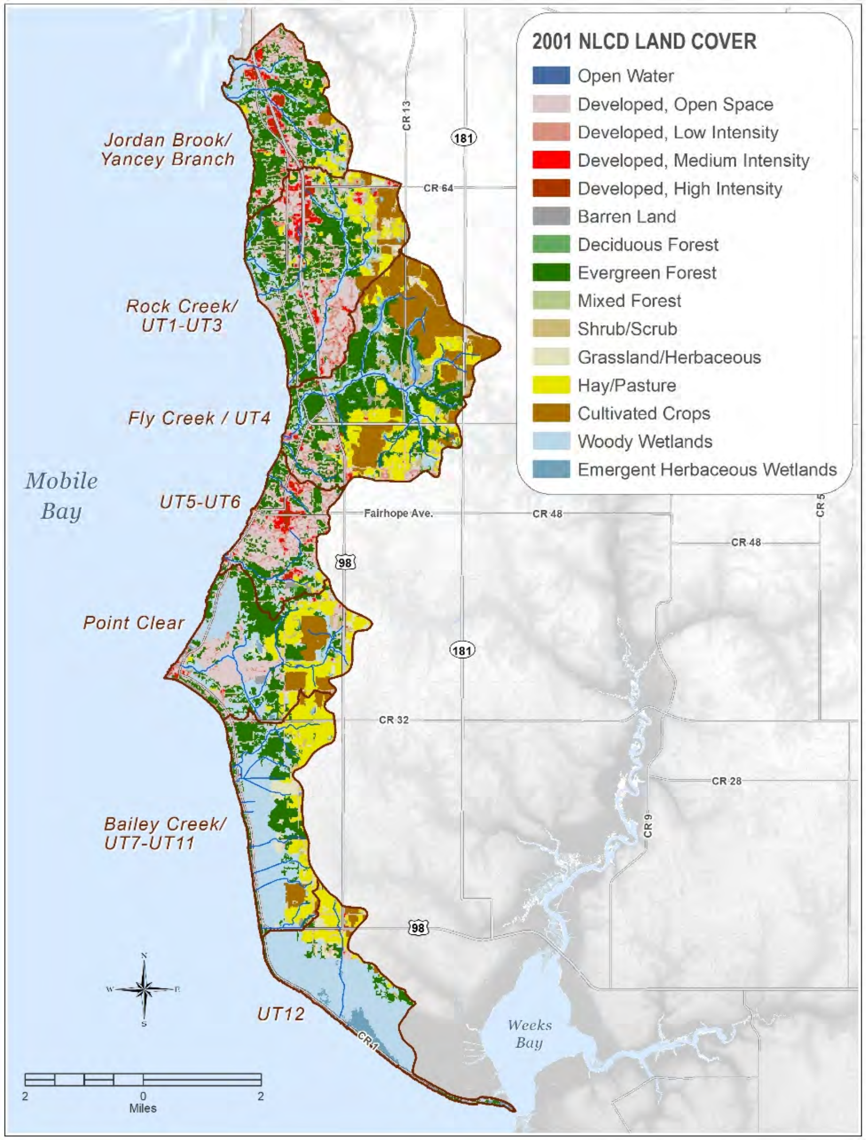


Figure 3.50 2001 Land Cover in Eastern Shore Watershed

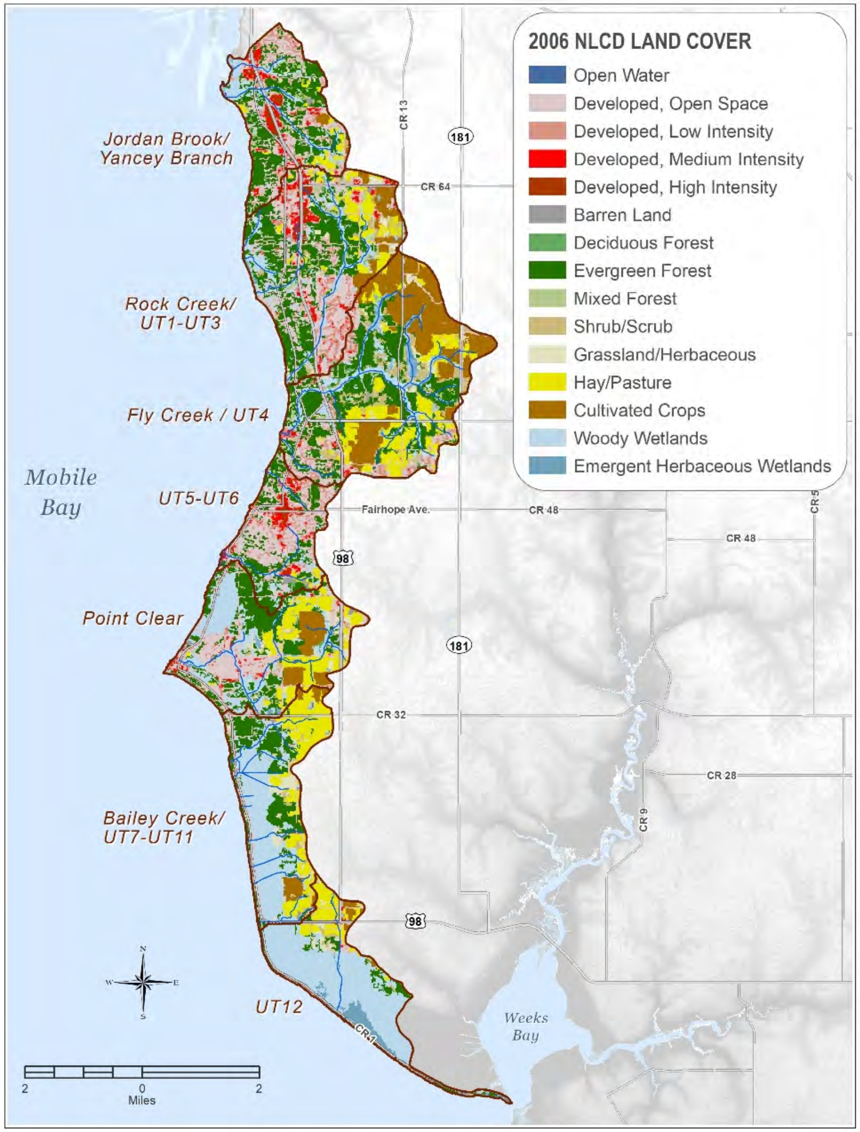


Figure 3.51 2006 Land Cover in Eastern Shore Watershed

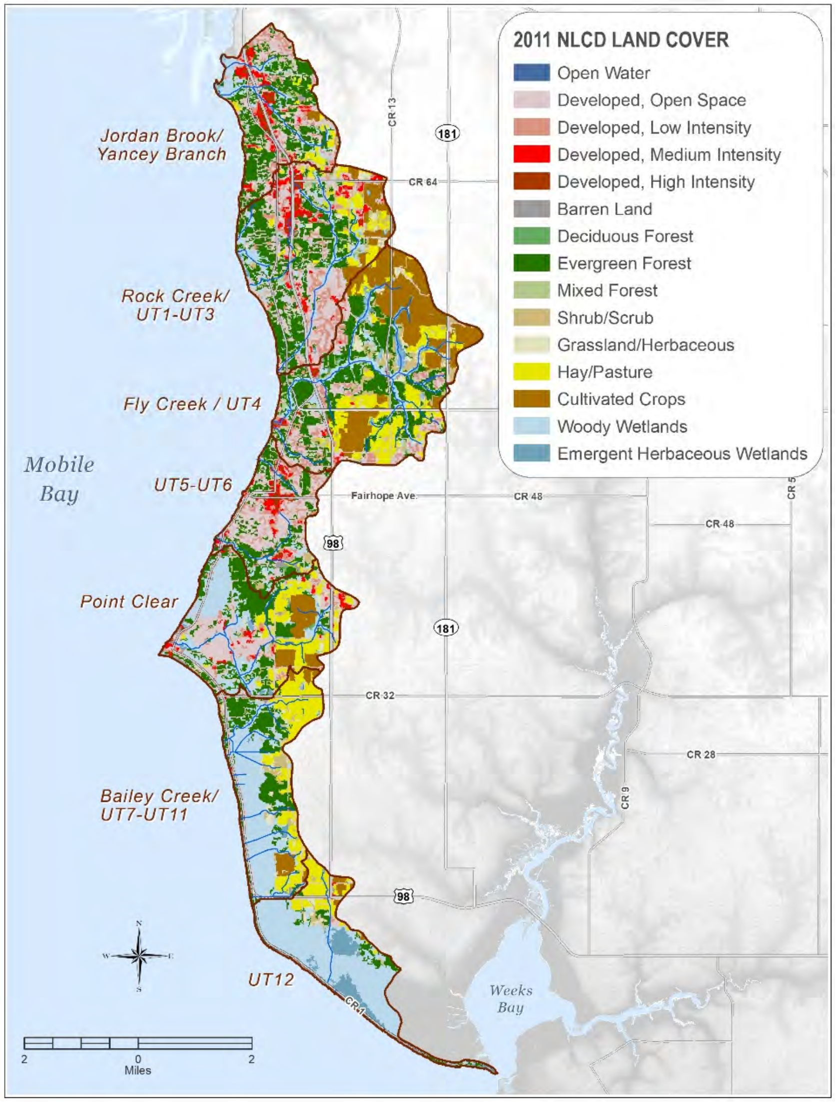


Figure 3.52 2011 Land Cover in Eastern Shore Watershed

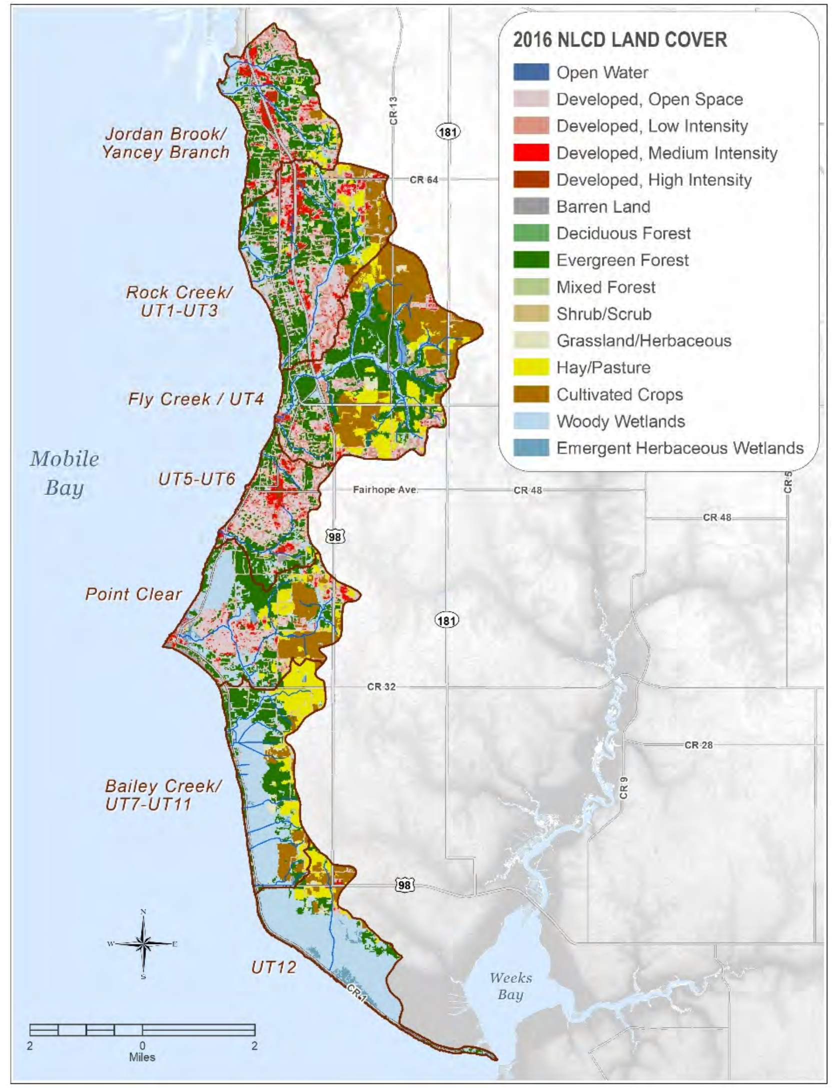


Figure 3.53 2016 Land Cover in Eastern Shore Watershed

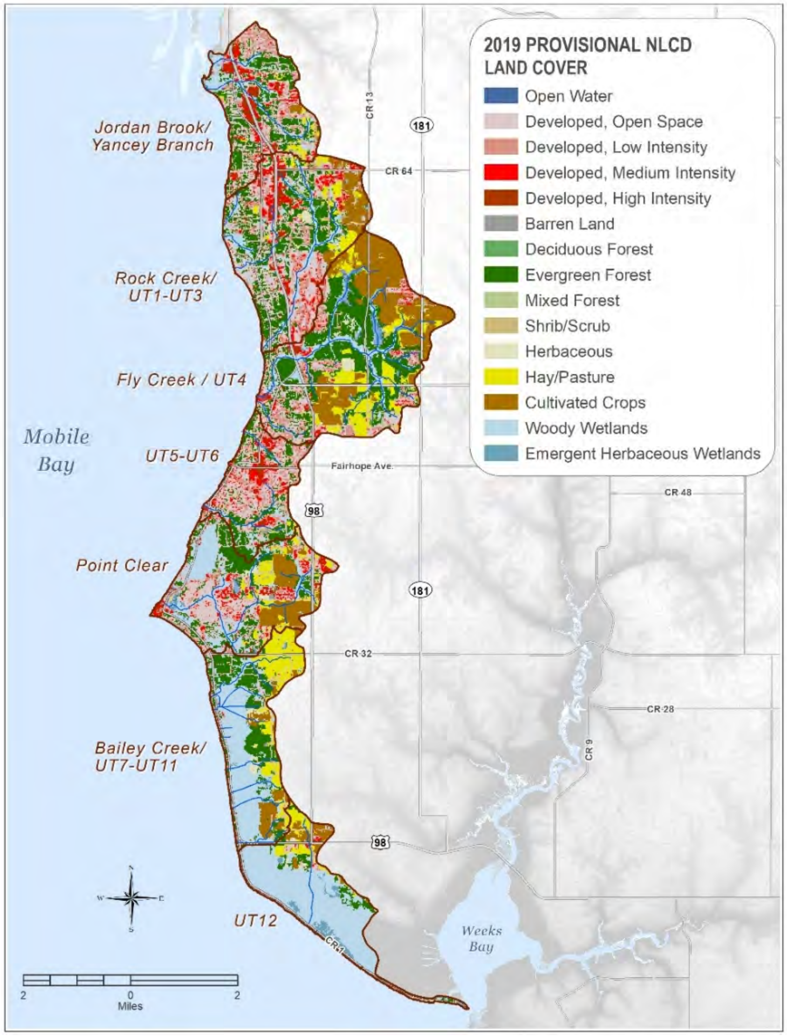


Figure 3.54 2019 Land Cover in Eastern Shore Watershed

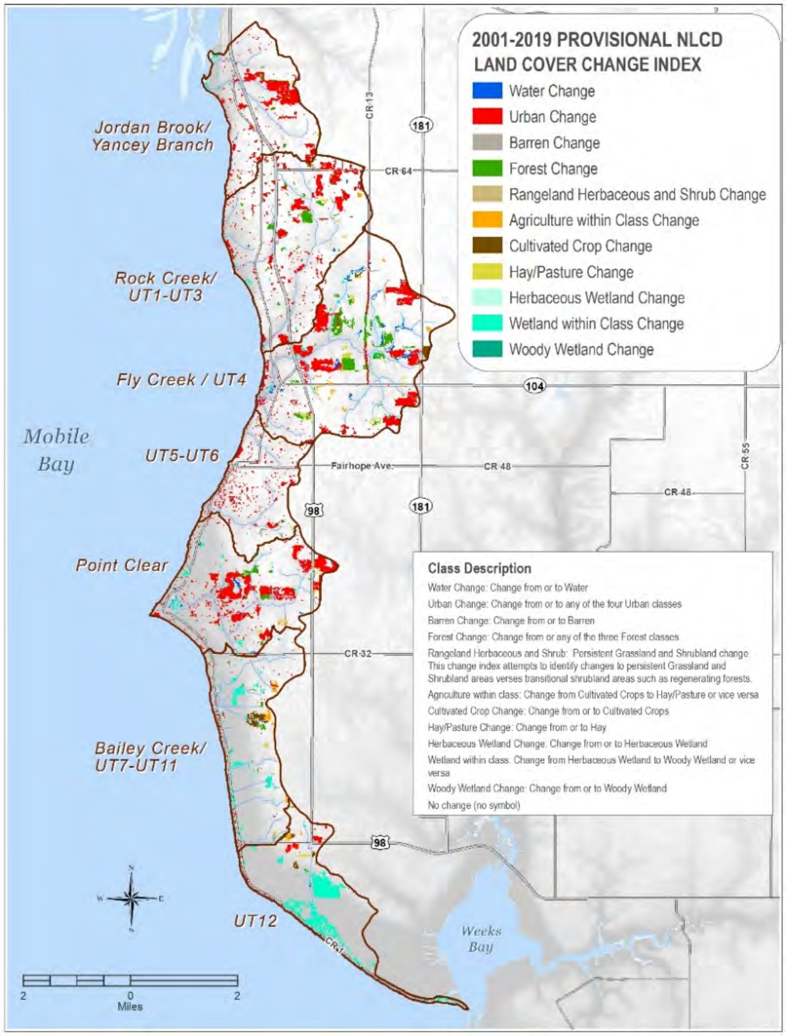


Figure 3.55 2001-2019 NLCD Land Cover Change Index

3.13.3 2040 Projected Land Use

The future land LULC projections for 2040 were developed to show the effects of continued urbanization/development within the Eastern Shore Watershed and to provide guidance for future planning and growth management (Figure 3.56).

The latest parcel data, zoning data, and imagery were utilized to develop a current LULC to future LULC change with the primary categories in focus being residential and business uses. Secondary focus categories were vacant lands, parks/conservation, agricultural, and industrial. Zoning data was utilized only as an indicator of potential land use. That is, the analysis was based on current ground conditions (irrespective of zoning) and a future LULC assigned based on location, imagery, new developments, and patterns of urban growth in the area. [*Note: since the time of this writing, unzoned areas have been assigned zoning by the County Planning Commission. Additional information regarding these recent changes are presented in Appendix C*]

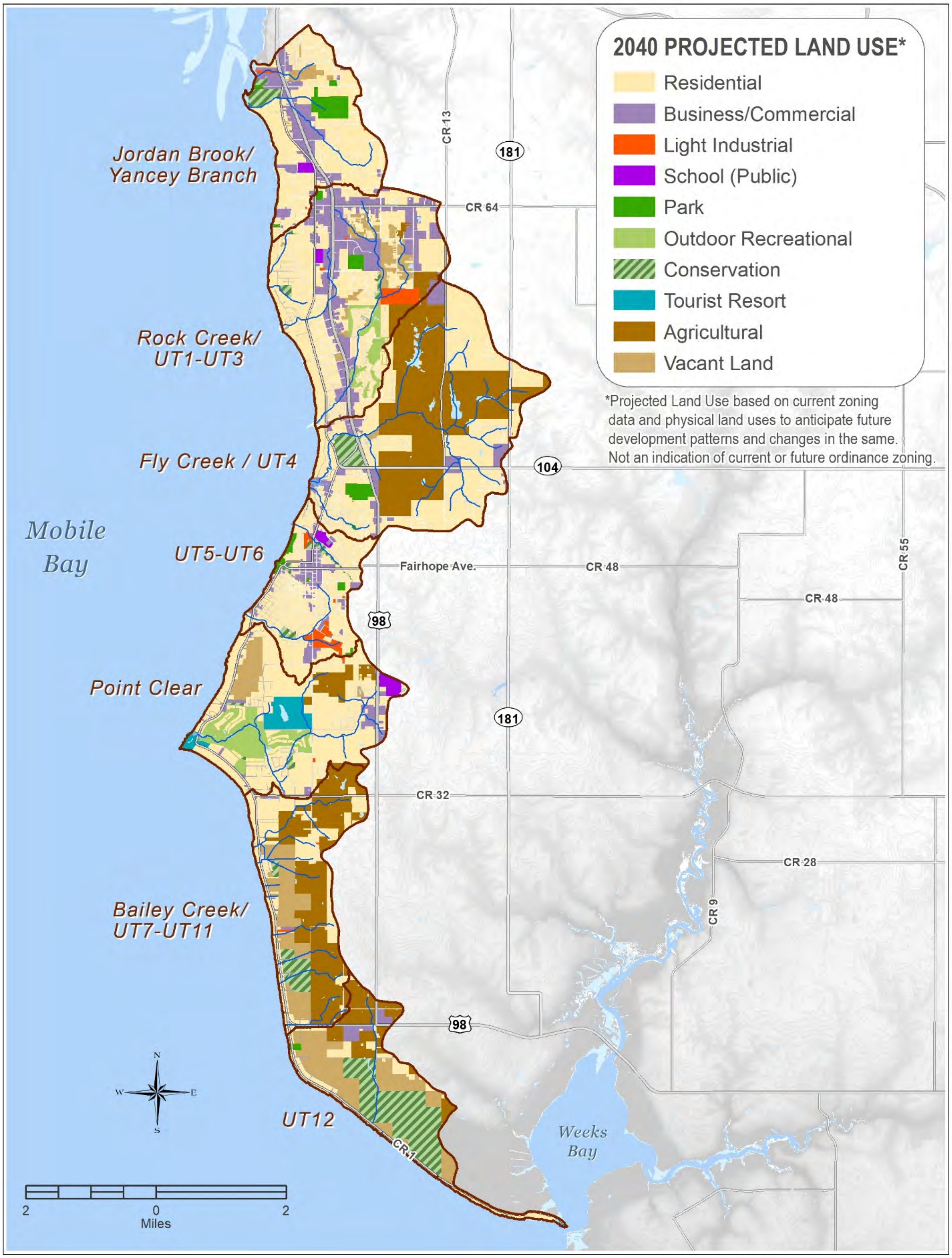


Figure 3.56 2040 Projected Land Use Map

Vacant parcels in urban areas of Daphne and Fairhope currently zoned and surrounded by residential uses are expected to be residential use in the future. Exceptions to this are locations near urban corridors and business and commercial corridors where the use is expected to change to commercial. Likewise, vacant lots along the shoreline of Mobile Bay from UT5-UT6 down to Pelican Point are anticipated to be residential use based on their location and continued residential development/re-development along the shoreline. No distinction has been made between low-residential or high-residential uses in the Watershed as this is particular to zoning regulations.

Current outdoor recreational and tourist resort areas are expected to remain in such use and were not modified. Business, commercial, or industrial-zoned areas were retained as such for future uses as well since these do not usually revert to residential uses. If anything, business and commercial uses encourage expansion of the same on adjacent lands.

The biggest change in LULC was applied to agricultural lands which changed primarily to residential uses and - in some cases - to business uses. Additionally, current residential uses were changed to business uses where growth and development patterns show a trend toward the abandonment of residential use – usually with older residences on large lots along corridors.

Numerous vacant lands were retained as vacant due to their location and condition. This is particularly prevalent in the Bailey Creek and UT12 Subwatersheds, where wetlands are predominant east of Scenic 98. City-owned lands along streams and ravines were also kept as vacant despite surrounding residential uses or zoning.

While all land uses fall into consideration for future planning, predicting locations of increased population growth was a primary focus. As discussed in the previous population chapter, the ESMPO 2040 projections were utilized for our study area. These projections placed the majority of the population increase outside of our study area and into the areas of Spanish Fort, Loxley, and the eastern peripheries of the cities of Daphne and Fairhope. Therefore, the MPO projections along the Eastern Shore and in our study area could potentially be underestimated. Likewise, the projected future land use as an indicator of population increase may be over-estimated. While subdivisions are the primary driver of land conversion and population inflow (normally from agricultural or vacant lands), in-fill trends in the area are driven by the appeal of traditional residential living outside a subdivision, near the city centers, and in proximity to interstate access and Mobile Bay. Thus, the 2040 future land use projections may be more consistent with future development patterns.

For the Jordan Brook/Yancey Branch Subwatershed, a total of 80 acres is projected to change from agricultural to residential use. These agricultural lands are along Whispering Pines Road and County Road 64. Based on an average lot size of 1/3 acre and a household size of 2.5 per household (2020 Census 2.8 average household size of owner-occupied, and 2.3% average household size of renter-occupied), this would accommodate 600 residents. Another approximately 150 acres of vacant land are projected to convert to residential use, with some lots due to in-fill in existing residential areas and other larger lots east of Hwy 98 that can accommodate subdivisions. The MPO projections for this Subwatershed showed no population increase between 2020 and 2040, and only 83 new residents for 2045. However, between 2010 and 2020, the population increased by approximately 9% according to the Census. In analyzing future LULC, a population increase based on projected land use could add an additional 1,000 residents to this Subwatershed (roughly 15% increase to the 2020 population). Business use is expected to increase along the Hwy 98 Corridor where zoning currently accommodates it, and approximately 30 vacant acres converted to business/commercial use (residentially zoned) where corridor improvements and nearby uses provide for business rather than residential use of the land.

The Rock Creek/UT1-UT3 Subwatershed has a projected agricultural to residential use change of approximately 195 acres in the northeast area of the Subwatershed along CR 64 and CR 13 where residential developments and a future private school generate development pressures. With the average parcel size for subdivisions and household size specified above, this would provide an additional 1,462 residents to the Subwatershed. The MPO's 2040 population projections fell short of the 2020 Census by approximately 655 people. Between the 2010 and 2020 censuses, 1,367 people (or 24%) were added to the Rock Creek Subwatershed. In addition, approximately more than 200 acres of vacant lands within residential areas are also available for in-fill by 2040 – mostly west of Hwy 98. While residential development is expected in such areas for any of the Subwatersheds due to in-fill, the rate and density per acre is hard to predict, as large parcels may or may not be subdivided and some may be consolidated. For business and commercial land uses, approximately 27 acres of agricultural land, 137 acres of vacant land, and 80 acres of residential lands are projected to convert to business uses. These lie primarily along major commercial corridors and are currently zoned business/commercial, such as Hwy 98, County Road 64, Friendship Road, and the Daphne center.

Land uses in the Fly Creek Subwatershed are largely residential and agricultural use. Approximately 921 acres of agricultural lands are expected to convert to residential uses. Some of these lands lie between CR 13 and Highway 181 south of Corte Road, where subdivisions continue moving westward from Hwy 181; some lie on the south side of the Subwatershed. An additional 130 acres of vacant lands in residential areas could also transition to residential use as in-fill occurs west of Hwy 98. The conversion of agricultural acreage alone would provide for an additional 6,900 people in the Fly Creek Subwatershed. With the highest projected growth rate in our study area, the population is expected to increase by 5,978 people between 2020 and 2045 – a 132% increase from the 2020 census population of 4,545 people. The 130 acres of vacant land could provide between 650 to 975 people, depending on the size of the lot per household (as discussed). Lot sizes in established residential areas and near the shoreline can vary and may be larger or smaller than the 1/3 acre used for average lot size. Transition to business and commercial uses are projected to be approximately 20 acres of current residential along Hwy 98 and Hwy 104, 90 acres of agricultural, and 70 acres of vacant land along Hwy 98, Hwy181, Hwy 104, and CR 13.

The UT5/ UT6 Subwatershed has the core of the City of Fairhope within its boundary, and for this reason, has been experiencing a high degree of in-fill and re-development in both residential and commercial properties. The MPO 2045 population projections are essentially equal to the 2020 census population for the watershed at approximately 5,494 people. With the in-fill and redevelopment in this Subwatershed, it is expected that most vacant residential lands will be developed in the next 20 years. While there are approximately 157 acres of vacant land in the south portion of the watershed that can provide for subdivision style development, the approximate 97 vacant acres scattered in current residential areas are likely to be developed first. As the City of Fairhope enjoys mixed-uses near its core, the type of development and land use for each vacant lot is hard to predict. This is evident in the type of re-development in last five years where zoning did not dictate or deter re-development of properties into residential use - particularly those zoned business/commercial. In terms of a population projection, based on the vacant lands available, 700 to 1,000 people might be added to the Subwatershed in the next 20 years. Likewise, a conservative estimate of transition to commercial and business uses shows approximately 15 acres of current residential use transitioning to the zoned business use near the city center, and 27 acres of vacant land on south end of the watershed transitioning to business.

The Point Clear Subwatershed has a population growth projection of approximately 2,031 people (or 62%) by 2045. Largely comprised of agricultural, residential and vacant lands, this Subwatershed has few commercial and business uses. Approximately 350 acres of current agricultural land could potentially transition to residential use in the next 20 years. These large, unzoned tracts of land located east of Section Street may provide for similar "tourist resort" developments as the Lakewood Club. In addition, approximately 500 acres of vacant and wooded lands could also experience future development to residential per current zoning. These vacant wooded lands do not include 193 acres of Freshwater Forested/Shrub wetlands in the northwest section of the Subwatershed that are expected to remain vacant. Depending on the development patterns, type of development, and density, these vacant lands could provide for 2,600 to 5,000 new residents in the future. As residential uses increase, additional commercial and business uses are expected to develop to service these communities - particularly along Greeno Road. Thus, approximately 60 acres of residential use lands and an additional nine acres of vacant lands are projected to transition to business uses due to their location and their proximity to similar uses.

The Bailey Creek Subwatershed is projected to increase in population by approximately 500 people between 2020 and 2045 per the MPO projections. Largely agricultural and vacant lands, there are approximately 53 acres of agricultural lands and about 200 acres of vacant and forested lands that could transition to residential use. Numerous vacant parcels along Scenic 98 would be expected to develop first, followed by some along the east side of the watershed near CR 32 and CR 3. These 200 acres would provide for an additional 1,000 residents depending on development density. Approximately 655 acres on the east side of Scenic 98 are projected to remain vacant lands due to presence of large Freshwater Forested/Shrub Wetlands that encompass roughly 28% of the entire Subwatershed. Nearly 161 acres of these are currently conservation lands through the Weeks Bay Foundation. Agricultural lands in this Subwatershed are largely projected to remain unchanged. Business and commercial uses are minimal with only 25 acres total use for 2045, only seven of these acres are transitional to business from residential or vacant lands.

The UT12 Subwatershed consists almost entirely of agricultural and vacant lands with relatively little residential or business use. As with Bailey Creek, UT12 largely comprises of freshwater forested/shrub wetlands that encompass 60 % of the Subwatershed and include most of the vacant and forested lands – a total 1,367 acres. Of these, 722 acres are conservation lands through the Alabama Trust Fund and the Weeks Bay Foundation. The MPO 2045 projections show a 26% increase in population by 200 residents from the 2020 census. The majority of the residential use is located along CR 1. About 68 acres along this corridor are vacant lots that will likely transition to residential uses and can accommodate an additional 500 residents. Some vacant lands along Hwy 98 may also accommodate additional residential uses. Business and commercial uses are located along the Hwy 98 and Greeno Road and one vacant parcel of land adjacent to Pelican Point. Agricultural lands are generally expected to remain in agricultural use.

3.13.4 Impervious Cover

Four principal factors influence stormwater runoff (quantity and quality): rainfall, soil characteristics, topography, and land cover. Of these, the most important factor we can control to manage stormwater runoff is land cover. Land cover (in addition to topographic features and soil characteristics) is the variable most often influenced by man in developing landscapes. The potential for adverse effects on stormwater increases as natural vegetation is replaced with impervious cover in a developing watershed.

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 permit little or no water infiltration into the soil. Impervious cover fundamentally alters the hydrology of urban watersheds by generating increased stormwater runoff and reducing the amount of rainfall that soaks into the ground.

3.13.4.1 Impervious Cover Background

Vegetative cover protects the soil from raindrop impact, reduces stormwater runoff velocities, increases infiltration of rainfall, and holds soil in place with root structures. Through the process of evapotranspiration, liquid water in the soil is absorbed by plant roots and released through stoma of the leaves as water vapor during normal metabolic processes.

As depicted in Figure 3.57, in the natural, undisturbed environment, rainfall is intercepted by trees and other vegetation and/or infiltrates into the soil. When permeable soils are present, runoff typically occurs only with significant precipitation events (USEPA, 2009) or under saturated soil conditions.

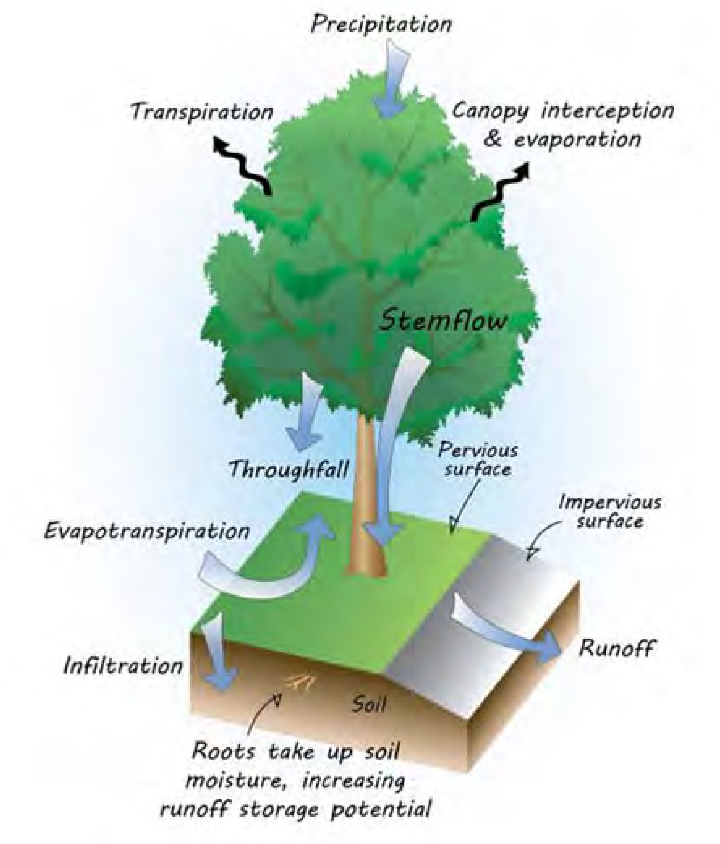


Figure 3.57 Important Ways a Tree Helps with Stormwater Management
Source: U.S. EPA

Traditional urbanization of a watershed results in the removal of the native vegetation and replacement of large areas with impervious surfaces like roads, driveways, sidewalks, and buildings. Land cover changes also increase soil compaction and alter natural drainage patterns. These changes increase the imperviousness of a watershed so that runoff occurs even during small precipitation events that would normally have been absorbed by the soil and vegetation. Multiple studies have identified the negative impacts of poorly managed post-construction stormwater on our nation's waters. As landscapes become more urbanized, there is a corresponding increase in the amount of impervious surfaces that limit the ability of stormwater to infiltrate into the ground.

In some watersheds, as much as 55% of rainfall runs off an urban landscape and only 15% of rainfall soaks into the ground. In comparison, a more natural landscape will infiltrate 45% of the rainfall with only 10% running off (Alabama *Low Impact Development Handbook,* https://ssl.acesag.auburn.edu/natural-resources/water-resources/watershed-planning/stormwater-management/documents/LIDHandbookDisplay.pdf). (Figure 3.58)

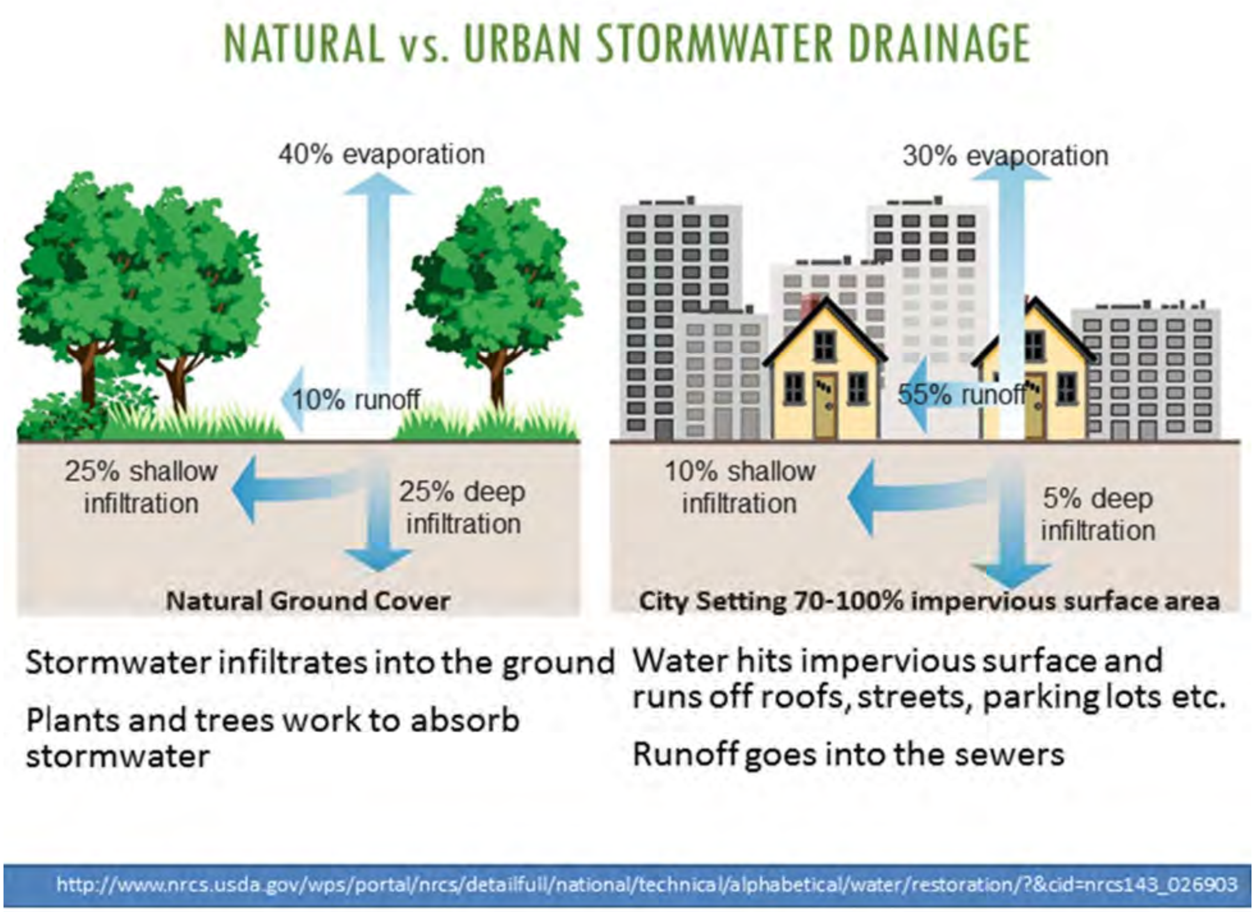


Figure 3.58 Natural vs. Urban Stormwater Drainage
**Source NRCS/USDA*

The cumulative impacts of the LULC changes result in the natural hydrology of a site/watershed being altered, producing increased runoff volumes and peak runoff velocities. Development results in an increase in the impervious surface area, a higher degree of connectivity between impervious areas, and the loss of soils and vegetative cover that previously slowed or reduced runoff in the pre-developed condition. Figure 3.59 illustrates the impacts of development on runoff volume and timing of the runoff on the hydrograph of a receiving stream. Changes in watershed land cover result in greater discharge velocities, greater volumes, and shorter discharge periods. As shown in this figure, pre-development runoff velocities are lower than those on developed sites, and the discharges occur over a longer period. The pre-development peak discharge rate is also much lower than the post-development peak discharge rate due to attenuation and absorption by soils and vegetation. In addition, development shortens the time before runoff begins.

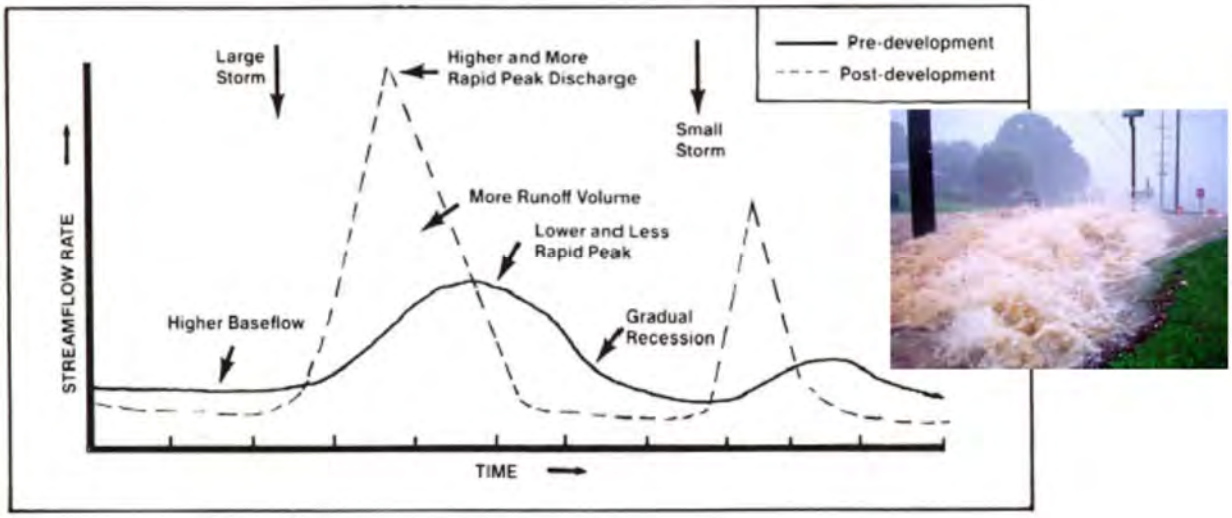


Figure 3.59 Comparison of Pre-Development and Post-Development Hydrographs
Source: Schueler, undated

Degradation of aquatic ecosystems can occur when the hydrology of a watershed is altered by large increases in impervious area. The collective force of the increased runoff scours streambeds, erodes streambanks, and causes large quantities of sediment and associated pollutants to enter streams each time it rains.

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 impervious cover in a watershed is closely linked to the specific land cover types that reflect the intensive LULC traditionally associated with urban growth. Typically, increases in impervious cover result in the fragmentation of natural area remnants; create interruptions in the stream corridor; reflect encroachments into and expansion of developments within floodplains; and increase the density of stormwater hotspots.

3.13.4.2 The Impervious Cover Model (ICM)

The Center for Watershed Protection (CWP, 2003 and CWP, 2005) has developed an Impervious Cover Model (ICM) that can be used to predict changes in stream health as a consequence of watershed development and to assess the effectiveness of stream restoration. According to the ICM, when the imperviousness of a watershed begins to exceed 10%, increased nonpoint source pollutant loads begin to appear from urban runoff; stream temperatures become elevated due to reduced canopy cover; and increases in stream scour and channel instability begin, reducing the quality of stream habitat and diminishing biodiversity.

The ICM (CWP, 2005) identifies four classifications of urban streams based on the extent of IC and future restoration potential. The four types of stream are as follows:

- **High Quality Streams** have less than 10% IC in their contributing drainage area and generally retain their hydrologic function. Such streams support good to excellent aquatic diversity.
- **Impacted Streams** have between 10 and 25% IC in their supporting watershed and show clear signs of declining stream health. Most indicators of stream health fall in the fair range, although some reaches may still be rated as being of good quality. These streams often exhibit the greatest restoration potential, since they exhibit only moderate degradation, have an intact stream corridor,

and usually have enough undeveloped land available in the watershed in which to install restoration practices.

- **Non-Supporting Streams**[1] range between 25 and 60% IC in their supporting watershed. These streams no longer support their designated uses as defined by hydrology, channel stability, habitat, water quality and biological indicators. Watersheds at the lower end of the IC range (25 to 40%) may show promise for partial restoration but are so altered they normally cannot attain pre-development conditions for most indicators. In some circumstances, streams in the upper range of the non-supporting category (40 to 60% IC) may show some potential for stream restoration. In most circumstances, however, the primary restoration goals are to reduce pollutants, improve the stream corridor, or enhance community amenities.
- **Urban Drainage** refers to streams that have watersheds with more than 60% IC and where the stream corridor has essentially been eliminated or physically altered to the point that it functions merely as a conduit for flood waters. Water quality indicators are consistently poor, channels are highly unstable, and both stream habitat and aquatic diversity are rated as very poor or eliminated altogether. Thus, the prospects to restore aquatic diversity in urban drainages are extremely limited, although it may be possible to achieve significant pollutant reductions.

The ICM displayed in Figure 3.58 expresses the IC/stream health relationship as a "cone" that is widest at the lower levels of IC and progressively narrows at higher levels of IC. At lower levels of IC (i.e., less than 10%), stream quality varies widely according to the amount of forest cover, road density, extent of riparian vegetative cover, and other factors present in less urban watersheds. At higher levels of IC, the correlation between IC and stream health is stronger. The transition between the four stream health categories is shown in this figure as ranges (i.e., 5%-10%, 20%-25%, and 60%-70%) as opposed to sharply defined thresholds because of the variability between streams (Hirschman and Kosco, 2008). According to the CWP, use of the ICM to classify urban watersheds allows reasonable restoration expectations to be developed. The ICM helps define general thresholds at which current water quality standards or biological conditions cannot be consistently met during wet weather conditions. These predictions help set realistic objectives to protect stream quality based on current and future conditions.

3.13.4.3 Current Impervious Cover in the Eastern Shore Watershed

Impervious cover has unique properties that can be measured, tracked, forecast, managed, regulated, and mitigated. The extent of IC in a watershed can be accurately measured using either remote sensing or more detailed aerial photography. Impervious cover is usually reported as the percentage of IC occurring within a specific area at a specific time, which can range in size from an individual lot to an entire watershed.

Percent developed imperviousness includes two areal increments: Impervious Surface Area (ISA), which calculates the area of imperviousness proportion in every 30-meter pixel, and Impervious Effect Area (IEA), which totals the number of 30-meter pixels that contain any impervious surface (>0%) (Xian, G. et al., 2011). The ISA and IEA data from NLCD 2001, 2006, 2011, 2016, and 2019 for the Eastern Shore Watershed are compiled and can be found in the Appendices. The areas of ISA and IEA are presented in 10% categories (1 – 10, 11 – 20, etc.) for each Subwatershed. A summary is presented in Table 3.24 for each of the four HUC 12 Watersheds as well as for the entire Eastern Shore Watershed.

The Percent Developed Imperviousness for the Eastern Shore Watershed is displayed visually for 2001, 2006, 2011, 2016, and 2019 on Figures 3.60 through Figure 3.64, respectively. The Change in Percent Developed Imperviousness from 2001 to 2011 is presented in Figure 3.65.

The ISA values in 2019* (shown in Table 3.24), compared to total areas of each Subwatershed, range from 2% to 20%. The ICM discussed above (see Figure 3.59) suggests that urbanization is beginning to impact stream health in many of these Subwatersheds. Four out of seven of the Subwatersheds have values in the 10% to 25% range, which indicates that the streams in those Subwatersheds are impacted. When the imperviousness within developed areas is considered, as represented by the ISA/IEA ratios, impervious values range from 17% to 30%. The ICM suggests that streams in these developed areas would fall in the Impacted Streams category.

Table 3.24 Summary of IEA and ISA Factors in the Eastern Shore Watershed

Imperviousness Effect Area >0% (IEA)							
Subwatershed:	Jordan Brook / Yancey Branch	Rock Creek / UT1 - UT3	Fly Creek / UT4	UT5 - UT6	Point Clear	Bailey Creek / UT7 - UT11	UT12
Total Watershed Area (ac) :	2,429	4,168	5,430	1,831	3,380	2,845	2,317
2001 IEA Area (ac)	971	1,706	776	1,123	909	312	222
2001 IEA (% of total)	40%	41%	14%	61%	27%	11%	10%
2006 IEA Area (ac)	1,043	1,754	928	1,125	953	312	222
2006 IEA (% of total)	43%	42%	17%	61%	28%	11%	10%
2011 IEA Area (ac)	1,099	1,891	1,101	1,144	1,081	314	221
2011 IEA (% of total)	45%	45%	20%	62%	32%	11%	10%
2016 IEA Area (ac)	1,179	1,985	1,131	1,172	1,132	209	176
2016 IEA (% of total)	49%	48%	21%	64%	33%	7%	8%
*2019 IEA Area (ac)	1,368	2,193	1,330	1,281	1,377	306	245
*2019 IEA (% of total)	56%	53%	24%	70%	41%	11%	11%

Imperviousness Surface Area >0% (ISA)							
Subwatershed:	Jordan Brook / Yancey Branch	Rock Creek / UT1 - UT3	Fly Creek / UT4	UT5 - UT6	Point Clear	Bailey Creek / UT7 - UT11	UT12
Total Watershed Area (ac):	2,429	4,168	5,430	1,831	3,380	2,845	2,317
2001 ISA Area (ac)	231	342	125	221	98	27	33
2001 ISA (% of total)	10%	8%	2%	12%	3%	1%	1%
2006 ISA Area (ac)	261	376	160	239	128	27	33
2006 ISA (% of total)	11%	9%	3%	13%	4%	1%	1%
2011 ISA Area (ac)	284	432	204	251	174	27	33
2011 ISA (% of total)	12%	10%	4%	14%	5%	1%	1%
2016 ISA Area (ac)	302	461	222	268	191	20	31
2016 ISA (% of total)	12%	11%	4%	15%	6%	1%	1%
*2019 ISA Area (ac)	404	591	315	359	326	51	60
*2019 ISA (% of total)	17%	14%	6%	20%	10%	2%	3%
ISA/IEA Ratio (%)							
Subwatershed:	Jordan Brook / Yancey Branch	Rock Creek / UT1 - UT3	Fly Creek / UT4	UT5 - UT6	Point Clear	Bailey Creek / UT7 - UT11	UT12
2001 ISA/IEA Ratio	24%	20%	16%	20%	11%	9%	15%
2006 ISA/IEA Ratio	25%	21%	17%	21%	13%	9%	15%
2011 ISA/IEA Ratio	26%	23%	19%	22%	16%	9%	15%
2016 ISA/IEA Ratio	26%	23%	20%	23%	17%	10%	18%
*2019 ISA/IEA Ratio	30%	27%	24%	28%	24%	17%	24%

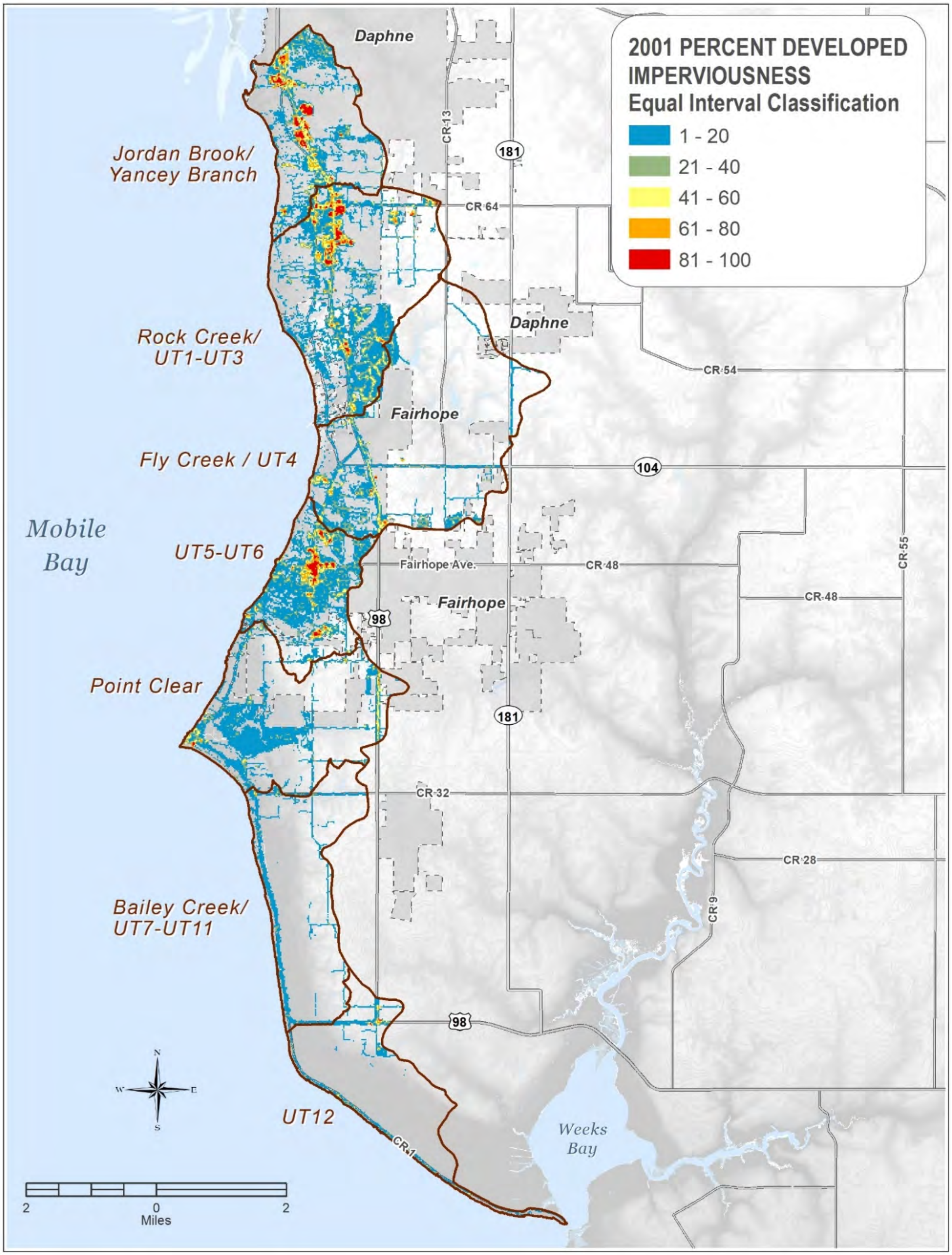


Figure 3.60 2001 Percent Developed Imperviousness

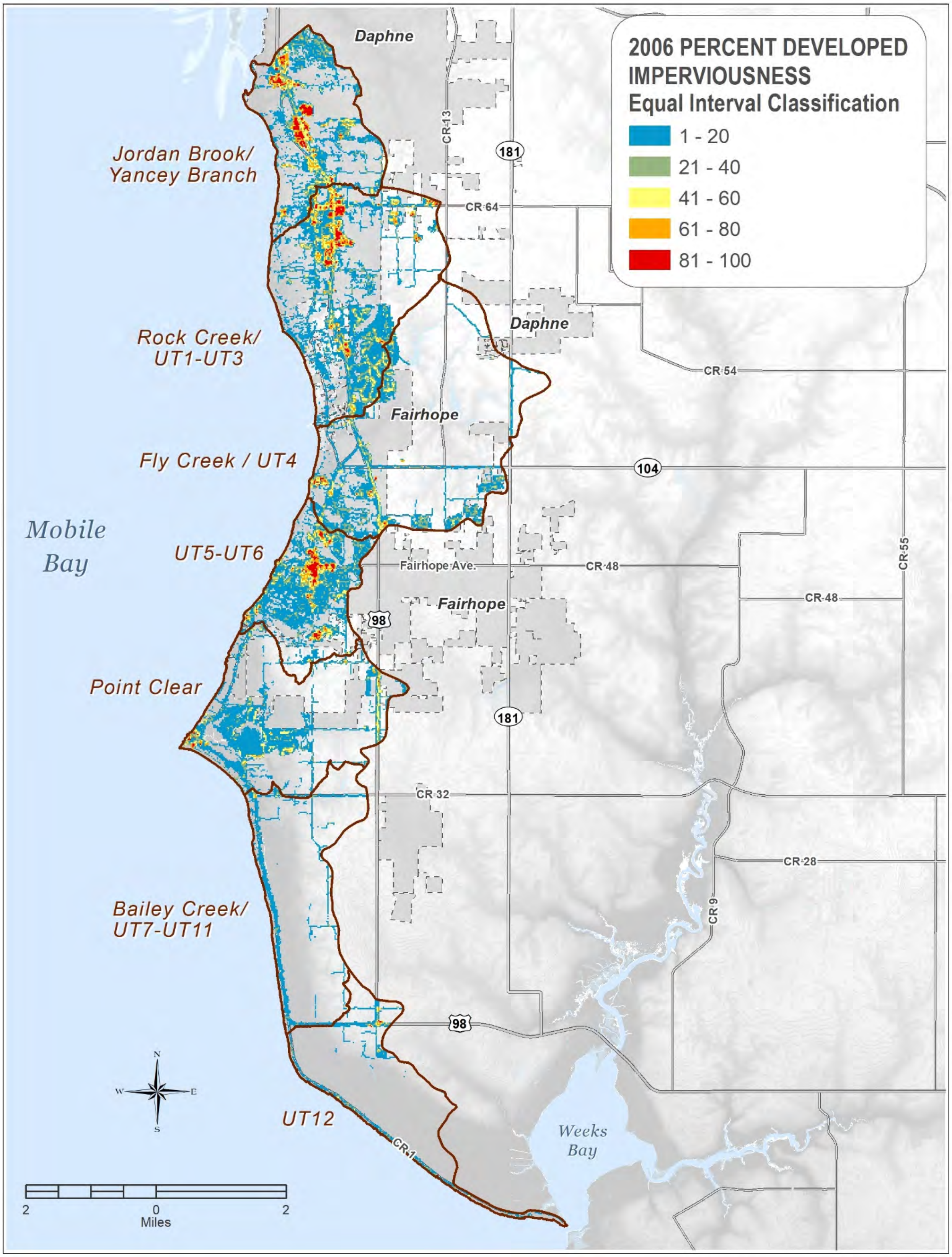


Figure 3.61 2006 Percent Developed Imperviousness

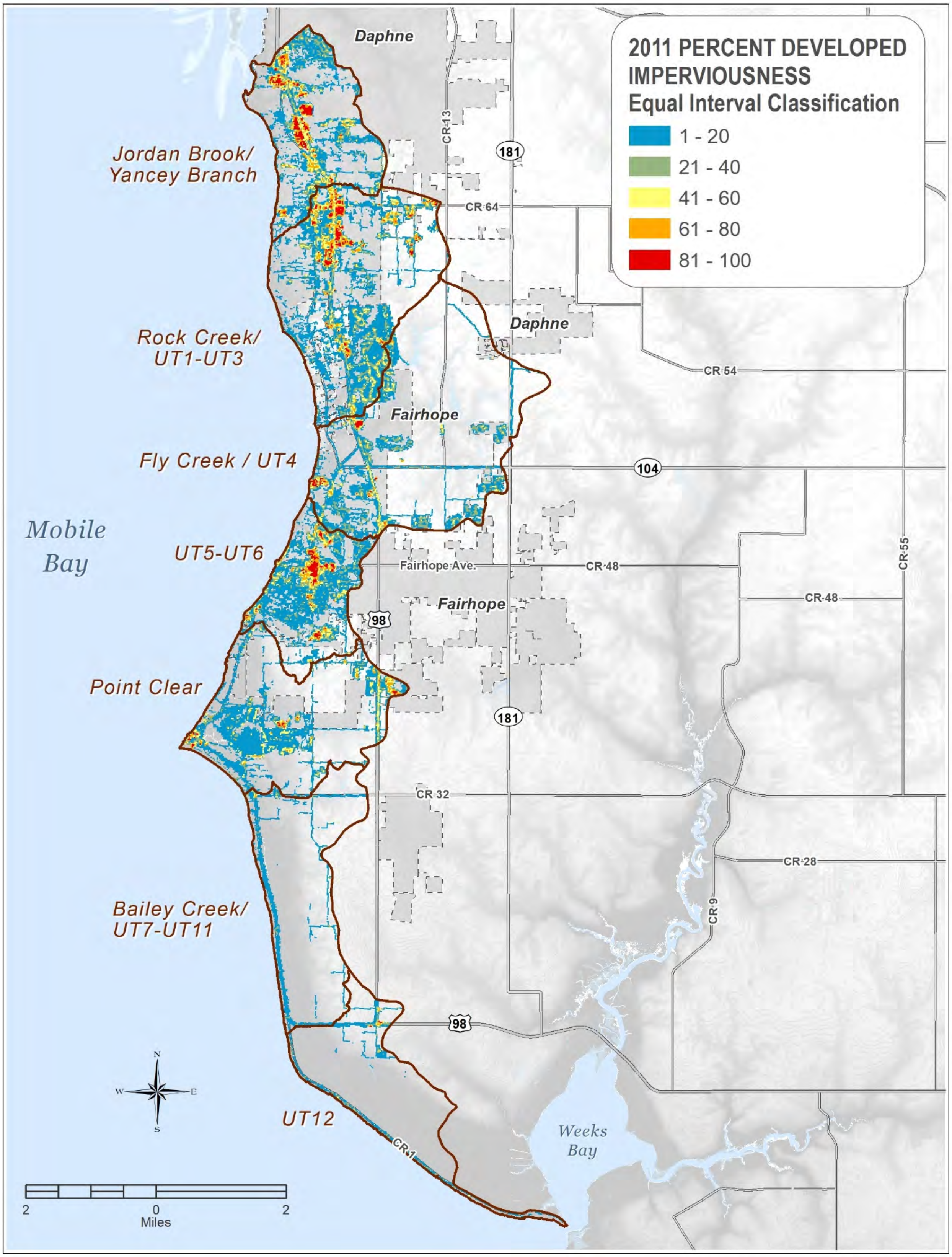


Figure 3.62 2011 Percent Developed Imperviousness

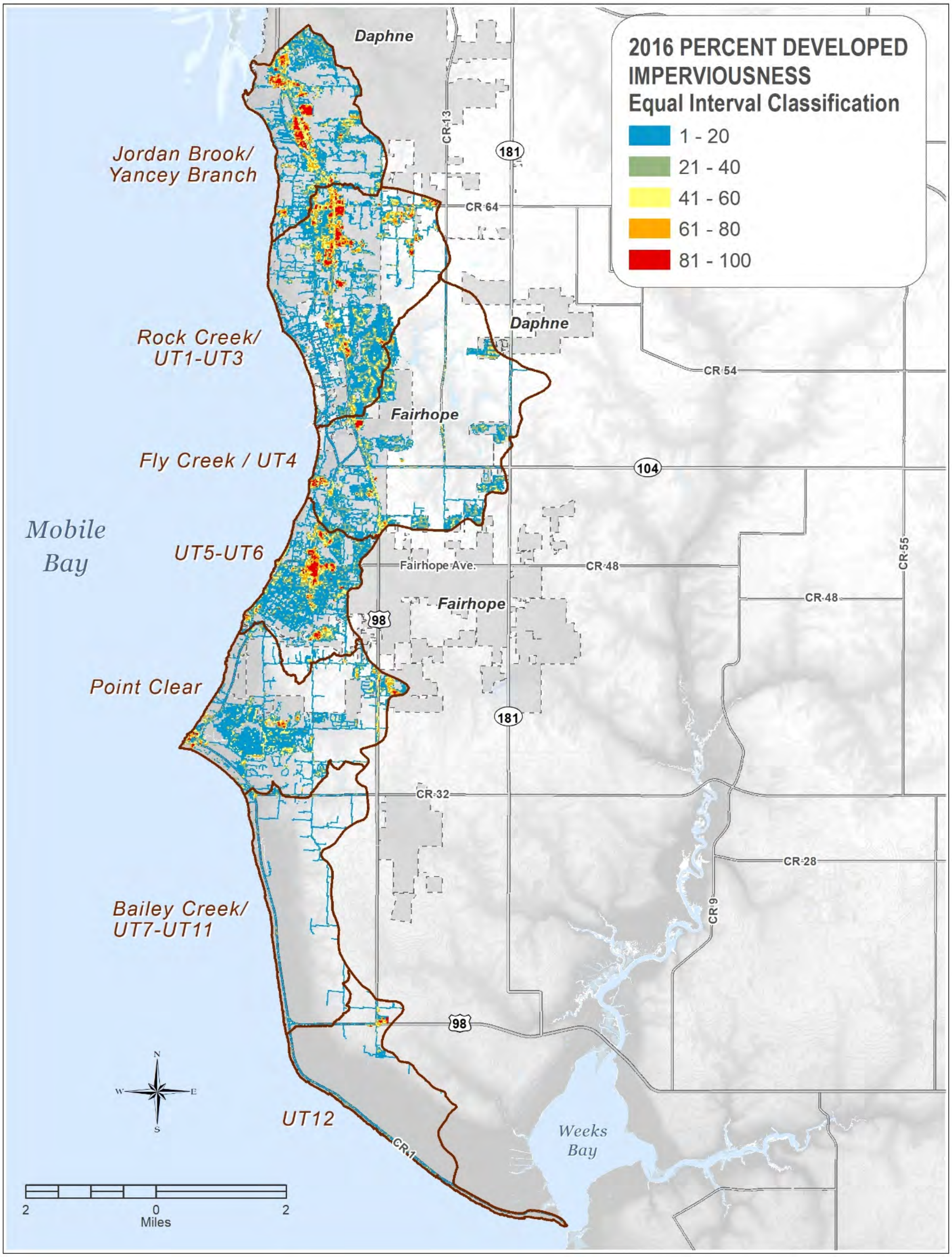


Figure 3.63 2016 Percent Developed Imperviousness

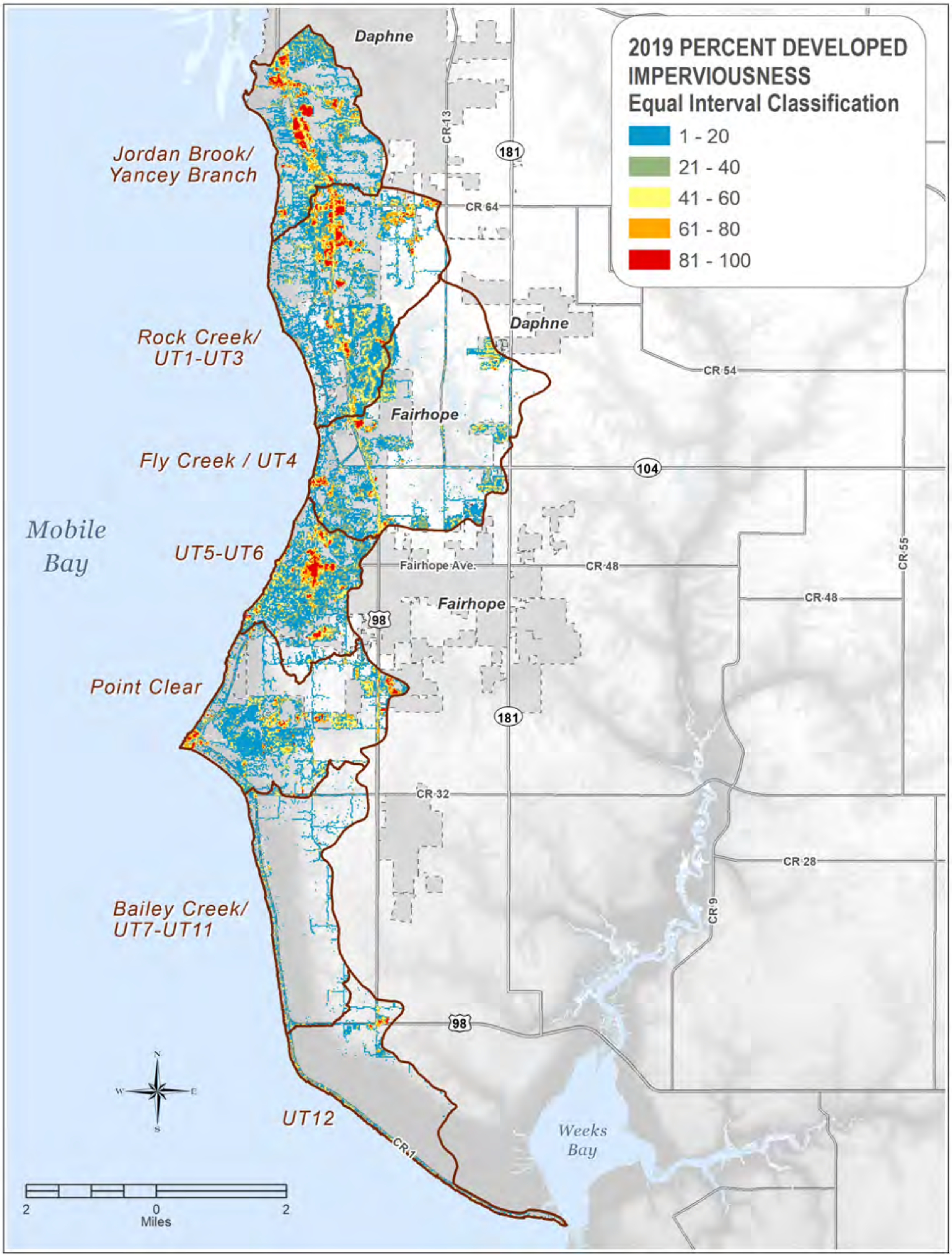


Figure 3.64 2019 Percent Developed Imperviousness

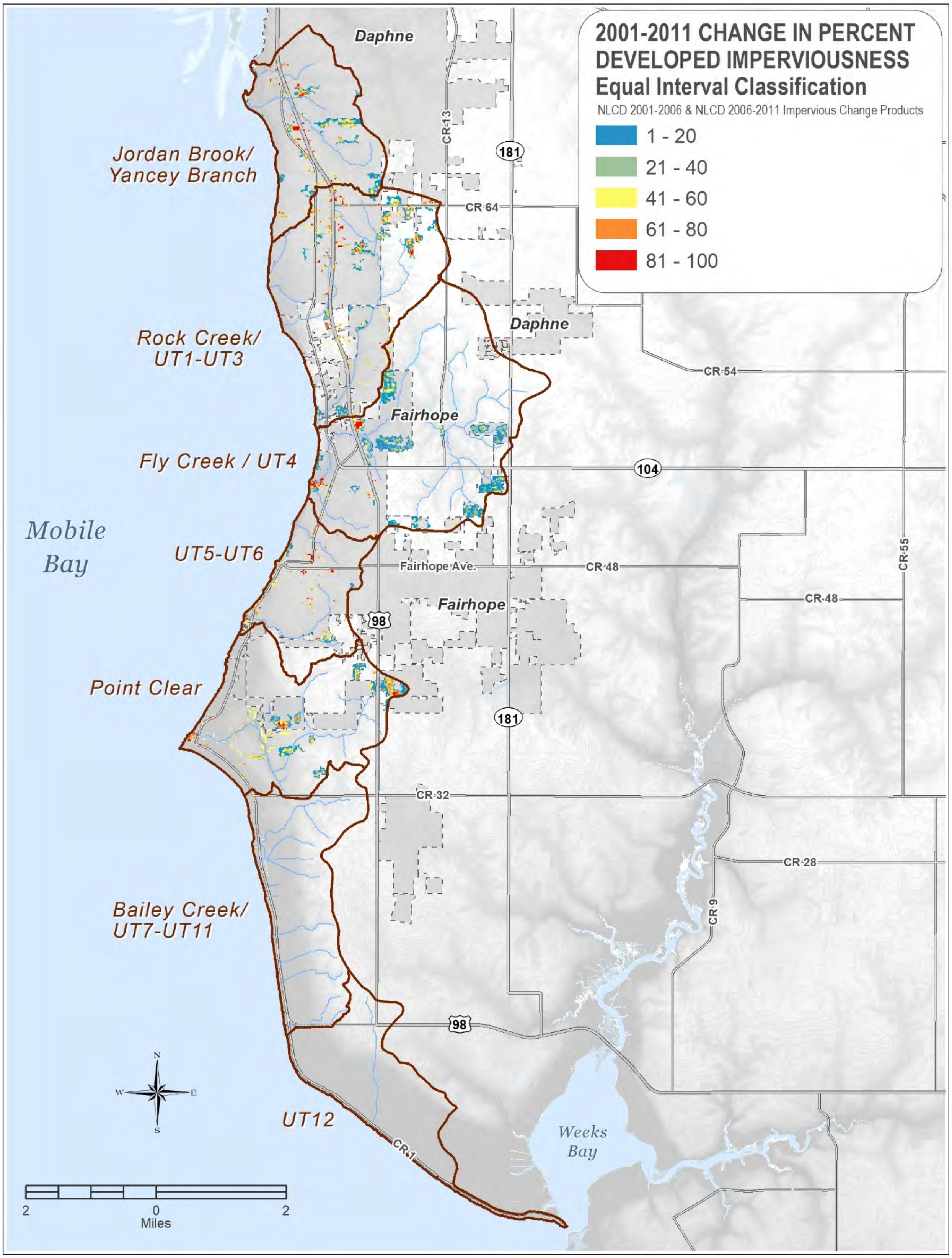


Figure 3.65 2001-2011 Percent Developed Imperviousness Change

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4.0 Watershed Conditions

4.1 Water Quality Standards and NDPES Permitting

4.1.1 Introduction

Federal and state programs implemented pursuant to the Clean Water Act (CWA) or the Federal Water Pollution Control Act govern the regulation of discharges of pollutants to waterways and stormwater management within the Eastern Shore Watershed. These include the CWA Section 303(d) Impaired Waters and Total Maximum Daily Load (TMDL) program and the Section 402 National Pollutant Discharge Elimination System (NPDES) permitting program. The NPDES permitting program includes point source discharges from industrial and municipal sources (Wastewater Treatment Plants), stormwater discharges from various industrial activities (i.e. mining, manufacturing, construction activities, etc.), and the Municipal Separate Storm Sewer System (MS4) program. The Alabama Water Pollution Control Act (AWPCA) and Environmental Management Act provide basis for the State of Alabama to be delegated the authority to implement portions of the CWA related to water quality standards and NPDES permitting. A more detailed overview of these existing federal and state regulations is presented in Chapter 9 of this Plan.

4.1.2 Water-use Classification and Water Quality Criteria

The CWA (Section 303) requires that states develop and describe water quality standards and criteria. Alabama's water quality criteria have been developed by ADEM and are based on a water use classification system for each waterbody. Use classifications and the general and specific narrative and numeric water quality criteria for each classification can be found in ADEM Admin. Code R. 335-6-10 and ADEM Admin. Code R. 335-6-11, respectively. The Use classifications utilized by the State of Alabama are as follows:

Outstanding Alabama Water	OAW
Public Water Supply	PWS
Swimming and Other Whole Body Water-Contact Sports	**S**
Shellfish Harvesting	**SH**
Fish and Wildlife	**F&W**
Limited Warmwater Fishery	LWF
Agricultural and Industrial Water Supply	A&I

The three classifications in **bold font** are assigned to various waterbodies within the Eastern Shore Watershed. The streams and tributaries within the Watershed are classified as S and F&W while the coastline is classified as S, SH, and F&W. There are two special designations that ADEM has adopted that may be applied to high quality waters which allow for added protection. These designations are Treasured Alabama Lake (TAL) and Outstanding National Resource Water (ONRW) (ADEM Admin. Code R. 335-6-10-.10). There are currently no waters within the Eastern Shore Watershed that have either of these classifications.

The use classification system applies both narrative and numeric water quality criteria appropriate for the particular uses based on existing utilization, uses reasonably expected in the future, and those uses not now possible because of correctable pollution but which could occur if the effects of pollution were controlled or eliminated. The water quality criteria are primarily used for assessment purposes (CWA Section 305(b)), setting water quality targets for impaired waters (TMDL program), and for the permitting and regulation of discharges of pollutants to waters of the State of Alabama. However, they also provide an indication of expected ambient water quality conditions. Of necessity, the assignment of use classifications must take into consideration the physical capability of waters to meet certain uses. It should also be noted that under certain natural conditions or phenomena values may range outside the criteria for the parameters of pH, dissolved oxygen and turbidity and not be considered a contravention of the standard (ADEM Administrative Code R. 335-6-10-.05(4)). In some instances, a waterbody may be assigned multiple classifications (e.g. S/F&W). A number of waterbodies throughout the state are specifically named in the ADEM regulations and those not named are assigned the classification of F&W.

The primary numeric water quality criteria for the three water use classifications applicable to the Eastern Shore Watershed are provided in Table 4.1.

Table 4.1 ADEM Water Quality Criteria by Use Classification

Water Use Classification	pH (s.u.)	Water Temperature °F	Dissolved Oxygen[1] mg/l	Bacteria[2] Colonies per 100 ml	Turbidity[4] NTU
Swimming and Other Whole Body Water-Contact Sports (S)	6.0-8.5(fresh) 6.5-8.5 (salt)	<90	>5.0	126/235 *Escherichia coli (E. coli)* 35/100 *Enterococci*	<50
Shellfish Harvesting	6.0-8.5 (fresh) 6.5-8.5 (salt)	<90	>5.0	35/100 *Enterococci*	<50
Fish and Wildlife (F&W)	6.0-8.5 (fresh) 6.5-8.5 (salt)	<90	>5.0	548/2,507 *E. coli* 126/298 *E. coli*[3] 275 *Enterococci* 35/158 *Enterococci*[3]	<50

Source: ADEM Administrative Code R. 335-6-10, February 3, 2017

[1]*Dissolved oxygen criteria applies at surface and at mid-depth or 5 feet whichever is greater (ADEM Administrative Code R. 335-6-10-.09). In estuaries and tidal tributaries, values may be less than 5.0 mg/l in dystrophic waters due to natural phenomenon*

[2]*Bacteria standards are shown as the "geometric mean/single sample maximum" concentrations. E. coli standards apply to non-coastal waters; Enterococci standards apply to coastal waters*

[3]*Seasonal "swimming" standards apply to waters classified as Fish and Wildlife (May – October)*

[4]*Turbidity criteria apply to discharges which shall not cause or contribute to an increase in the turbidity of the receiving waters by more than 50 NTU (nephelometric turbidity units) above background*

Water use classifications assigned to specific waterbodies within the Eastern Shore Watershed are listed in Table 4.2.

Table 4.2 ADEM Water Use Classifications in the Eastern Shore Watershed

Waterbody	From	To	Classification	Subwatershed
Jordan Brook	Mobile Bay	Its source	F&W[1]	NOT CLASSIFIED
Yancey Branch	Mobile Bay	Its source	F&W[1]	NOT CLASSIFIED
Rock Creek	Mobile Bay	Its source	F&W[1]	Rock Creek/UT1-UT3
Fly Creek	Mobile Bay	Its source	S/F&W[1]	Fly Creek/UT4
Point Clear	Mobile Bay	Its source	F&W[1]	Point Clear
Bailey Creek	Mobile Bay	Its source	F&W[1]	NOT CLASSIFIED

Source: ADEM Administrative Code R: 335-6-11, February 15, 2021

[1]*For these streams, the portions below +10 feet MSL are considered "coastal waters" and the portions above +10 feet MSL are considered "non-coastal waters" for the purposes of applying water quality criteria*

All of the streams and creeks in the Eastern Shore Watershed feed separately into Mobile Bay. In addition, there are miles of coastline adjacent to Mobile Bay that need to be considered. These features make the Eastern Shore Watershed one of the more physically and environmentally diverse watershed study areas in Baldwin County.

Section 303(d) of the CWA requires that states develop lists of "impaired waters," those waters that do not meet state water quality standards for their designated uses. Figure 4.1 depicts 303(d) listed streams in the Eastern Shore Watershed. These listings must be approved by EPA and are published biannually. The CWA also requires that states establish priority rankings for waters on the 303(d) lists and develop a Total Maximum Daily Load (TMDL) for these waters. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards. The TMDL calculates the maximum amount of a pollutant allowed to enter a waterbody (i.e., also known as the loading capacity) so that the waterbody will meet and continue to meet water quality standards for that particular pollutant. The TMDL then allocates the pollutant load to point sources (Wasteload Allocation or WLA) and nonpoint sources (Load Allocation or LA), which include both anthropogenic and natural background sources of the pollutant. Once a waterbody is placed on the 303(d) list, it can only be removed when the TMDL is completed or if new information indicates that water quality criteria are being met. The 303(d) list is submitted to the U.S. Environmental Protection Agency (EPA) for approval after an opportunity for public comment.

The only currently 303(d)-listed stream in the Eastern Shore Watershed is Fly Creek. Fly Creek was placed on the list in 2018 for pathogens due to "pasture grazing" from +10 feet MSL to its source. This segment of Fly Creek continues to remain on the 303(d) list. Also as shown on Figure 4.1, there are two nearby areas of Mobile Bay and Bon Secour Bay on the 303(d) list for Enterococcus bacteria, added to the list in 1998.These openwater areas do not include the areas from the shoreline to 1,000-feet offshore. The reported sources for the offshore Mobile Bay area extend from the Ragged Point in Daphne southward to Mullet Point, where the Bon Secour Bay listed segment starts and runs southward to the mouth of Weeks Bay (Pelican Point) as it pertains to proximity to the Eastern Shore Watershed. The listed sources by ADEM for the Mobile Bay segment is urban runoff and storm sewers, while the Bon Secour Bay segment also lists onsite wastewater systems in addition to the urban runoff and storm sewers.

An area of approximately one square mile in Mobile Bay extending from Ragged Point to the mouth of Yancey Branch, extending out to 1,000 feet offshore was placed on the list in 2010 for pathogens (*Enterococci*) based on ADEM beach monitoring program data collected in 2008 and 2009, then removed in 2015 from the 303(d) when a TMDL was developed and approved (ADEM 2015). This TMDL shoreline area, approximately 1.08 square miles, has been assigned the Assessment Unit ID of AL03160205-0300-501. The TMDL percent reduction is based solely on the highest exceedance value measured in terms of concentration. It was determined that the highest percent reduction was calculated for a single sample violation of 1,230 colonies per 100 milliliters measured on June 11, 2012, at the MAY_DAY beach monitoring station. This violation resulted in a 92% reduction, which equates to an allowable concentration of up to 94 colonies per 100 milliliters. Additional discussion regarding bacterial pathogen monitoring and results is presented in Section 4.3.3.4.

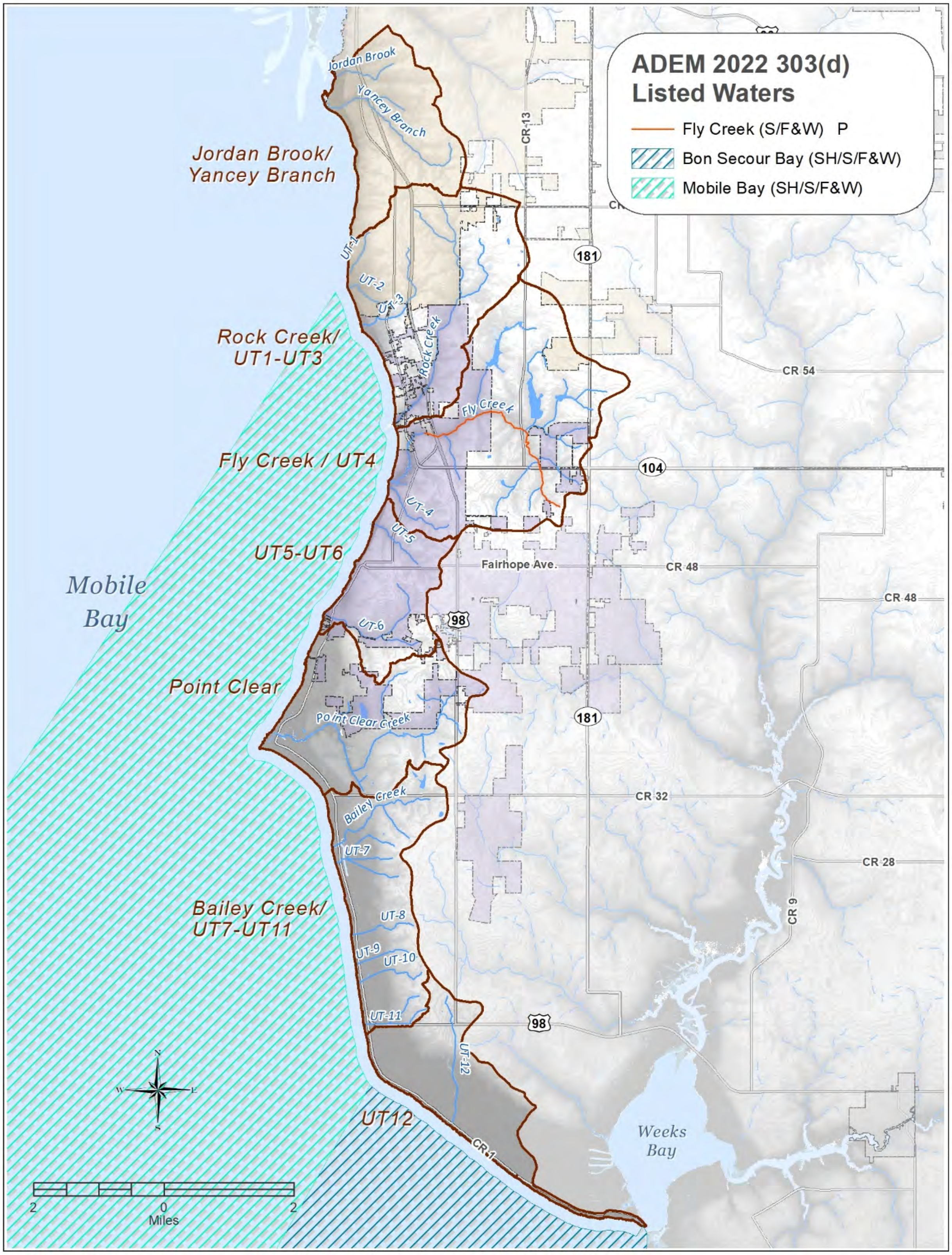

Figure 4.1 303(d) Listed Waters in Eastern Shore Watershed
Source: ADEM 2022

4.1.2.1 CWA Section 402 NPDES Permitting Program

Section 402 of the CWA sets forth the national permitting program for discharges of pollutants to waters of the United States. ADEM is a delegated state, authorized to implement the NPDES permitting program within Alabama. Facilities discharging pollutants are divided into a number of categories based on the type and/or size of the facility (e.g. major industrial, major municipal, minor industrial, 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 an “Individual” NPDES permit. The Daphne Water Reclamation Facility discharges treated wastewater into Mobile Bay just north of the Eastern Shore Watershed into the Blakeley River approximately 800-feet downstream of Interstate 10 and the Fairhope Wastewater Treatment Plant discharges into Mobile Bay approximately 3,350-feet northwest of the mouth of Big Mouth Gully in Fairhope. 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.

4.1.2.2 NPDES MS4 Program

Stormwater runoff in urbanized areas is also subject to NPDES permitting regulations pursuant to the MS4 program, 40 CFR 122.32. Large municipalities and certain other MS4 operators (such as departments of transportation, universities, etc.) must obtain NPDES permit coverage and develop a stormwater management program. Currently the MS4 program is in Phase II, which began in 1999, and requires that cities or certain urban areas and counties with populations of 50,000 or more to obtain NPDES permit coverage for their stormwater discharges. Each regulated MS4 is required to develop and implement a local stormwater management program to reduce the contamination of stormwater runoff and prohibit illicit discharges. See Figure 4.2 for the MS4 Permit Areas in the Eastern Shore Watershed. As shown on that figure approximately 99% of the Eastern Shore Watershed is covered by the MS4 program. The only areas not covered are approximately 200 acres of the Fly Creek Subwatershed located east of Highway 181 and approximately 53 acres of the UT12 Subwatershed along County Road 1 east of Mary Ann Beach Road (CR 27).

The general requirements of MS4 permits are to develop, implement and enforce a Storm Water Management Program Plan (SWMPP) that addresses the following six 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.

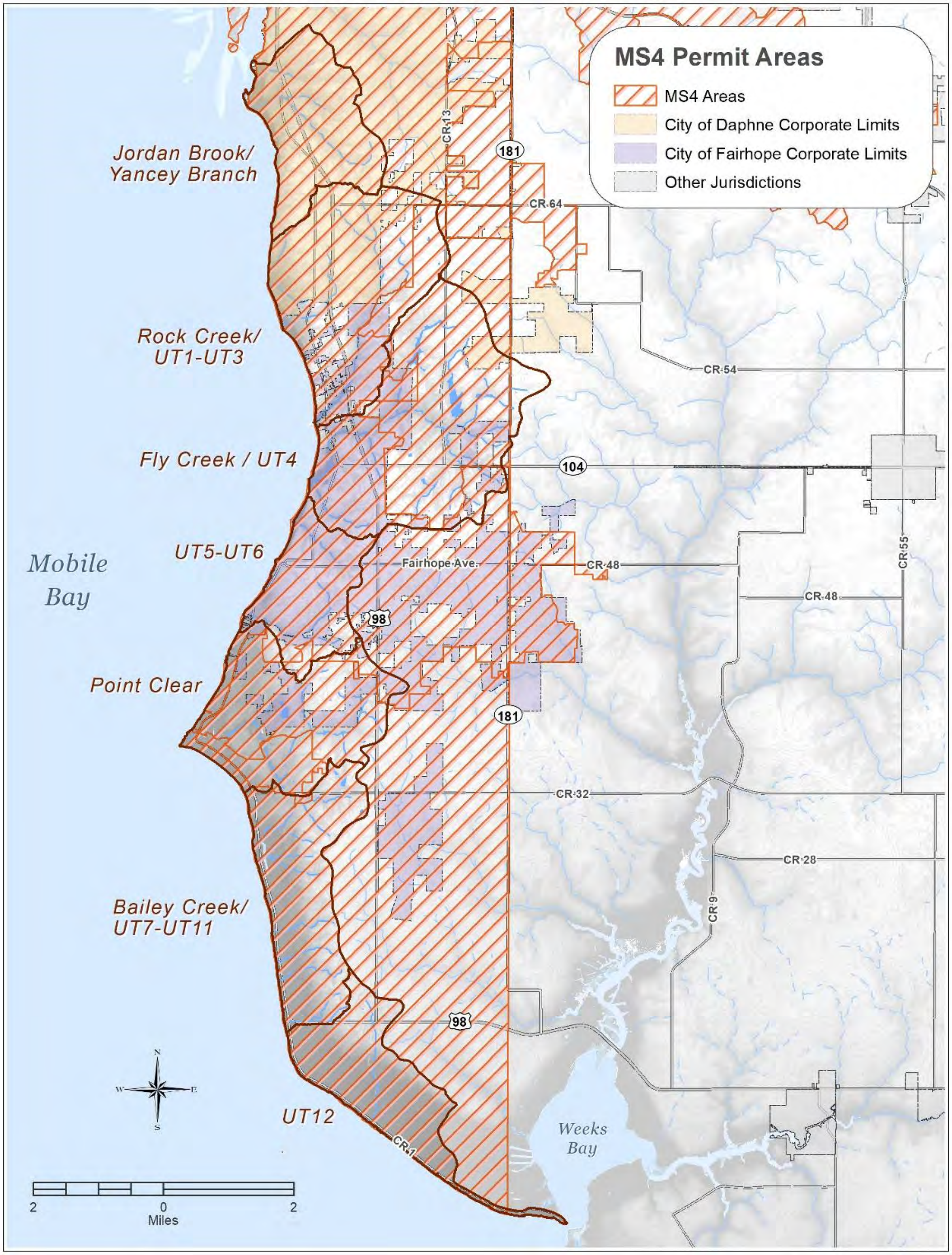

Figure 4.2 MS4 Permit Areas
Source: ALDOT

4.2 Other Potential Sources of Pollutants

In addition to the permitted discharges of pollutants directly to waterways under the NPDES program, other potential sources of pollution to surface and groundwater may include hazardous waste generators, animal feeding operations, landfills, and various nonpoint sources (septic tanks, agriculture, etc.). Many of the nonpoint sources are currently not subject to regulation or permitting requirements.

4.2.1 Regulated Waste Generators

Sites or facilities that generate regulated waste materials (hazardous chemicals, used oil, etc.) are potential sources for surface water or groundwater contamination due to leaks, spills or improper disposal methods. A review of the EPA Enforcement and Compliance History Online (ECHO) data indicates that there are 125 registered generators of regulated waste in the Watershed (one major facility (Fairhope Wastewater Treatment Plant [WWTP]) and 124 minor facilities), most being classified as "categorically exempt" small quantity generators such as automotive repair shops or pharmacies (USEPA ECHO 2020). One facility has had a violation within the last three years and one facility has had a formal enforcement action in the past five years. There were ten facilities with informal enforcement actions in the past five years.

4.2.2 Landfills

There are currently two ADEM permitted landfill operations within the Watershed, the Fairhope Landfill (ADEM Permit No. 02-07) operated by the City of Fairhope and the Tallent Lane Facility Construction and Demolition Landfill (ADEM Permit No. 02-13) operated by City of Daphne (http://adem.alabama.gov/programs/land/default.cnt). The Fairhope landfill is regulated by municipal ordinances that directly prohibit the disposal of construction and commercial debris into the city landfill (City of Fairhope 2020). The Tallent Lane Facility is permitted for construction and demolition waste (ADEM 2020a). Other sources of information were found at: https://www.baldwincountyal.gov/departments/solid-waste/landfills and https://www.fairhopeal.gov/home/showdocument?id=20971

4.2.3 Animal Feeding Operations

Although many agricultural activities are not subject to regulation under the Clean Water Act, ADEM does regulate, and require NPDES permit coverage for certain types of animal feeding operations (ADEM Administrative Code R. 335-6-7). Facilities where the equivalent of 300 animal units are concentrated, for a period of 45 days per year, that do not contain crops, are not vegetated or do not produce forage, are considered Animal Feeding Operations (AFOs). Feeding operations with 1,000 animal units are considered Concentrated Animal Feeding Operations (CAFOs). These types of facilities can be a source of nutrient and pathogen pollution from stormwater runoff and inadequate waste management practices. Currently there are no AFO/CAFO operations permitted within the Eastern Shore Watershed.

4.2.4 Non-Point Sources

Other sources of pollution not originating from a discrete discharge location are generally lumped into the category of nonpoint sources and are generally not regulated under the state or federal water pollution control acts. These nonpoint sources of pollution can convey natural and anthropogenic pollutants into waterbodies. Nonpoint source pollution generally comes from runoff from overland flow, atmospheric deposition, agricultural activities (crop production, grazing, etc.), silvicultural activities, and other diffuse sources. 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. Such pollutants are commonly observed throughout the Watershed and can block drainage systems, resulting in decreased flows and localized flooding. Other non-point sources of pollution can be generated on commercial agricultural and forest lands, however, these land uses in the Watershed are small as shown in the Land Use discussion within Section 3.13.2.2 of this report. Dirt roads can also contribute sediments and other pollutants but that issue in the Eastern Shore Watershed is not as significant as some other coastal Alabama watersheds. Marinas are another potential source for release of pollutants into public waters, particularly petroleum products such as fuel, oil, and grease. Appropriate officials are required to conduct periodic inspections of the commercial marina sites within the Eastern Bay Watershed to observe compliance with regulations governing the handling of these petrochemicals.

4.2.4.1 On-Site Sewage Disposal Systems (OSDS)

On-Site Sewage Disposal Systems (septic tanks) can be a source of pollution when they fail to function properly due to improper siting, lack of maintenance or failure of the disposal system (field lines). In areas where there is no centralized sanitary sewer collection service, septic tanks are the primary option for treatment and disposal of sewage. A permit from the Alabama Department of Public Health (ADPH) is required to install a septic tank. Since 2016, Baldwin County has permitted the installation of 20 new septic tanks and the repair of 75 existing septic tanks within the Eastern Shore Watershed. The installation of new septic tanks indicates that wastewater disposal in the Eastern Shore Watershed remains a mixture of centralized sanitary

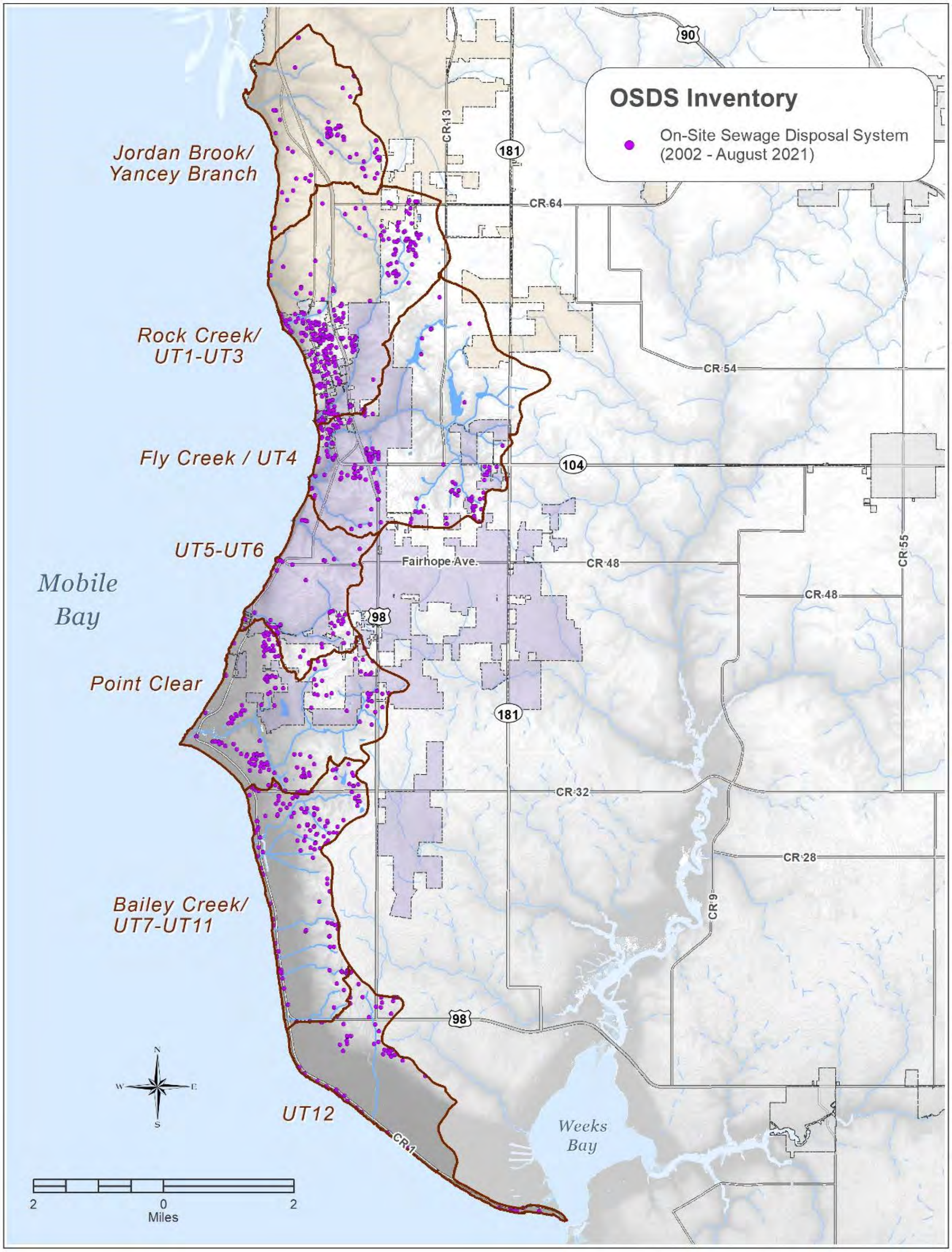

Figure 4.3 On-site Sewage Disposal Systems (Septic Tanks) in Eastern Shore Watershed
Source: Alabama Department of Public Health 2021

sewer and septic tanks. OSDS locations are presented below in Figure 4.3 based on the ADPH data (2021), indicating approximately 1,000 septic tanks within the Eastern Shore Watershed. While septic tanks are spread across the entire Watershed, there are more concentrated in the Daphne area than in other areas.

4.2.4.2 Mercury

Mercury (Hg) can occur both naturally in the environment (e.g., cinnabar) and from various anthropogenic sources (e.g., industrial processes, waste incineration, coal burning, aerial deposition, etc.). Mercury, once vaporized, may persist in the atmosphere for days and up to a year (depending on species) and can be transported for great distances. Mercury persists in the environment and under certain conditions will transform to methylmercury which is the form that is readily taken up by organisms and bio-accumulates. The natural water quality conditions present in coastal streams, primarily the amount of dissolved organic matter, higher temperature, low pH and, to a lesser degree, fluctuations in salinity (chlorides) and low dissolved oxygen, are thought to be particularly conducive to the methylation process. Bays and estuaries are thought to be “sinks” or “traps” for mercury and most coastal streams in the United States have mercury related fish consumption advisories, as does the Gulf of Mexico, for long-lived top predator species.

The presence of mercury and other pollutants in fish tissue at certain levels triggers the issuance of a consumption advisory by the ADPH and subsequent inclusion on the 303(d) list. These advisories are intended to provide information and guidance on the consumption of fish and shellfish to the public. The advisories apply mainly to “at-risk” groups, e.g. babies, children under the age of 14, and women who are nursing, pregnant, or who plan on becoming pregnant.

Fish samples are routinely collected and analyzed by ADEM and the results, along with information on the type and size of fish and sampling locations are provided to ADPH. Based on this information, ADPH may issue a consumption advisory for fishes caught from all or portions of a waterway. These advisories can include: “no consumption,” “one meal per week,” “one meal per month,” or “no restriction” and may relate to one or more species of fishes. A meal is considered one eight-ounce serving. Once issued these advisories remain in effect until rescinded by ADPH. There are no current fish consumption advisories reported in the Eastern Shore Watershed in the Alabama Fish Consumption Advisories; however you should continue to check for the annual updates: https://www.alabamapublichealth.gov/tox/assets/fish-advisories.html . While there are no fish consumption advisories for the Eastern Shore Watershed, the public should be advised that some of the adjacent watersheds do have consumption advisories due to the prevalence of Hg in coastal waters general guidance from the State is that those in high risk groups best avoid consumption of risky species like largemouth bass, crappie, kingfish, shark, etc.

4.3 Surface Water

4.3.1 Surface Water Flow

As discussed in Chapter 3.2.2, the surface water flow within the Eastern Shore Watershed are from several relatively short perennial streams that drain this narrow Watershed. The flow channels begin in the higher elevations (maximum elevation of 170 feet MSL) to the east of Mobile Bay from a drainage divide that separates the Eastern Shore Watershed from the Fish River Watershed. The streams generally flow westward to their lower tidally influenced channels before emptying into the Bay. The majority of these 18 streams are unnamed and less than three miles long. Fly Creek is the longest named stream (13.1 miles), followed by Point Clear Creek (6.9 miles), Rock Creek (6.2 miles), Yancey Branch (3.5 miles), Bailey Creek (2.7 miles), and Jordan Brook (0.9 mile). The Fly Creek Subwatershed also has 20 man-made lakes/ponds that influence water quality within those lacustrine environments and downstream areas. Streams north of Fairhope have higher gradients and generally have higher potential for erosion and sediment transport. None of the streams within the Watershed have a permanent USGS stream gage to record flow or water quality parameters. Streamflow within the northern portion of the Watershed have flashy discharge due to the relatively high topographic relief and increased impervious surfaces due to residential and commercial developments. Based on Cook (2021), Table 4-3 presents flow data from 2019, representing base flow to flood conditions.

Table 4.3. Flow (cfs) Data by Subwatershed and Station (from Cook 2021)

Subwatershed Station	Average Flow (cfs)	Maximum Flow (cfs)	Minimum Flow (cfs)	Average Flow per unit area (cfs/sq mi)	Stream Gradient (ft/mi)
ES1 – Yancey Branch	7.9	15	1.7	4.7	54
ES2 – Red Gully	65.0	263	0.4	85.5	68
ES3 – Rock Crk	238.0	840	10.0	58.1	33
ES4 – UT Fly Crk at Headwater Rd	22.0	88	1.2	16.9	79
ES5 – UT Fly Crk at Woodland Dr	2.5	12	0.0	7.6	164
ES6 – Fly Crk at Scenic 98	*59.0*	*220*	*5.0*	*8.2*	29
ES7 – Fly Crk at CR13	173.0	950	8.0	44.4	200
ES8 – UT Fly Crk at Hwy104-West	24.0	106	0.0	28.2	92
ES9 – UT Fly Crk at Hwy 104 Mid	20.0	88	0.0	54.1	141
ES10 – UT Fly Crk at Hwy 104 East	6.9	40	0.0	40.6	182
ES11 – Volanta Gully at Scenic 98	12.0	38	0.0	23.5	71
ES12 – Big Mouth Gully at Bancroft	34.0	250	0.0	58.6	67
ES14 –Tatumville Gully at Scenic 98	143	800	0.3	110.0	56
ES15 – Point Clear Crk at Scenic 98	*N/A*	*500*	*N/A*	*N/A*	21
ES16 – Bailey Crk at Scenic 98	*N/A*	*137*	*N/A*	*N/A*	41

Source: Cook 2021
Notes: Discharge data not available or impacted by tidal influence shown in italics font. Station ES13 was unavailable for access and was abandoned. Station locations shown on Figure 4.14 later in this Chapter of the ESWMP.

4.3.2 Sediment Transport

The impact of sediment on aquatic systems is one of the leading causes of stream impairment in the United States. Excessive sediment delivery can cause a number of biological (disruption of the food web, smothering of benthic organisms, irritating or clogging fish gills, impairing spawning of fish, screening out sunlight, etc.) and physical impacts (reducing hydraulic capacity, increased flooding, loss of navigation, increased maintenance costs for stormwater management systems, etc.). Sediment can be generated from upland sources in the form of sheet, rill or gully erosion and transported to nearby waterbodies during stormwater runoff events. Sediment can also be generated from stream and channel erosion due to stream scour and bank erosion due to increases in stream flow (velocity and/or volume) resulting from increases in stormwater runoff associated with development or agricultural practices. Erosion is the process whereby soil particles are detached from the land surface and sedimentation is the process where eroded soil particles are transported from areas of higher elevation and deposited in areas of lower elevation. These processes are influenced by a number of factors, including topography, climate (precipitation), soil types, and LULC.

Sediment is usually characterized as suspended sediment or suspended solids (particles suspended in the water column) or as bed load. Sediment or soils with a high percentage of “fines” (clay, muck, fine silts) are the primary contributors to turbidity in waterbodies. There currently are no state or federal water quality standards for sediment or sedimentation, however there are standards associated with turbidity as a result of stormwater or point source discharges. Since there are no formal sediment loading criteria, assessment efforts usually will use only relative comparisons (e.g. “this Subwatershed has a higher sediment yield than another”) or will compare to yields or loadings to some generally accepted “natural” or “acceptable” projection. Additional discussion of sediment within the Eastern Shore Watershed is presented in the following Water Quality section.

4.3.3 Water Quality

As presented in Chapter 3.10 of this plan, the 2020 U.S. Census data ranks Baldwin County as the seventh fastest-growing metropolitan area in the country with a 27.2% population increase from 2010, and a 65% increase since 2000. Accelerated growth can compound existing water quality issues and increase stormwater runoff. Cook (2021) describes the Watershed’s compounded issues of highly erodible soils and high intensity rainfall events from hurricanes as severe. Impacts from rapid runoff and erosion can result in increases in nutrient runoff, sediment transport, and loss of biological habitat in downstream streams. Sources of these impacts are listed as impervious surfaces, deforestation, and transition of land uses from vegetated and agriculture to commercial and residential.

As data are available, this section presents a narrative summary of existing Subwatershed water quality conditions from the review of previously collected data and findings. The seven Subwatersheds are provided below (in north-to-south order): Jordan Brook/Yancey Branch, Rock Creek/UT1-UT3, Fly Creek/UT4, UT5/UT6, Point Clear, Bailey Creek/UT7-UT11, and UT12

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

- **Physiochemical 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 human and animal waste products (e.g., viruses, disease causing bacteria), including:

    - Fecal coliform
    - *E. coli*
    - *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 Eastern Shore Watershed is characterized with regard to the various classes of water quality parameters where ambient data are available.

4.3.3.1 Data Sources

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

- **ADEM** – programmatic ambient monitoring and assessment data

    - Pathogen data collection in the Eastern Shore Watershed during the period 2005-2022

- **Watershed Reports**
  - Pre-Restoration Analysis of Discharge, Sediment Transport Rates, Water Quality, and Land-Use Impacts in Watersheds along the Eastern Shore of Mobile Bay, Baldwin County, Alabama (Cook, 2021).
  - Final Weeks Bay Watershed Management Plan (Thompson, 2017)
  - Assessment of Fly Creek Water Quality (Mobile Baykeeper 2018)

Table 4.4 provides a summary of the surface water quality data collected available from the National Water Quality Monitoring Council (NWQMC) (https://www.waterqualitydata.us/) which provides data warehousing for state, federal and local agencies including USGS, EPA and the state of Alabama. It is important to note that long-term monitoring is only available at limited stations, predominantly associated with bacterial monitoring for beach access. Overall, minimal water quality data are available to characterize water quality conditions within the sub-watersheds with some tributaries containing no data for characterization. Data collected as part of volunteer monitoring organizations, such as Mobile Baykeeper and Alabama Water Watch, were also reviewed to assist in describing existing water quality conditions in the Eastern Shore Watershed.

Table 4.4. Summary of Data Collection in the Eastern Shore Watershed

Sampling Entity	Subwatershed	Site ID	Monitoring Type	First Sampling Date	Last Sampling Date
ADEM/ADPH	Fly Creek / UT4	VOLANTA AVENUE	BEACH Program Site-Estuary	11-Jan-05	8-Dec-20
ADEM	Fly Creek / UT4	VOL_AVE	Estuary	4-May-10	4-May-10
ADEM	Fly Creek / UT4	FLYB-96	River/Stream	15-May-01	4-May-16
NALMS	Fly Creek / UT4	Fly Creek	River/Stream	8-Jun-03	29-Jun-03
USGS-AL	Fly Creek / UT4	FLY CREEK AT US HWY 98 NEAR FAIRHOPE, AL.	Stream	15-Sep-94	15-Sep-94
ADEM/ADPH	Jordan Brook / Yancey Branch	MAY DAY PARK	BEACH Program Site-Estuary	11-Jan-05	8-Dec-20
ADEM	Rock Creek / UT1- UT3	RDGB-1	River/Stream	26-Aug-97	26-Aug-97
USGS-AL	Rock Creek / UT1- UT3	ROCK CREEK AT US HWY 98 NEAR FAIRHOPE, AL.	Stream	13-Sep-94	15-Sep-94
ADEM/ADPH	UT12	MARY ANN NELSON BEACH	BEACH Program Site-Estuary	15-Feb-05	8-Dec-20
ADEM	UT12	MAN_BEACH	Estuary	4-May-10	4-May-10
ADEM/ADPH	UT5 / UT6	FAIRHOPE PUBLIC BEACH	BEACH Program Site-Estuary	11-Jan-05	8-Dec-20
ADEM/ADPH	UT5 / UT6	ORANGE STREET PIER/BEACH	BEACH Program Site-Estuary	11-Jan-05	8-Dec-20
ADEM	UT5 / UT6	F_HOPE	Estuary	4-May-10	4-May-10
ADEM	UT5 / UT6	ORANGE_ST	Estuary	4-May-10	4-May-10

Source: NWQMC website

As previously discussed, there are several tributaries which drain westward to Mobile Bay in the Eastern Shore Watershed. For parameters which lack specific water quality criteria, ADEM compares site-specific water quality data to ecoregional reference guidelines based on the 90th percentile data distribution from selected reference site(s) in a particular Ecoregion level (ADEM 2020e). The 2015 ecoregional reference guidelines for the level IV Southern Pine Plains and Hills (65f) region are provided in Table 4.5.

Table 4.5. Alabama Level IV (65f) Ecoregional Reference Guidelines

Parameters	Basis of comparison	Ecoregion 65f
Physical		
Temperature (°C)	90th %ile	25.0
Turbidity (NTU)	90th %ile	8.00
Total Dissolved Solids (mg/L)	90th %ile	66.0
Total Suspended Solids (mg/L)	90th %ile	10.0
Specific Conductance (µmhos)	Median	24.2
Hardness (mg/L)	Median	5.7
Total Alkalinity (mg/L)	90th %ile	12.00
Chemical		
Dissolved Oxygen (mg/L)	10th %ile	6.32
pH (SU)	10th %ile	4.7
pH (SU)	90th %ile	6.8
Ammonia Nitrogen (mg/L)	90th %ile	0.0485
Nitrate + Nitrite Nitrogen (mg/L)	90th %ile	0.3470
Total Kjeldahl Nitrogen (mg/L)	90th %ile	0.4700
Total Nitrogen (mg/L)	90th %ile	0.7822
Dissolved Reactive Phosphorous (mg/L)	90th %ile	0.0208
Total Phosphorous (mg/L)	90th %ile	0.0310
CBOD-5 mg/L	90th %ile	1.99
Chlorides (mg/L)	90th %ile	6.00
Total Metals		
Total Alumnium (µg/L)	90th %ile	501.00
Total Iron (µg/L)	90th %ile	1337.00
Total Manganese (µg/L)	90th %ile	50.70
Dissolved Metals		
Dissolved Alumnium (µg/L)	90th %ile	308.00
Dissolved Antimony (µg/L)	90th %ile	3.75
Dissolved Arsenic (µg/L)	90th %ile	2.50
Dissolved Cadmium (µg/L)	90th %ile	0.1555
Dissolved Chromium (µg/L)	90th %ile	39.5000
Dissolved Copper (µg/L)	90th %ile	2.5000
Dissolved Iron (µg/L)	90th %ile	634.00
Dissolved Lead (µg/L)	90th %ile	2.50
Dissolved Manganese (µg/L)	90th %ile	47.00
Dissolved Mercury (µg/L)	90th %ile	0.25
Dissolved Nickel (µg/L)	90th %ile	8.4000
Dissolved Selenium (µg/L)	90th %ile	4.13
Dissolved Silver (µg/L)	90th %ile	1.5000
Dissolved Thallium (µg/L)	90th %ile	0.50
Dissolved Zinc (µg/L)	90th %ile	34.5000
Biological		
Chlorophyll a (µg/L)	90th %ile	3.24
E Coli (mpn/100 ml)	10th %ile	8.60

Source: ADEM 2020e (Table 18)

4.3.3.2 Geochemical and Physiochemical Parameters

Limited geochemical and physiochemical data are available to summarize the surface water characteristics of the Eastern Shore Watershed. Isolated sampling events have been completed but are insufficient to provide a confident evaluation of conditions. Short-term monitoring efforts have been performed in the Watershed and Subwatersheds in an effort to inform project specific objectives (Cook 2021; Mobile Baykeeper 2018). A brief summary of the data provided as part of those efforts is provided below, but the context and limitations of the data collection is important to avoid extrapolating to characterize the ambient conditions. For example, those data collected by Cook (2021) were completed after rain events to evaluate sediment transport and land-use impacts to the streams and, as such, the data should not necessarily be considered representative of ambient conditions. Overall, the geochemical and physiochemical parameters measured at the thirteen (13) sites monitored in 2019 by Cook (2021) in the Eastern Shore Watershed were at or below the appropriate regulatory criteria or established reference conditions.

Water temperature can directly impact biological activity and growth in aquatic plants and animals. Aquatic plants and other organisms often have a preferred temperature range in which they thrive. Water temperatures were observed to be lower in Yancey Branch and warmer in Rock Creek/UT1-UT3 sub-watersheds, with seven to nine degree seasonal variation in water temperatures. Water temperatures were consistently below the 90° F (32.2 °C) ADEM criteria (see Table 4.6).

Specific conductance concentrations are influenced by a variety of physical and chemical conditions such as the hydrology (discharge), geology (soil conditions), and geography (proximity to tidal influences). Specific conductance readings were elevated above the ecoregion level IV reference condition (24.2 mS/cm). Cook (2021) observed that values remained relatively low after precipitation events indicating no significant contaminant sources in the upstream contributing landscape.

Alkalinity is an indication of the buffering capacity of water, or the ability to neutralize acids and bases and thus maintain a relatively stable pH level. pH levels can be directly impacted by both natural and anthropogenic factors including meteorological events (e.g., rainfall or snowfall), the surrounding geology (e.g., presence of limestone) or biological processes (e.g., respiration). The state regulatory standard for pH provides a range between 6.0 and 8.5 for freshwater. All monitored stations were below the upper criteria (8.5); however, many locations reported values below the lower criteria (6.0; Cook 2021). These depressed pH values could be natural conditions and/or attributed to sampling efforts associated with rainfall events.

Turbidity is a measurement of the amount of light scattered by inorganic and organic material (i.e., fine particles, algal cells, dissolved colored organic compounds) in the water column. Increased turbidity is inversely correlated with light penetration resulting in a reduction in photosynthetic activity, including phytoplankton production. Turbidity can be directly associated with upstream land use activities such as urban development or agricultural activities. Cook (2021) reported that the majority of streams with increased urban development reported higher average turbidity values (Figure 4.4). In contrast, the two streams with relatively small contributing basins with increased urban development had lower average turbidity values (Volanta Gully and Big Mouth Gully).

Table 4.6. Water Temperature (°C) Summary Statistics by Subwatershed and Station

Subwatershed	Station	N	Minimum	Average	Maximum
Fly Creek/UT4		35	16.9	23.4	27.3
Fly Creek/UT4	Fly Creek at Baldwin County Road 13	8	18.2	23.3	27.3
	Fly Creek at Main Street	8	18.1	23.8	26.3
	Unnamed tributary to Fly Creek at Alabama Hwy 104 (East)	2	24.8	25.9	27.0
	Unnamed tributary to Fly Creek at Alabama Hwy 104 (Mid)	3	16.9	22.6	25.9
	Unnamed tributary to Fly Creek at Alabama Hwy 104 (West)	2	24.7	26.0	27.2
	Unnamed tributary to Fly Creek at Woodlands Drive	6	17.1	22.1	26.8
	Volanta Gully at Main Street	6	18.4	22.8	25.1
Rock Creek/UT1-UT3		24	17.4	22.9	27.6
Rock Creek/UT1-UT3	Red Gully at Bay Shore Drive	8	17.4	21.5	25.2
	Rock Creek at US Hwy 98	8	18.5	22.4	25.2
	Unnamed Tributary to Fly Creek @ Headwater Road	8	19.6	24.9	27.6
UT5/UT6		13	18.1	23.2	25.9
UT5/UT6	Big Mouth Gully at N Bancroft Street	5	23.6	24.7	25.9
	Tatumville Gully at Scenic Hwy 98	8	18.1	22.3	25.2
Yancey Branch		8	16.2	21.6	24.8
Yancey Branch	Yancey Branch at Harbor Place	8	16.2	21.6	24.8

Source: Cook 2021

A comprehensive analysis and reporting of sediment transport and loads was completed which concluded that the tributary creeks to Mobile Bay from the Eastern Shore typically have highly variable sediment loads and good water quality. Variations in sediment loadings may be attributed to urban development, wetlands, and forest cover in the contributing watershed (Cook 2021). Overall, all of the monitoring streams had normalized total sediment loads in excess of the "background" geologic erosion rate indicating increased erosion within the streambeds likely exacerbated by increased discharge and flow velocities due to increased impervious surfaces. Additional discussion on sediment is presented later in this section of the report.

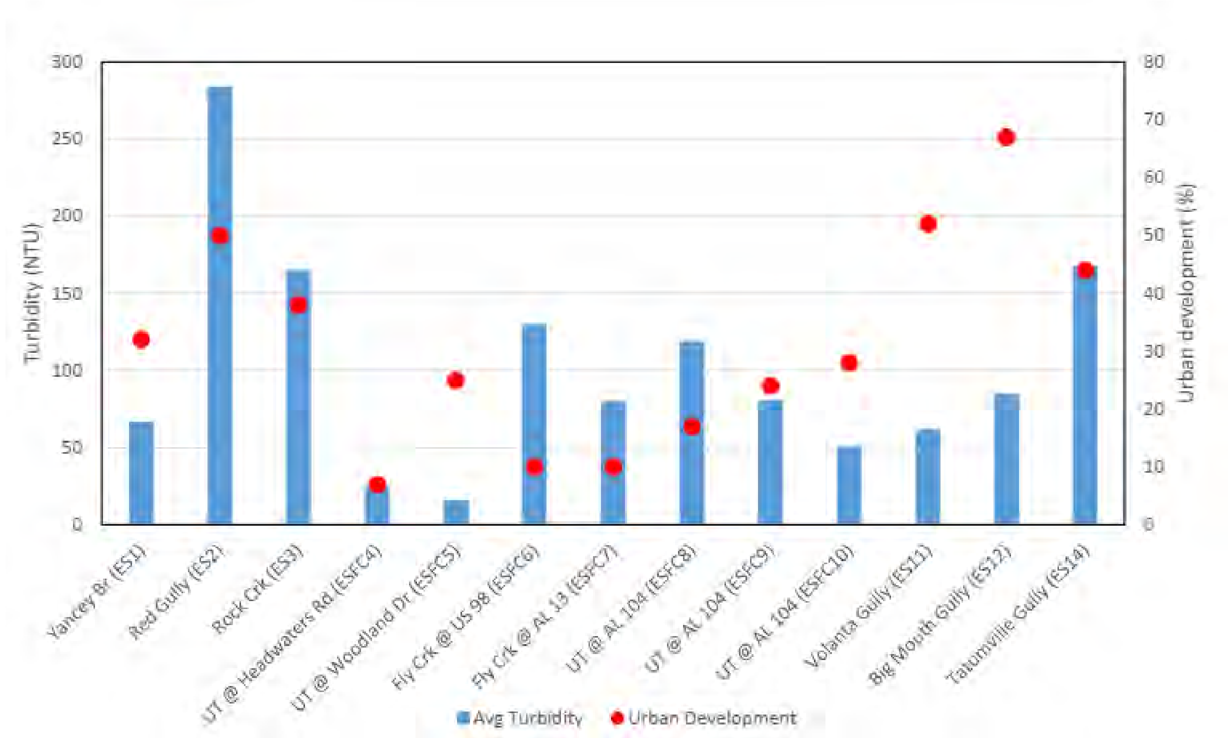

Figure 4.4 Average Turbidity and Percentage of Urban Development in Monitored Eastern Shore Watersheds
Source: Cook 2021

4.3.3.3 Nutrient Over-enrichment

Nitrogen and Phosphorus are the dominant nutrients required to support primary productivity in aquatic systems. Excess nutrients can lead to over-enrichment (eutrophication) resulting in increased phytoplankton production, increased biological activity and depressed dissolved oxygen concentrations. Limited ambient nutrient (nitrogen or phosphorus) data are available in the Eastern Shore Watershed to characterize the stream water quality. Data collected as part of the Cook (2021) study provide a narrow overview of nutrient conditions in the monitoring streams. Elevated nitrate+nitrite, dominant inorganic form of nitrogen which is readily available for biological assimilation, were reported in the Fly Creek Subwatershed compared to the EcoRegion Level IV reference conditions (0.347 mg/L). Similarly, elevated Total Phosphorus (TP) concentrations were observed in most of the monitored streams compared to the EcoRegional Level IV reference conditions (0.031 mg/L). Erosion and weathering of soil and rocks are common sources of phosphorus in aquatic systems; therefore, it is not unexpected that elevated concentrations would be reported associated with rain events.

Cook (2021) found the highest nitrate+nitrite levels in the Watershed (1.19 mg/L and 1.1 mg/L, respectively) in the Fly Creek Subwatershed at the Main Street Station and the Woodlands Drive Station. The highest level of total phosphorus was also found in the Fly Creek Subwatershed (0.88 mg/L) at the Woodlands Drive Station, and also a high level of 0.86 mg/L at the Red Gully/Bay Shore Drive Station. For the 32 sampling values collected for nitrate+nitrite nitrogen the median value was 0.12 mg/L, the average value was 0.279 mg/L, with 9% of the samples exceeding the 2015 ecoregional reference guidelines for Ecoregion 65f. For the 26 sampling values collected for total phosphorus the median value was 0.215 mg/L, the average value was 0.285 mg/L, with 100% of the samples exceeding the 2015 ecoregional reference guidelines for Ecoregion 65f.

Based on this limited sampling for nutrients within the Eastern Shore Watershed it appears that nitrogen is of less concern compared with phosphorus levels. By comparison ADEM data from nearby long-term trend monitoring stations (since 1985) the adjacent Fish River at Highway 104 shows a nitrate+nitrite nitrogen median value of 1.33 mg/L and at the Fish River at the downstream U.S. Highway 98 to be 0.456 mg/L. For total phosphorus, the ADEM trend stations recorded at Highway 104 was 0.056 mg/L median value and at U.S. Highway 98 was 0.054 mg/L median value. The long-term Fish River data for nutrients would indicate that the Eastern Shore Watershed streams have lower nitrate+nitrite nitrogen median values and higher total phosphorus median values.

4.3.3.4 Pathogens

Bacterial concentrations are used as indicators of the presence of fecal material in drinking and recreational waters, specifically *E. coli* and *Enterococci*. 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 may include improperly functioning wastewater treatment plants, leaking septic systems, storm water runoff, decaying animal remains, and runoff from animal manure and manure storage areas.

In an effort to routinely monitor coastal bacterial concentrations, ADEM and ADPH implemented a coastal beach monitoring program in response to the 2000 Beaches Environmental Assessment and Coastal Health (B.E.A.C.H.) Act. There are five (5) long-term bacterial monitoring sites in the Eastern Shore Watershed: May Day Park, Volanta Avenue, Fairhope Public Beach, Orange Street Pier, and Mary Ann Nelson Beach. 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 coastal waters, while *E. coli* should be measured in non-coastal waters. The bacterial surface water quality criteria are dependent on the respective designated use of the waterbody (see Table 4.1). Instances in which *Enterococci* values are above the whole body water contact standard (104 colonies/100mL for single day maximum) are denoted as having an elevated risk associated with swimming and a public health advisory is issued if elevated values persist. Figures 4.5 – 4.8 display the period of record (2005-2020) *Enterococci* concentrations at the five (5) B.E.A.C.H. monitoring stations compared to the regulatory criteria. All B.E.A.C.H monitoring sites have reported elevated *Enterococci* concentrations resulting in a potential health risk to the public. In addition, concentrations have been reported not only above "Swimming" standards, but also above the criteria established for the protection of "Fish and Wildlife". It is important to note that the B.E.A.C.H. monitoring program provides data which are "biased" toward events which may result in a public health advisory as supplemental monitoring events are performed as a protective measure to adequately document elevated or recovered bacteria levels. In regard to public health, a study by Environment America Research and Policy Center and the Frontier Group (2019) reported that testing of a sampling site at Fairhope Public Beach in Baldwin County indicated it was potentially unsafe for 21 days, more than any other site in the State of Alabama.

The B.E.A.C.H. monitoring sites characterize the downstream waters of the Eastern Shore Watershed which have been designated as impaired for elevated bacteria. Looking further upstream, a review of the most recent ADEM 303(d) list identifies Fly Creek as impaired for elevated *E. coli* concentrations within the Eastern Shore watershed (ADEM 2020d) likely caused by animal grazing within pastures. The Alabama Water Watch implements a volunteer-based monitoring program to characterize bacterial levels in the State's waterbodies including within the Eastern Shore Watershed. Water quality data were reviewed on the Alabama Water Watch website but like most volunteer programs, the data are from a limited number of stream points within the Watershed and most sites only collected data for a short period.

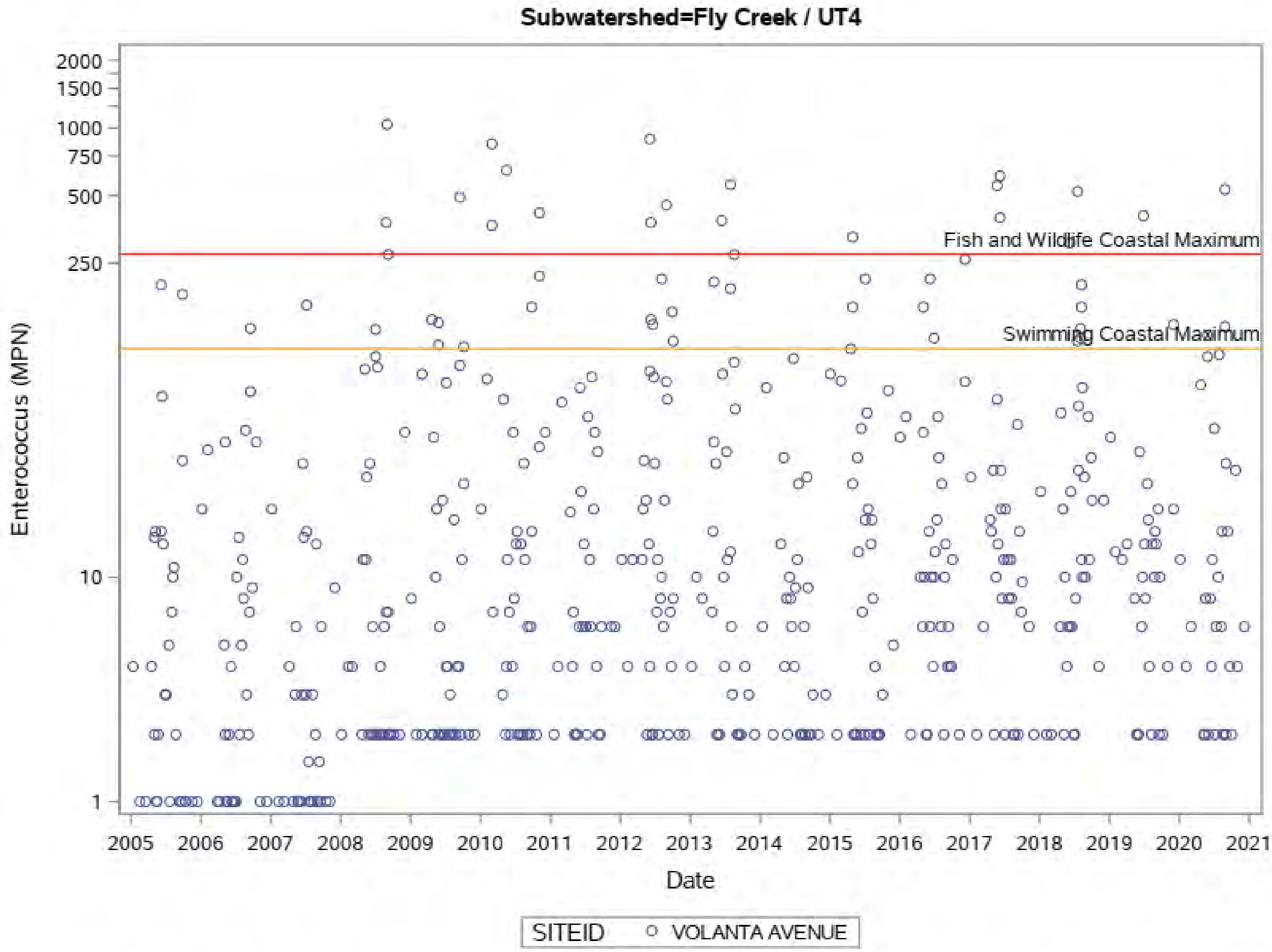

Figure 4.5 B.E.A.C.H Volanta Avenue *Enterococci* concentrations in the Fly Creek Subwatershed

**y-axis values are displayed on a Log_{10} scale.*

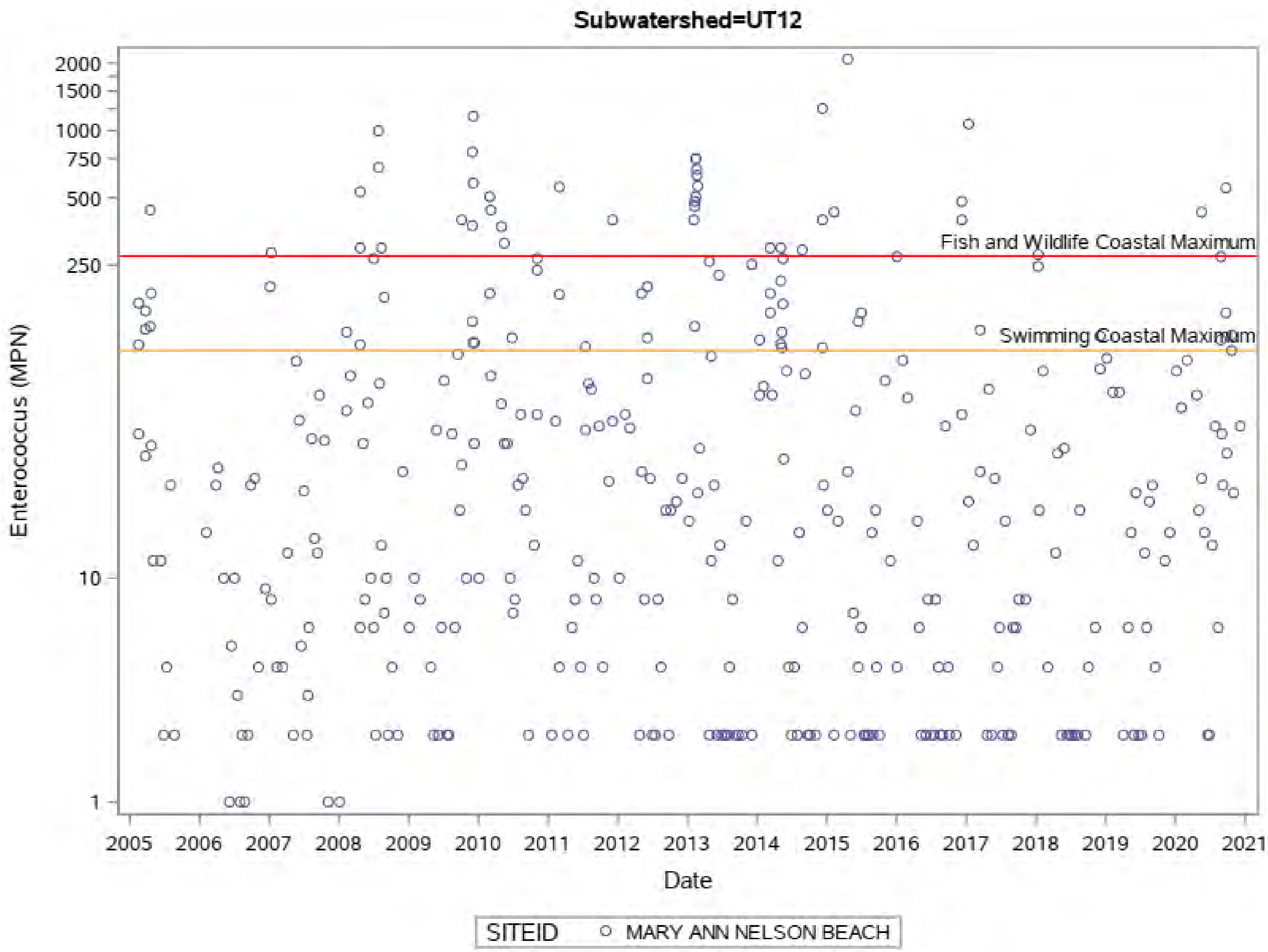

Figure 4.6 B.E.A.C.H Mary Ann Nelson Beach *Enterococci* concentrations in the UT12 Subwatershed
**y-axis values are displayed on a Log10 scale.*

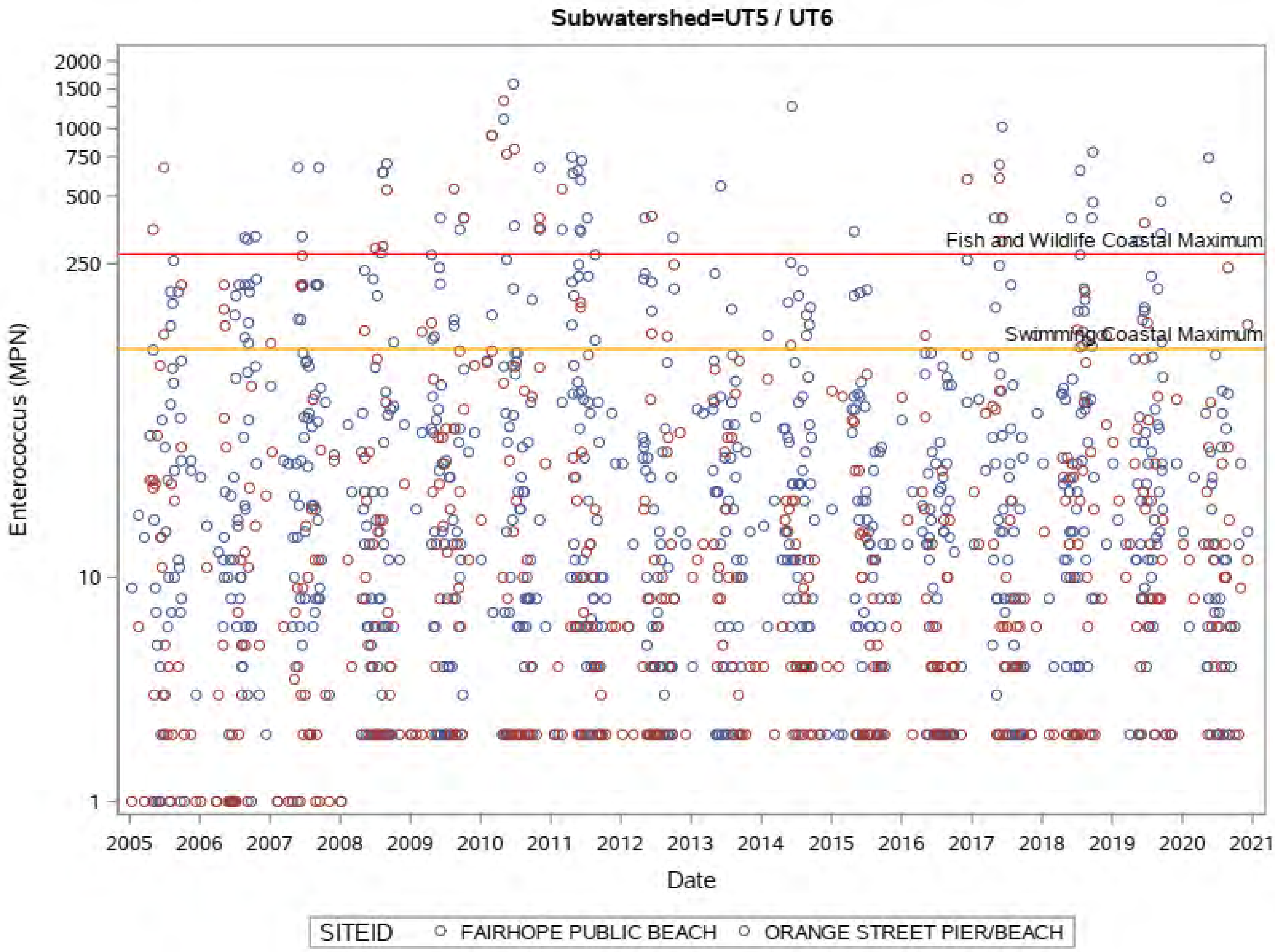

Figure 4.7 B.E.A.C.H Fairhope Public Beach and Orange Street Pier *Enterococci* concentrations in the UT5/UT6 Subwatershed
**y-axis values are displayed on a Log$_{10}$ scale.*

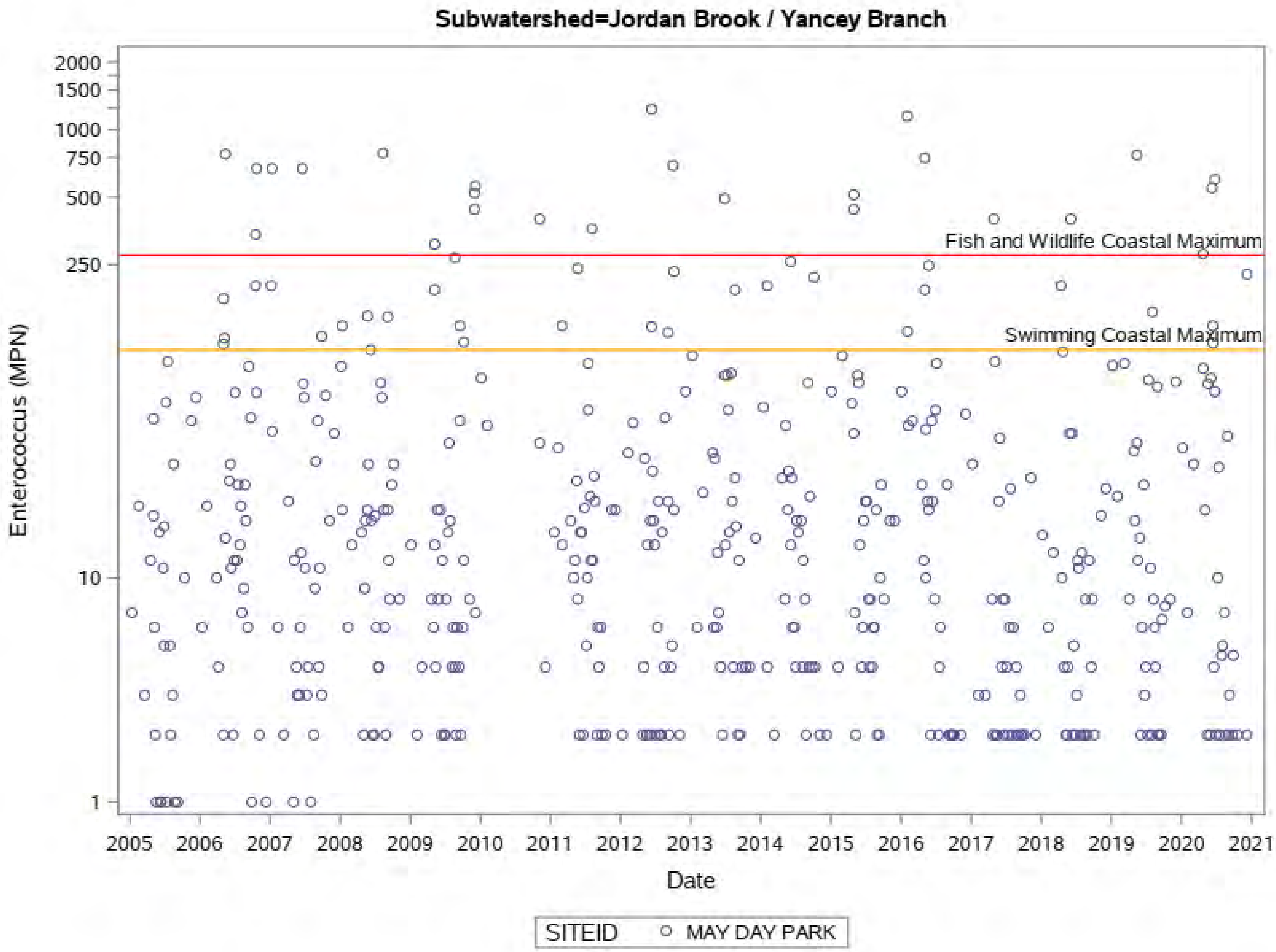

Figure 4.8 B.E.A.C.H May Day Park *Enterococci* concentrations in the Jordan Branch/Yancey Branch Subwatershed
**y-axis values are displayed on a Log_{10} scale.*

On May 15, 2020 the State of Alabama Attorney General and the ADEM filed a lawsuit against the City of Fairhope for violations of permits issued under the AWPCA and for unpermitted discharges of pollutants under this act (Baldwin County 2020). The lawsuit lists several complaints including: more than two-million gallons of treated sewage spilled during 99 sanitary sewer overflows between April of 2015 and April 2020; monitoring noncompliance on two occasions; and approximately 2,300 gallons of sludge entered Big Mouth Gully on October 8, 2018, due to a broken pump line from the digester. Multiple sanitary sewer overflows (SSOs) from 2020 and 2021 have been documented in the Eastern Shore Watershed ranging from less than 1,000 up to 500,000 gallons which contribute both bacteria and nutrients to the region (Figures 4.9 and 4.10; Mobile Baykeeper, https://www.mobilebaykeeper.org/). At the time of the preparing this WMP, there are no additional information on the status of the lawsuit.

Mobile Baykeeper (2021) reports the top reasons for sewage spills in Mobile Bay in 2018 were:

- System Failure = 89%: includes pump, lift station, or mechanical failures.
- Blockages = 7%: includes grease, wipes, and other materials that clog drains.
- Lightning or Power Loss = 2%
- Broken or Damaged Lines = 2%

Mobile Baykeeper (2021) also reported Hurricanes Sally and Christobal caused sewage spills brought on by heavy rain, flooding, and power outages. Baykeeper's Fly Creek Water Quality Report (2018) summarized that high levels of bacteria in the lower watershed were likely the result of sewer, septic, stormwater, or boats; high bacteria levels in Upper Fly Creek were likely from livestock and septic systems; and that ponds helped reduced bacteria concentrations downstream.

4.3.3.5 Eastern Shore Watershed Pollutant Loading

In watersheds with limited water quality data, like the Eastern Shore Watershed, a pollutant loading evaluation can provide additional information in assessing the overall water quality in the watershed. Pollutant sources vary within individual Subwatersheds according to variation in the contributing land use types, rainfall runoff, stream discharge and topography. Urbanization is often associated with an increase in impervious surfaces (e.g., roadways, buildings), loss of natural land uses (e.g., riparian buffer, wetlands), hydrological alterations (e.g., channelized waterways, irrigation, water supply) and nutrient amendments and additions (e.g., fertilizer, sanitary sewer). The development of pollutant loads at the Subwatershed scale is intended to allow for the comparison between Subwatersheds within the Eastern Shore Watershed, as well as with nearby watershed systems. Identifying Subwatersheds with elevated pollutant loadings can aid prioritization of projects directed to reduce loads. As discussed in the following paragraphs the limited data, particularly regarding nutrients, the only pollutant loading projections for the Eastern Shore Watershed is for sediments.

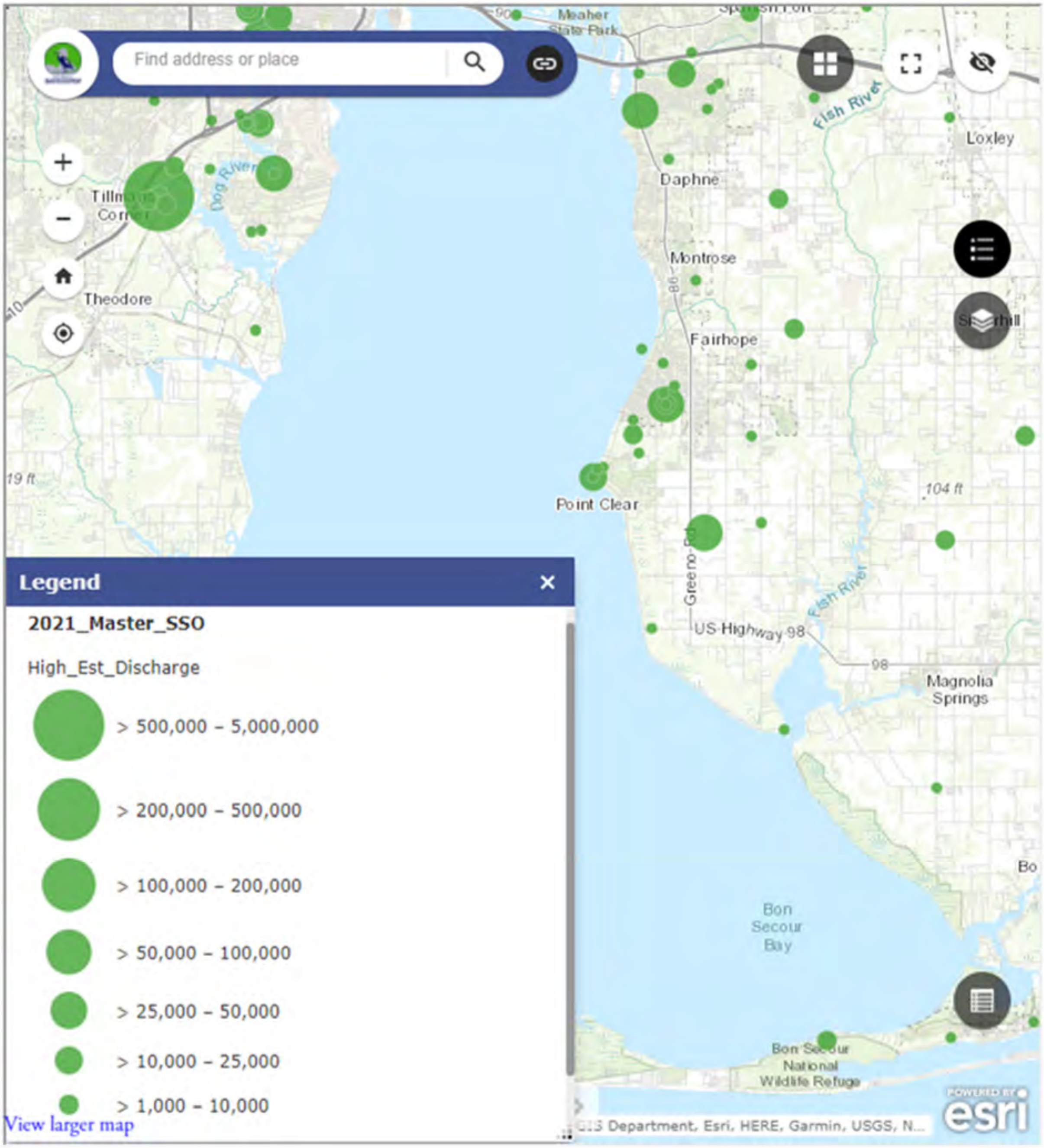

Figure 4.9 Snapshot of Sanitary Sewer Overflows (SSOs) in 2020
Source: Mobile Baykeeper (https://www.mobilebaykeeper.org/sewage-spills).

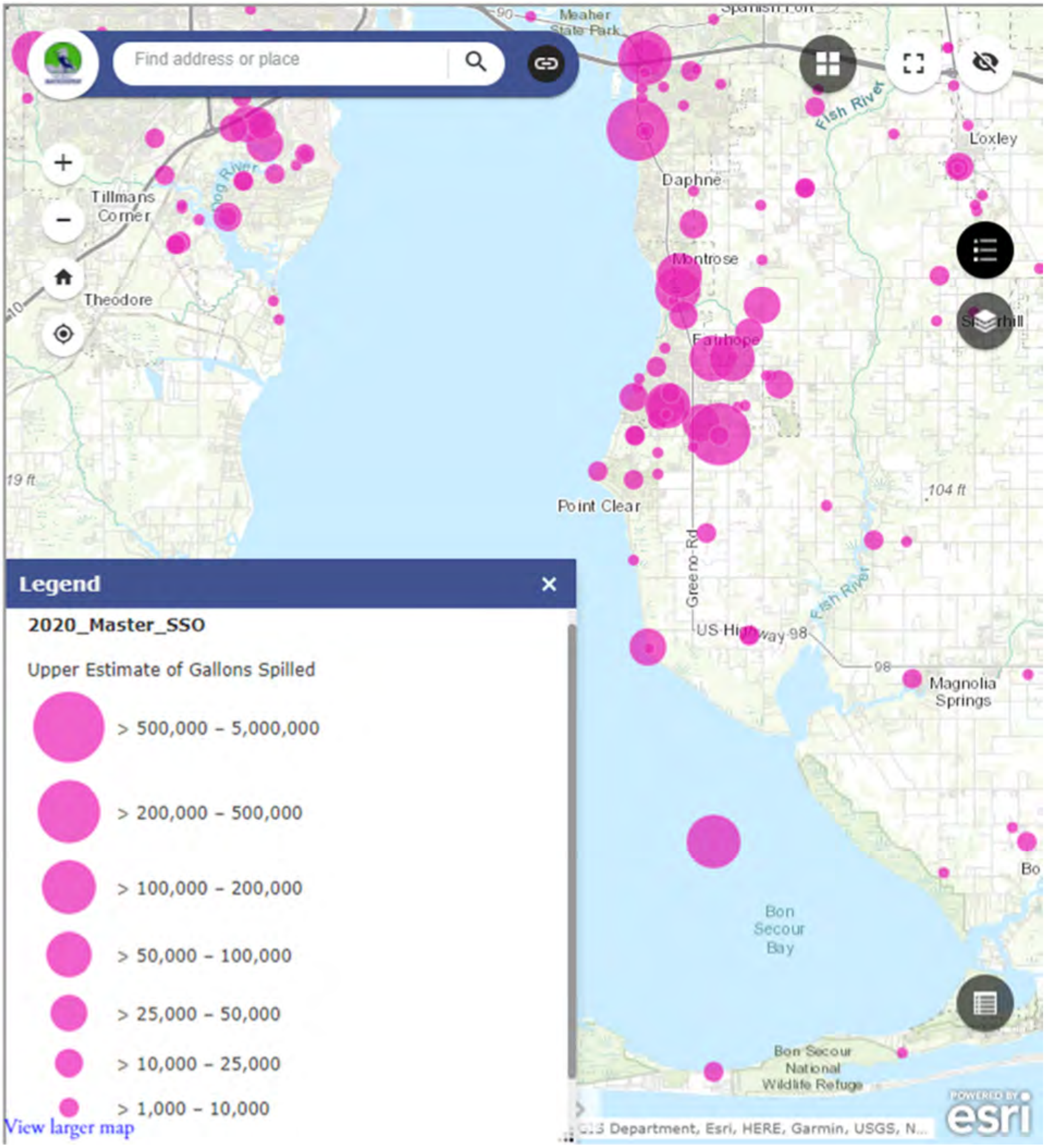

Figure 4.10. Snapshot of Sanitary Sewer Overflows (SSOs) in 2021
Source: Mobile Baykeeper (https://www.mobilebaykeeper.org/sewage-spills).

The general hydrogeological and water quality conditions of the several major tributaries within the Eastern Shore Watershed were characterized to support the estimates of sediment transport and nutrient loads (Cook 2021). As part of the Cook effort, thirteen non-tidal monitoring sites were established on accessible streams, and the contributing Subwatersheds delineated by an online tool, USGS Stream Stats (Figure 4.11). For each site, the average daily discharge and total sediment loadings (suspended and bed) were estimated.

Additionally, at each site, geochemical and physiochemical parameters were measured, and grab samples were collected for laboratory analyses of nutrients (nitrate+nitrite nitrogen and total phosphorus). It is important to note that nutrient data were limited (usually 2, sometimes 3, samples per station) representing only those discrete conditions which existed at the time of sampling in 2019. Also weather events during the sampling period ranged from high flows during Hurricane Barry to zero flow in some of the streams during drier sampling events. The nutrient data limitations do not support meaningful calculations of nutrient loadings.

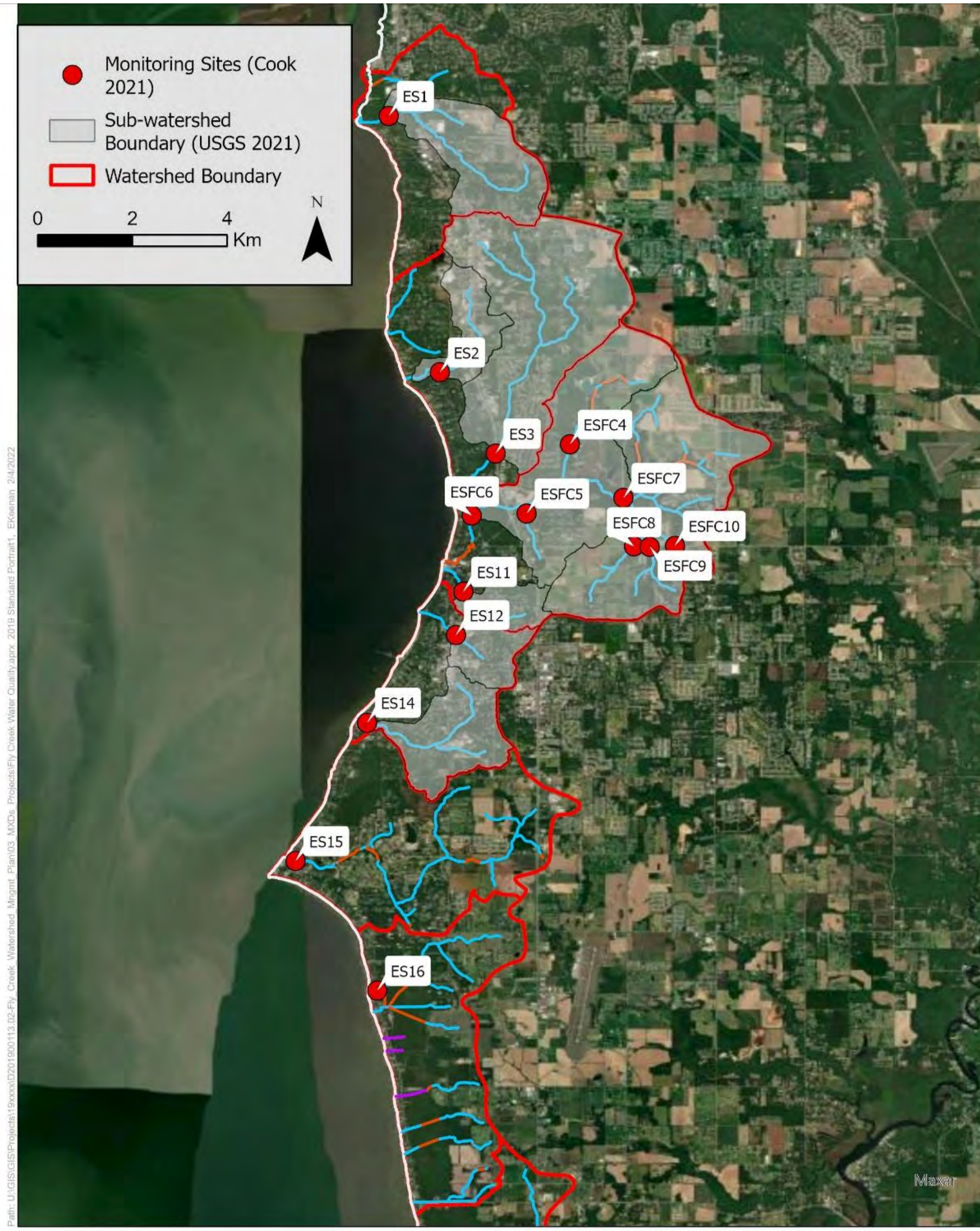

Figure 4.11 Eastern Shore Watershed Monitoring Stations with Respective Portions of Subwatershed Above the Sampling Site Delineated
Source: Cook 2021
**Note: Stations ES15 and ES16 are tidally influenced and not used for loading estimates.*

Table 4.7. Normalized Sediment Load for Monitored Eastern Shore Subwatersheds

Site	Total Sediment Load ($Tons/mi^2/yr$)*
Yancey Branch at Harbor Place	798
Red Gully at Bay Shore Drive	15,590
Rock Creek at US Hwy 98	4,644
UT to Fly Creek @ Headwater Road	76
UT to Fly Creek at Woodlands Drive	1,636
Fly Creek at Main Street	551
Fly Creek at Baldwin County Road 13	73
UT to Fly Creek at Alabama Hwy 104 (East)	185
UT to Fly Creek at Alabama Hwy 104 (Mid)	796
UT to Fly Creek at Alabama Hwy 104 (West)	230
Volanta Gully at Main Street	221
Big Mouth Gully at N Bancroft Street	813
Tatumville Gully at Scenic Hwy 98	5,581

Normalized estimated total sediment loads were greater than the 64 $tons/mi^2/yr$ Geologic Erosion Rate ("natural" erosion in the absence of human impact) in all of the Eastern Shore Subwatersheds (Cook 2021). The Eastern Shore monitoring sites with the greatest annual normalized sediment loadings (shaded cells) were Red Gully (15,590 $tons/mi^2/yr$), Tatumville Gully (5,581 $tons/mi^2/yr$), Rock Creek (4,644 $tons/mi^2/yr$), and the unnamed tributary to Fly Creek at Woodland Drive (1,636 $tons/mi^2/yr$) (Table 4.7; Figure 4.12). Consistent with Cook (2021), the monitored Subwatersheds with greater sediment loads corresponded with increased urban development. This is likely attributed to increased surface-water runoff that results in excessive stream discharges and increased erosion. Three of the four monitored subwatersheds (Red Gully, Tatumville Gully and Rock Creek) have estimated sediment loads greater than portions of other watersheds within Mobile and Baldwin Counties (Cook 2021).

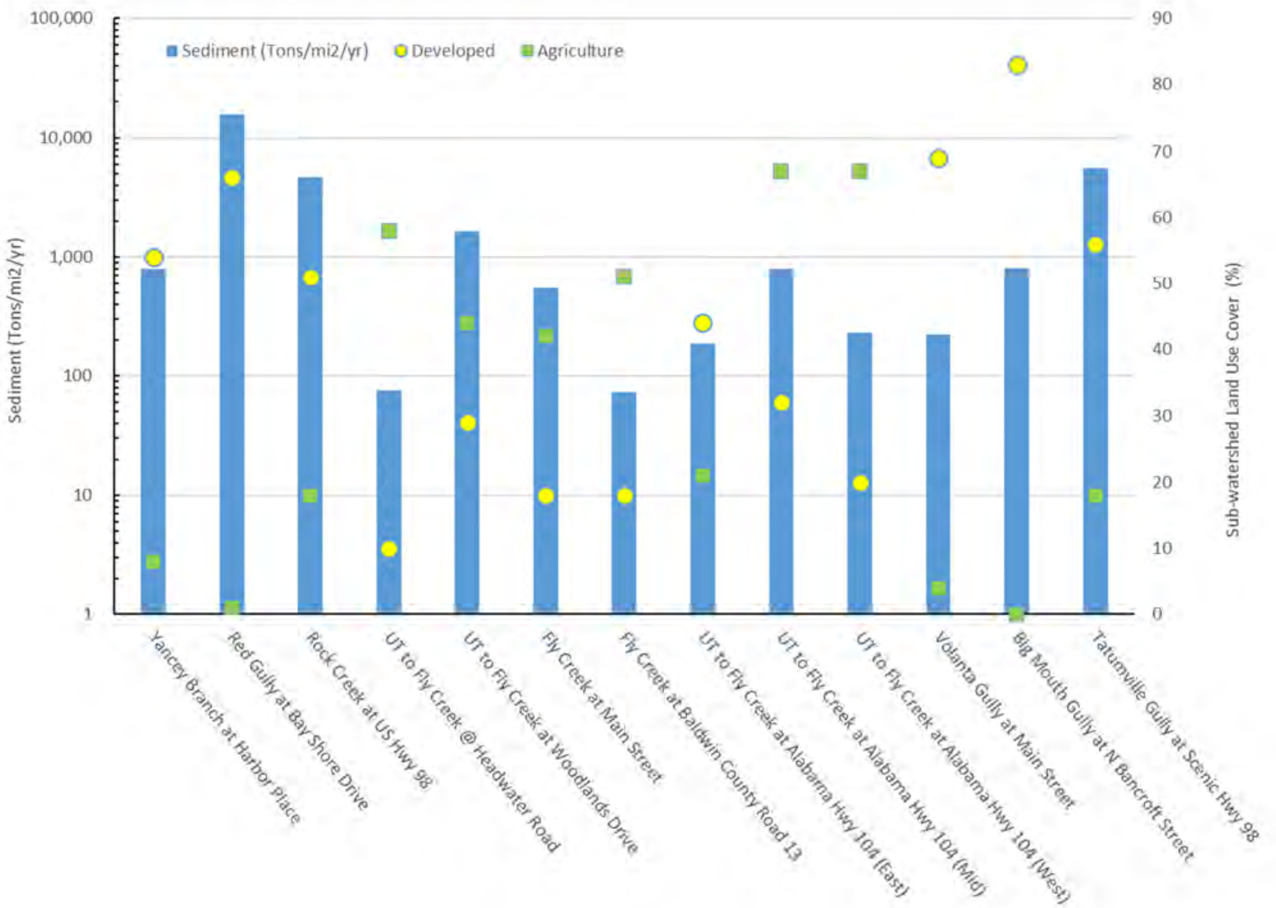

Figure 4.12 Normalized Estimated Total Sediment Loads and Percentage of Developed and Agriculture Land Use (2019) for Monitored Eastern Shore Watersheds
Source: modified from Cook 2021

Figure 4.17 displays a comparison of most recent (2019) major land use classifications compared to projected 2040 future land use. It should be noted that these projections only pertain to the watershed areas associated with the sample sites monitored in Cook (2021) and are not applicable to all Eastern Shore Subwatersheds, notably Bailey Creek / UT7 – UT11 and UT12. A substantial increase in development is anticipated in all of the monitored Eastern Shore Subwatersheds, with an average 34 percent increase projected resulting in a 29 percent reduction in natural-native land uses types. As noted above, land use has a direct impact on pollutant loads.

Due to the limited amount of nutrient data available for the Eastern Shore Watershed, an important need in the future is the necessity to establish a systematic field sampling of nitrogen and phosphorus data to enable a better understanding of the nutrient loading on the streams in this Watershed and downstream effects on Mobile Bay, as well as having sufficient nutrient data to develop nutrient loads for these streams (discussed further in Section 11.2. The implementation of best management practices to reduce sediment and nutrient loadings to Mobile Bay is recommended to prevent degradation of water quality within the Eastern Shore Watershed as well as the receiving water.

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Figure 4.13 Comparison of Existing (2019) and Projected (2040) Future Land Use Types in Select Eastern Shore Monitored Watersheds (top: developed, middle: agriculture, and bottom: natural).

4.4 Flora and Fauna

4.4.1 Introduction

Major environmental alterations of the Alabama coastal area have occurred historically, and continue as natural lands increasingly accommodate human uses. Coastal habitats are altered and fragmented by agriculture, forestry, and urban development. Ditching and drainage projects have changed the natural flood regime of many floodplains, swamps, marshes, and bogs. The direct effects of conversion from natural land occur at the project site and downstream through non-point source pollution, erosion and sedimentation, and altered biological habitat. Environmental degradation can be due to runoff containing elevated amounts of sediments, pesticides, fertilizers, and other pollutants. Disturbed and actively maintained areas are also highly susceptible to invasion by invasive exotic plants.

4.4.2 Watershed Land Cover

A condition assessment for natural communities in the Watershed relies primarily on a landscape scale assessment (Level 1). Level 1 assessment considers linkages among landscape components, such as land cover type and proximity to areas of ecological sensitivity, which have predictive capability regarding habitat quality at sub-watershed and site-specific levels. Landscape indicators that quantify the amount of and distance to land converted to human uses often explain variability in water chemistry parameters and habitat quality among watersheds.

A dominant feature of urbanization is an increase in the imperviousness of a watershed to precipitation due to hardening of land surfaces, leading to a decrease in infiltration and an increase in runoff. Impervious surface coverage correlates closely with the adverse environmental impacts of increased and polluted runoff. A generally accepted rule of thumb is that stream health begins to decline when 10% of the land in a watershed or subwatershed is impervious surface and becomes severely degraded when imperviousness exceeds 30% (McClintock and Cutforth, 2003). The spatial arrangement of land cover types may also play an important role in modulating adverse effects of land alteration on stream ecosystems (O'Neill *et al*., 1997; King *et al*., 2005). A detailed discussion of land use and impervious cover (historic, current, and projected) is presented in Chapter 3 of this report.

4.4.3 Riparian Buffer Condition

Land conversion and hydrologic alteration negatively affect the ecological quality of riparian buffers, wetlands, and stream habitats (Gergel *et al*., 2002; Tiner, 2004; Mack, 2007; Wang *et al*., 2008; Falcone *et al*., 2010; Rooney *et al*., 2012; Stapanian *et al*., 2018; Hanna *et al*., 2019). Undisturbed riparian zones and wetland buffers with natural vegetation help maintain highly diverse and functional aquatic communities while narrow and impaired buffers, such as those associated with roads, pasture, cropland, lawns, and impervious surfaces often result in poor biological conditions (Brown and Vivas, 2005).

Riparian buffer widths ranging from 10 to 656 ft (3 to 200 m) have been found to be effective at protecting streams, with an intact buffer of at least 50 ft (15 m) necessary under most conditions (Castelle *et al*., 1994). For riparian buffers in the Watershed, both 100-ft-wide (30.5-m-wide) and 50-ft-wide (15.3-m-wide) corridors bordering both sides of streams were analyzed, with wetland, water, and upland forest considered natural land cover.

Table 4.8 presents the percentage of natural riparian buffers for each Subwatershed. Figures D.1 through D.7 (Appendix D) present the condition of 100-ft riparian buffers for each Subwatershed according to natural and unnatural land cover.

The Jordan Brook-Yancey Branch Subwatershed has the greatest amount of natural riparian buffers in both the 100-ft and 50-ft stream corridors, at 78% and 81%, respectively, followed by Rock Creek-UT1-UT2-UT3 (74% and 75%), Fly Creek-UT4 (73% and 74%), and Bailey Creek-UT7-UT8-UT9- UT10-UT11 (71% and 72%) (Table 4.8). The Point Clear Creek (59% and 63%), UT5-UT6 (59% and 61%), and UT12 (58% and 58%) have the least amount of natural riparian corridor cover among the Subwatersheds. Overall, there is little difference in the proportion of natural land cover comparing the 100-ft and 50-ft riparian buffers.

The main stems of Yancey Branch, Rock Creek, and Fly Creek (Figure 4.18) have uninterrupted stretches of intact riparian buffers (See Figures D.1, D.2, and D.4), whereas other streams, such as Point Clear Creek (Figure D.5) have more urban land cover within the riparian corridor. In the Bailey Creek (Figure D.6) and UT12 (Figure D.7) Subwatersheds, riparian buffers are largely intact throughout their large wetland areas, with developed and agriculture lands making up a large percentage of the corridors through the adjacent uplands.

Table 4.8 Percentage of natural land cover in riparian corridors by Subwatershed.

Subwatershed	Natural[1] Land Cover	
	100-ft Buffer	50-ft Buffer
Jordan Brook-Yancey Branch	78%	81%
Rock Creek-UT1-UT2-UT3	74%	75%
Fly Creek-UT4	73%	74%
UT5-UT6	59%	61%
Point Clear Creek	59%	63%
Bailey Creek-UT7-UT8-UT9-UT10-UT11	71%	72%
UT12	58%	58%

[1]*Wetland, water, or forested upland*

Developed land makes up the largest riparian corridor percentage in UT5-UT6 at 36.4%, followed by Rock Creek-UT1-UT2-UT3 and Point Clear Creek at 23.6% each (Table 4.9). Bailey Creek-UT7-UT8-UT9-UT10-UT11 and Fly Creek-UT4 have the least amount of developed land in their corridors at 9.6% and 12.2%, respectively.

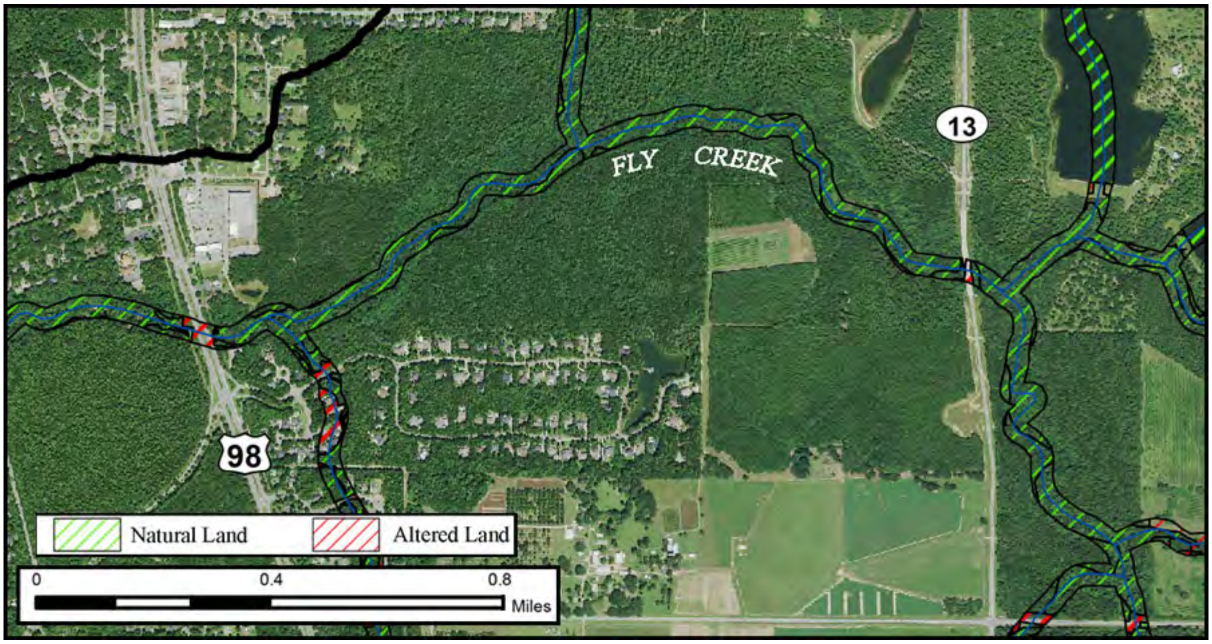

Figure 4.14 Forested wetlands and uplands comprise a natural 100-ft riparian buffer along much of the central portion of Fly Creek.

Other than developed areas, agricultural land makes up the largest proportion of riparian land cover in the Watershed as a whole. UT12 has the greatest percentage of agriculture within its total riparian area at 25.8%, followed by Point Clear Creek (16.7%), Bailey Creek-UT7-UT8-UT9-UT10-UT11 (14.4%), and Fly Creek-UT4 (14.3%) (Table 4.9). Agricultural land generally is located on the highest elevation portions of the Watershed, near the uppermost reaches of streams and their tributaries (Figure 4.19).

Table 4.9. Percentage of natural and altered land cover comprising 100-ft riparian buffers within each sub-watershed.

Subwatershed	Natural	Developed	Barren	Shrub	Grassland	Agriculture
Jordan Brook-Yancey Branch	78.2%	19.0%	1.0%	0.0%	0.0%	1.8%
Rock Creek-UT1-UT2-UT3	73.9%	23.6%	0.0%	0.7%	0.0%	1.8%
Fly Creek-UT4	72.5%	12.2%	0.0%	0.2%	0.8%	14.3%
UT5-UT6	59.5%	36.4%	2.4%	0.0%	0.0%	1.8%
Point Clear Creek	59.0%	23.6%	0.3%	0.0%	0.5%	16.7%
Bailey Creek-UT7-UT8-UT9-UT10-UT11	70.9%	9.6%	2.0%	0.9%	2.3%	14.4%
UT12	58.1%	15.1%	0.1%	0.0%	0.8%	25.8%

Cook (2021) found the largest nutrient concentrations for nitrogen (nitrate+nitrite) in the Fly Creek Subwatershed at sites ESFC5 (unnamed tributary to Fly Creek at Woodland Drive), ESFC6 (Fly Creek at Scenic US Highway 98), ESFC7 (Fly Creek at Baldwin Co Rd 13), and ESFC8 (unnamed tributary to Fly Creek at Alabama Highway 104) with concentrations of 1.10, 1.19, 0.96, and 0.71 mg/L, respectively. While nitrate+nitrite are elevated, sediment loads are not. This may be due to impoundments in the Fly Creek Subwatershed.

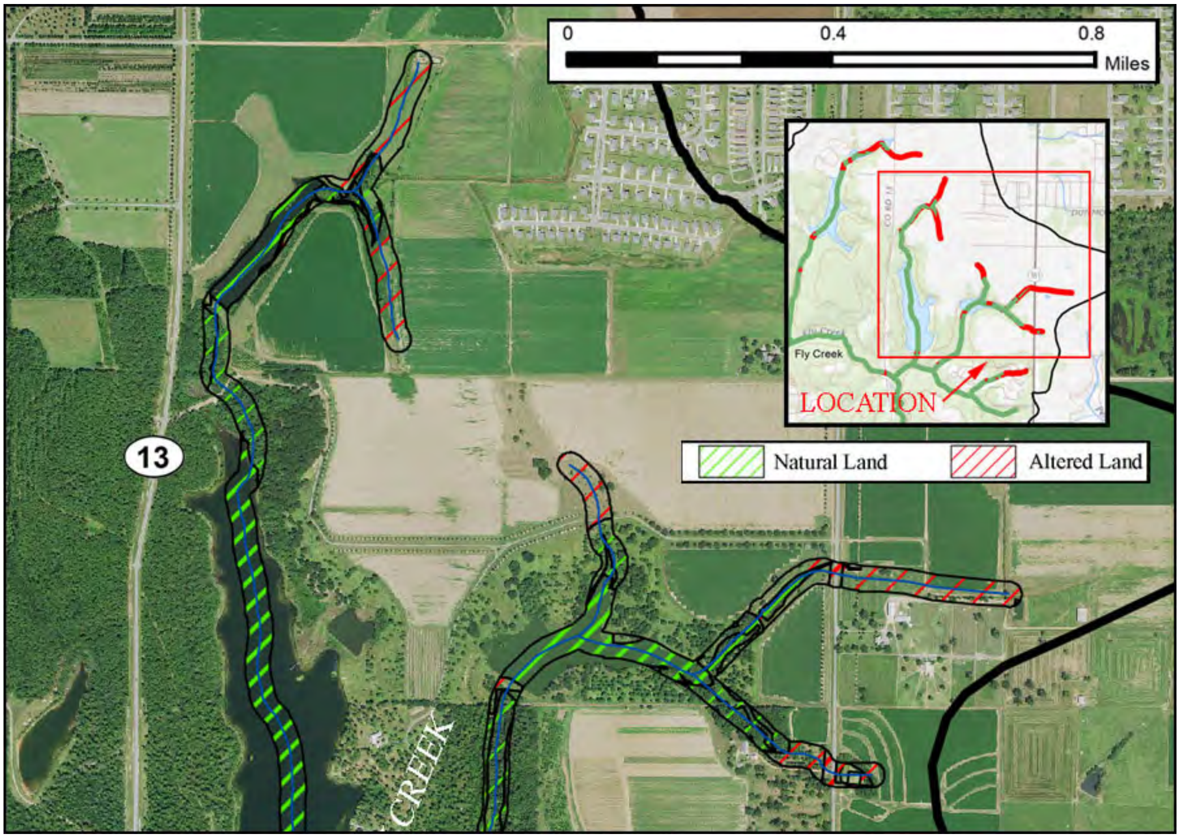

Figure 4.15 Riparian corridors in agricultural land along the upper reaches of Fly Creek.

4.4.4 Wetland Buffer Condition

A 300-ft wetland buffer, beginning at the upland-wetland boundary, is used by the U.S. Army Corps of Engineers, Mobile District as one part of the Wetland Rapid Assessment Procedure (WRAP) determination of the relative quality of wetlands. Specifically, land cover in adjacent upland buffers is used as an indicator of water treatment capacity prior to running off into the wetland system. Edge effects occur when development or land alteration encroaches on wetlands. Edge effects can extend for at least 300 feet, but decrease with distance, so preserving a wide buffer offers more protection to a wetland than a narrow one.

Stapanian *et al*. (2018) calibrated two different indices of wetland vegetation quality at 380 sites surrounding wetlands, including locations in the Alabama coastal area. Upland forest, followed by wetland, had the greatest overall positive effect on the quality indices, whereas agriculture had the greatest overall negative effect. For the purposes of this assessment, upland forest, wetland, and open water are considered natural land cover for 300-ft wetland buffers.

The Rock Creek and Fly Creek Subwatersheds have the greatest proportion of natural wetland buffers at 73.3% and 70.7%, respectively (Table 4.10). Wetland buffers in Point Clear Creek and UT12 Subwatersheds have the least amount of natural land at 37% and 42%, respectively. Relative to its overall land cover, UT12 has a low proportion of natural buffer due primarily to County Road 1 and bayfront homes located along the entirety of its western boundary.

Table 4.10 lists the percentages of land in natural and unnatural cover comprising wetland buffers. Figures E.1 through E.7 present the condition of 300-ft wetland buffers for each Subwatershed according to natural and unnatural landcover. Developed land makes up the largest wetland buffer percentage in UT5-UT6 at 47.0%, followed by UT12 (39.5%), Point Clear Creek (39.1%), and Jordan Brook-Yancey Branch (34.8%). Fly Creek-UT4 has the least amount of developed land in its wetland buffers at 14.6%. Point Clear Creek has the greatest percentage of agricultural land at 22.5% of its total wetland buffer area, followed by Bailey Creek-UT7-UT8-UT9-UT10-UT11 (18.5%) and Fly Creek-UT4 (13.3%).

Table 4.10 Percentage of natural and altered NLCD land cover comprising 300-ft wetland buffers.

Subwatershed	Natural	Developed	Barren	Shrub	Grassland	Agriculture
Jordan Brook-Yancey Branch	59.6%	34.8%	2.6%	0.3%	2.1%	0.6%
Rock Creek-UT1-UT2-UT3	73.3%	22.2%	0.3%	0.6%	0.4%	3.3%
Fly Creek-UT4	70.7%	14.6%	0.0%	0.6%	0.8%	13.3%
UT5-UT6	52.3%	47.0%	0.1%	0.0%	0.0%	0.6%
Point Clear Creek	31.9%	39.1%	0.5%	0.3%	1.0%	27.3%
Bailey Creek-UT7-UT8-UT9-UT10-UT11	54.2%	20.3%	2.3%	1.5%	3.2%	18.5%
UT12	41.9%	39.5%	9.7%	1.0%	2.2%	5.7%

Source: USGS 2020

Many of the wetlands in agriculture areas are Grady ponds, with production occurring right up to the pond edges. Grady ponds are not regulated under Section 404(b)(1) of the CWA as they are considered to be topographically isolated, lacking a surface connection to nearby wetlands or navigable waters. Nevertheless, they support wetland vegetation and serve as catchments for the local drainage area. Grady ponds also provide important habitat for several rare and protected species of conservation concern including southern dusky salamander (*Desmognathus auriculatus*), rusty blackbird (*Euphagus carolinus*), and wood stork (*Mycteria americana*).

Based on a visual inspection of 2019 aerial imagery, 74 of the 86 Grady soil polygons (86%) appear significantly altered through land conversion or development including those bisected by roads, cleared and converted to agricultural lands, deepened and sculpted for ponds, and filled for residential or commercial use.

The City of Fairhope has a requirement within its zoned locations to maintain a wetland buffer minimum of 30' for new developments, for both jurisdictional and non-jurisdictional wetlands. The City of Daphne also has a wetland buffer minimum requirement of 30'. Baldwin County subdivision regulations, including apartments, condominiums, and townhomes include a wetland buffer minimum of 30' within a Wetland Protection Overlay District, some of which covers a portion of the Watershed. While these required buffers help prevent even greater degradation of local wetlands, the urbanized condition in much of the Watershed, and continued development, will cause direct and indirect impacts to these resources in the future.

A strategy that protects and preserves natural lands, particularly priority habitats such as wetlands, streams, and riparian buffers, yields many important ecosystem benefits including improved water quality and wildlife habitat, and protection of biodiversity. There are protected conservation lands in the large areas of low, flat freshwater wetlands east of CR 1 and Scenic 98 south of Point Clear. State- and county-owned protected lands include tracts of primarily wetland habitat within the Weeks Bay Estuarine Research Reserve. The ADCNR State Lands Division and the Forever Wild Land Trust own parcels totaling 568 acres in the UT12 Subwatershed. The South Alabama Land Trust (SALT) also owns or holds protected land tracts and conservation easements within the Watershed. SALT parcels total nearly 400 acres, primarily in Bailey Creek-UT7-UT8-UT9-UT10-UT11 and UT12, including 72 acres of easements owned by the Weeks Bay Foundation.

4.4.5 Field Observations

Field observations were made in November 2020 and January 2021 at publicly accessible locations in the Watershed. The opportunistic observations found numerous degraded stream reaches and associated wetlands. Habitat degradation was typically due to siltation, sometimes with visible streambank erosion. At many locations significant erosion and headcutting have largely eliminated streambanks and beds, and the hydrology for wetland maintenance has apparently been eliminated. Degradation at these locations is mostly due to their proximity to the roads from which observations were made. Stream reaches and wetlands at locations more removed from the roadways are presumed to have generally better ecological quality, particularly where wetland and riparian buffers have natural land cover. However, locations with degraded conditions can in many cases adversely affect hydrologic, geomorphic, and natural community conditions downstream.

Information from field checkpoints, including locations where wetland and stream degradation were observed, are provided in Appendix F, including field notes and photographs at a select set of visited locations, and a corresponding map index. Figure 4.20 shows the locations of the field observation sites within the Eastern Shore Watershed. Conditions at some of these sites are described below.

At Pinehill Road in Daphne, the upper reach of drainageway leading to Jordan Brook has a heavily silted drain downstream of a culvert (Figure 4.21), leading to a silted bowl-like depression. At the time of the survey the depression held a large amount of trash. The upstream area on the opposite (north) side of the road is similarly degraded, also without a functional wetland. This riparian corridor has residential development bounding its north side and is just downstream from the southernmost portion of Lake Forest subdivision.

Figure 4.16 Flora and Fauna Field Observations Sites in the Eastern Shore Watershed

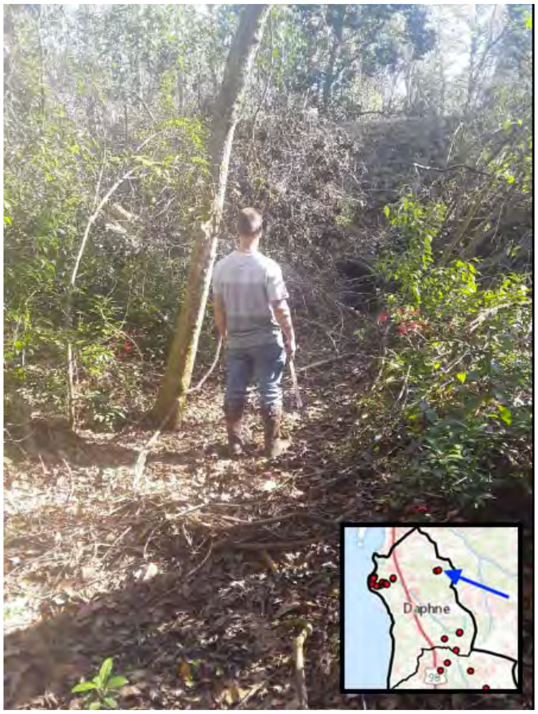

Figure 4.17 Heavily silted drainageway leading to Jordan Brook, west of Pinehill Road.

At Pollard Road near the headwaters of upper Rock Creek (Field Point 8, Appendix F) there are degraded conditions on both sides of the road. This location does not have jurisdictional wetlands. The rock-lined watercourse on the west side would be classified as an intermittent or ephemeral stream, but the watercourse is heavily scoured.

Figure 4.18 Heavily scoured drainageway at upper Rock Creek on the south side of CR 64

Figure 4.19 Highly incised watercourse with significant erosion and headcutting at a Fly Creek tributary on the north side of CR 104.

The upper reach of Rock Creek at Daphne Avenue (CR 64) has degraded conditions on both sides of the road. This location is a scoured wetland drain of low quality. Figure 4.22 shows the drain on the south side of the road. This riparian corridor has cleared areas on both the north and south sides of the roadway.

A Fly Creek tributary on the north side of CR 104 has a highly incised watercourse (Figure 4.23). There is significant erosion and headcutting at this location, which does not appear to have a discernable stream channel. There are no wetlands adjacent to the north side of the road. On the south side of the road there is also erosion and siltation and, as on the north side, a stream channel is not obvious. Degraded wetlands occur on the south side of the road.

The lower reach of UT4 is heavily silted in, with poor quality wetlands adjacent to the stream near Mobile Bay (Field Point 18, Appendix F). Upstream at North Section Avenue, UT4 has siltation and no wetlands along this reach of the stream (Field Points 21 and 22).

There is serious headcutting and erosion at the North Section Street crossing at UT5 (Field Point 23, Appendix F). Erosion is also an issue at the upstream portion of UT6 at Nichols Avenue (Field Point 25). Heavy siltation is apparent both along the rock-lined watercourse on the south side of the road and on the north side.

Where Point Clear Creek intersects Section Street just south of Battles Road there is a rock-lined culvert and headcut drain with an eroded watercourse (Figure 4.24). Upstream to the east, a rock berm blocks the creek channel at an impoundment a short distance from the Section Street culvert, within a large agricultural field. There are no wetlands in proximity to roadway crossing, or along most of an extended reach of this portion of the creek, including downstream of this location (See Figure F.5, Appendix F). The riparian corridor in this area of the Point Clear Subwatershed is primarily developed to the west and agricultural to the east.

South Section Street at the upper Bailey Creek crossing (Field Point 34) has a manmade pond on the west side of the road. To the east there is no stream or wetlands in the maintained open pasture.

Figure 4.20 Eroded watercourse with a headcutting drain along Point Clear Creek at Section Street.

4.4.6 Invasive Exotic Species

Non-native invasive and exotic plants are pervasive throughout the Watershed. While the most serious infestations occur in disturbed secondary woods closest to urban centers, many of the species are highly invasive and common invaders of natural communities. Appendix G provides a list of 60 exotic plant taxa considered to represent the most serious threats to the watershed's native biodiversity and its natural communities. These species should be included as targets for control/eradication measures in the development of future invasive species management plans.

Field surveys documented numerous exotic species at nearly every visited location. Camphor tree (*Camphora officinarum*), Chinese privet (*Ligustrum sinense*), and Japanese climbing fern (*Lygodium japonicum*) were documented at nearly all field locations. The ten most common exotic plant species occurring in wetlands are alligator weed (*Alternathera philoxeriodes*), torpedo grass (*Panicum repens*), Chinese tallow tree (*Triadica sebifera*), coral ardisia (*Ardisia crenata*), camphor tree, Chinese privet, Japanese honeysuckle (*Lonicera japonica*), Japanese climbing fern, pink wood sorrel (*Oxalis debilis*), Florida hedgenettle (*Stachys floridana*). Many of these are also abundant in uplands areas.

Cogon grass (*Imperata cylindrica*) is perhaps one of the most serious non-native species in uplands and threatens native longleaf pinelands, a rare natural community within the watershed. This species is also known to invade wetlands including pine savannas and pitcher plant bogs.

Coral ardisia is becoming a major problem in forested wetlands in the Watershed and control measures are greatly needed in several areas. For example, one area with a large infestation of coral ardisia is located on properties on both the north and south sides of Nichols Avenue in Fairhope, in undeveloped secondary woods. Heavy coverage was also observed along Fly Creek on the west side of Highway 98.

Chinese tallow tree has invaded many of the Grady ponds in the Watershed, completely replacing native trees such as swamp tupelo (*Nyssa biflora*) and red maple (*Acer rubrum*). Torpedo grass and alligatorweed are also a serious problem in these systems. Outside of the interior open water of Grady ponds, many additional non-native species can occur along the margins transitioning from wetlands to the adjacent uplands where drier conditions can support a wider variety of plants.

Sixteen species of naturalized non-native plants were identified from a forested wetland located directly north of the Fairhope Pier property. Among these were camphor tree, Japanese honeysuckle, pink wood sorrel, Florida hedgenettle, kudzu (*Pueraria montana*), Chinese tallow tree, Chinese privet, torpedograss, and alligatorweed.

At Village Point Park in Daphne, invasive exotic plants observed include camphor tree, Chinese privet, Japanese climbing fern, coral ardisia, torpedograss, pink wood sorrel, alligatorweed, and Florida hedgenettle. In the early to mid 1990s, approximately four acres of forested wetlands were impacted by excessive siltation originating in areas upstream of Village Point Park. Wetlands that have received heavy siltation are frequently invaded by pink wood sorrel and Florida hedge nettle. These two non-native herbaceous species appear to be aggressively invading into silted wetlands in the Watershed and could become future management issues.

4.5 Shoreline Assessment

A shoreline assessment was performed for the tidally-influenced portions of waterbodies within the Eastern Shore Watershed. This shoreline assessment provides a complement to the shoreline types discussion provided in Chapter 3 of this report, discussing the shoreline protection quantitatively based on information from the Geological Survey of Alabama (GSA) (Jones, Tidwell, and Darby 2009) report, followed by a shoreline change evaluation comparison utilizing aerial imagery from 1954/1955 with 2016 high-resolution imagery.

4.5.1 Shoreline Protection Classification

Eleven of the fourteen categories designated in the GSA report for Mobile Bay coastal waters were found within the Eastern Shore Watershed: Natural, Seawalls, Bulkheads, Breakwaters, Groins, Jetties, Beach Nourishment, Revetments, Rubble/Riprap, Sills, and Boat Ramps. Table 4.11 presents a summary of the various shoreline protection types for each of the seven Subwatersheds. Figure 4.25 shows a breakdown of the various types of shoreline protection for the Eastern Shore Watershed, with 65% of the shoreline consisting of man-made structural protection. Figure 4.26 shows the shows the GSA shoreline protection classification for the Eastern Shore Watershed.

Table 4.11 Shoreline Protection Type Lengths for Eastern Shore Subwatersheds

Subwatershed	Linear Feet
Jordan Brook-Yancey Branch	**17,273**
Boat Ramp	29
Bulkhead	2,624
Groin	165
Natural	13,888
Revetment	178
Rubble/Riprap	389

Subwatershed	Linear Feet
Rock Creek-UT1-UT2-UT3	**16,671**
Bulkhead	5,377
Groin	1,096
Natural	9,961
Rubble/Riprap	236
Fly Creek-UT4	**20,791**
Boat Ramp	16
Bulkhead	11,336
Jetty	500
Natural	8,762
Rubble/Riprap	177
UT5-UT6	**12,817**
Beach Nourishment	1,822
Boat Ramp	111
Bulkhead	4,523
Natural	5,743
Rubble/Riprap	40
Seawall	578
Point Clear Creek	**22,430**
Beach Nourishment	1,120
Bulkhead	11,793
Groin	1,363
Jetty	353
Natural	5,474
Revetment	194
Seawall	2,134
Bailey Creek-UT7-UT8-UT9-UT10-UT11	**20,288**
Bulkhead	18,464
Groin	1,072
Jetty	56
Rubble/Riprap	573
Seawall	122
UT12	**33,494**
Boat Ramp	78
Breakwater	102
Living Shoreline	216
Bulkhead	22,923
Groin	548
Jetty	111
Natural	6,735
Revetment	602
Rubble/Riprap	1,334
Seawall	305
Sill	540

Source: Jones, Tidwell, and Darby 2009

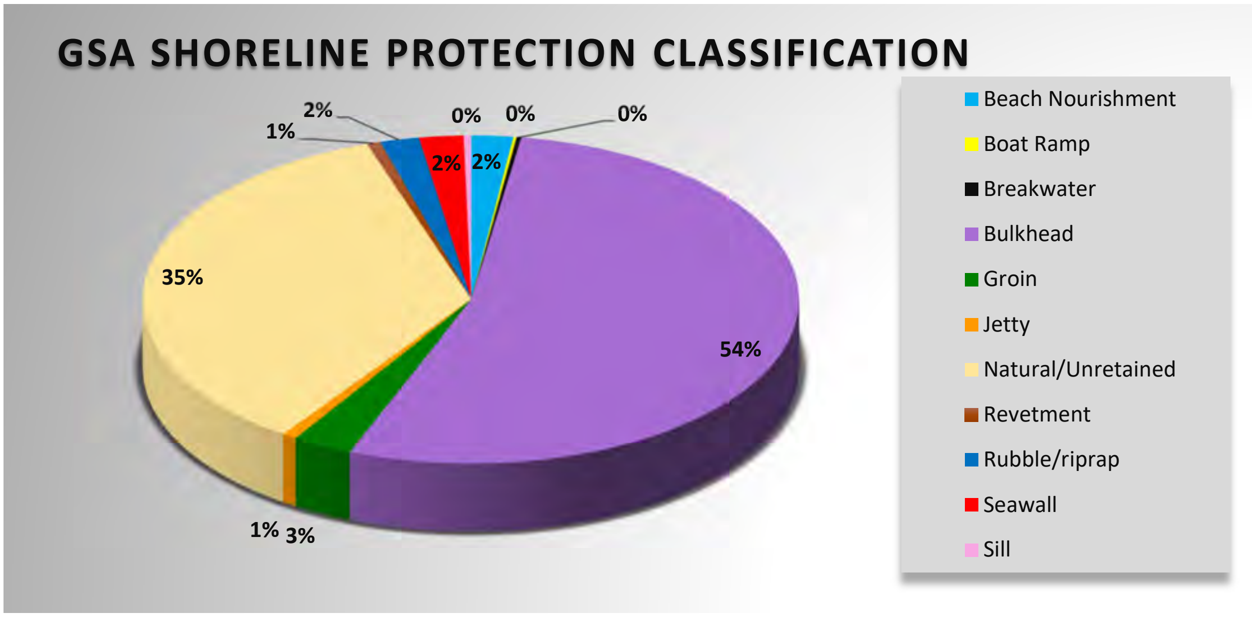

Figure 4.21 Eastern Shore Watershed Shoreline Protection Type Percentages
Source: Jones, Tidwell, and Darby 2009

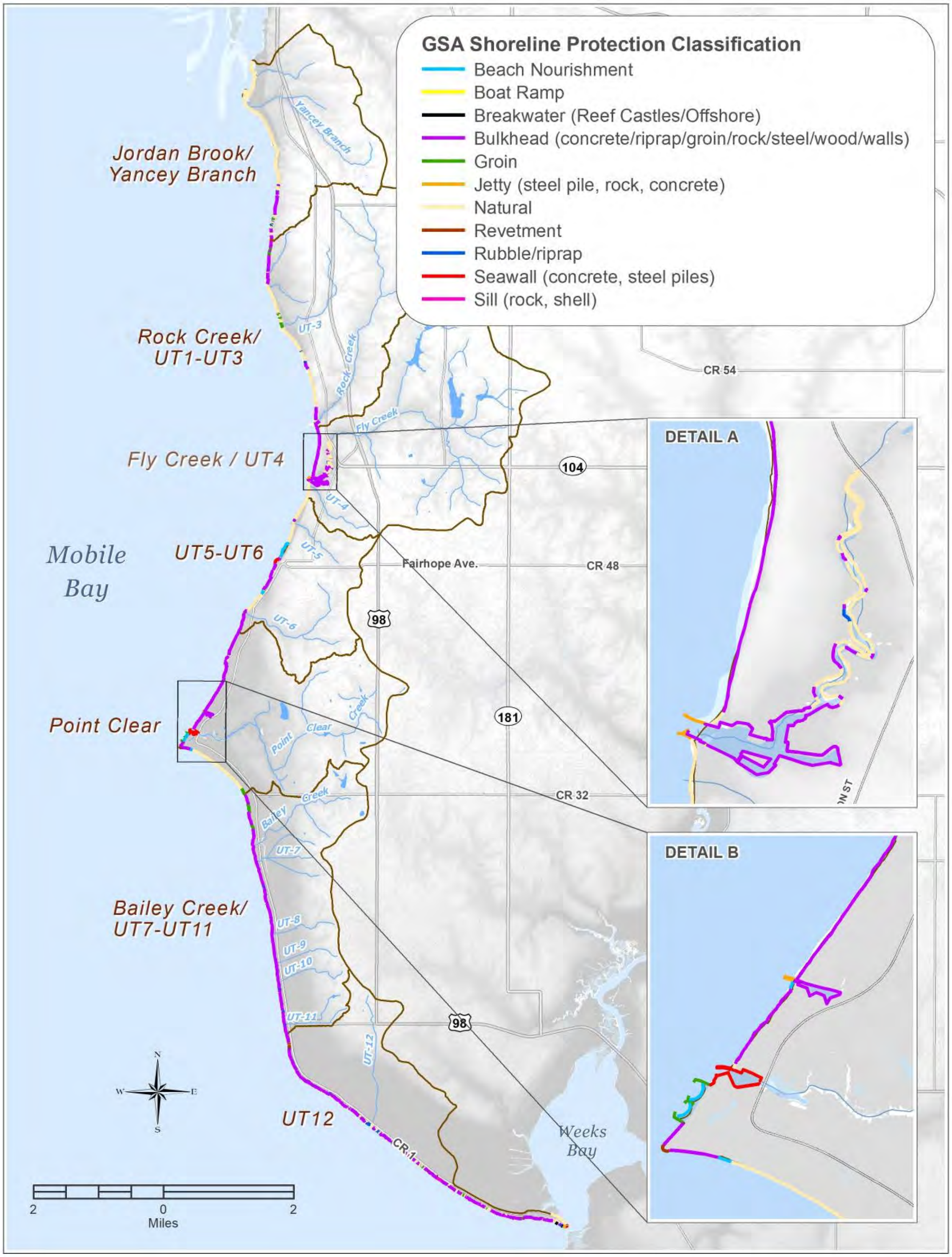

Figure 4.22 GSA Shoreline Protection Classification for Eastern Shore Watershed
Source: Jones, Tidwell, and Darby 2009

4.5.2 Shoreline Change Evaluation

A shoreline change evaluation was conducted along Mobile Bay by comparing 1954/1955 imagery with 2016 high-resolution imagery. The comparison focused on the northern portion of the Watershed to the lower reaches of Fly Creek and Point Clear Creek.

The 1955 imagery was obtained from the Baldwin County Natural Resources Conservation Service (NRCS) office in Bay Minette, Alabama in 2015 as hardcopy photograph tiles. These were scanned at high-resolution and georeferenced in order to analyze shoreline changes in a geographic information system (GIS) with current 2016 imagery. Two 1954 images for the Pelican Point and Point Clear areas were obtained from the USGS and georeferenced in the same manner. Figure 4.27 shows an overview of the notable areas of change found along the Watershed shoreline.

Figure 4.23 Shoreline Change Overview

Detail view of these areas, including site numbers, are shown in Figures 4.28 – 4.33, and are enumerated in Table 4.12 below. The majority of observed changes are man-made alterations consisting of shoreline and stream bank protection measures such as seawalls, bulkheads, and rip-rap. The most significant man-made alterations include excavation for marinas, jetties, and fill.

Table 4.12 Shoreline Change Overview

Site #	Location	Change	Notes
1	Bay Front Park/Village Point	Accretion	Accretion. Increased marshland
2	Bay Front Park/Village Point	Erosion	Peninsula Change - erosion and accretion. Noted stabilization with increased vegetation
3	Ragged Point	Erosion	Ragged Point Erosion. Beach loss to south and increased vegetation
4	Red Bluff	Erosion	Bank sloughing
5	Rock Creek Mouth	Man-made alterations	Stream bank reinforcement
6	Fly Creek Marina	Man-made alterations	Excavation, shoreline reinforcement
7	Fly Creek Marina	Man-made alterations	Excavation, shoreline reinforcement
8	Fly Creek Marina	Man-made alterations	Loss of peninsula, marina excavation
9	Fly Creek Marina	Stream Widening	Stream widening, shoreline reinforcements, loss of peninsula
10	Fly Creek	Man-made alterations	Shoreline reinforcement, excavation, possible fill
11	Fly Creek	Stream Width	Peninsula change, increased stream width
12	UT-5	Erosion	Big Mouth gully
13	Fairhope Pier	Man-made alterations	Shoreline reinforcement, fill for park round-about
14	Point Clear Marina	Man-made alterations	Excavation for marina
15	Grand Hotel Beach	Man-made alterations	Shoreline protection (jetties, bulkheads)
16	Private Marina	Man-made alterations	Shoreline alteration - excavation, reinforcement
17	Rock Creek	Man-made alterations	Stream width, marshes/wetlands
18	Pelican Point	Erosion	Erosion peninsula width, breakwater protection
19	Pelican Point	Man-made alterations	Shoreline reinforcement, boat ramp excavation

Site number locations are shown on Figures 4.31 – 4.36

Bay Front Park/ Village Point Figure 4.31 shows the Bay Front Park and Village Point areas in the Jordan Brook/Yancey Branch Subwatershed where erosion and accretion have taken place.
At location #1, the 1955 aerial depicts more transient sandy deposits/beaches along the shoreline. The shoreline associated with this location in 2016 does not appear to have the same sandy deposits and instead is dominated by marsh habitat. While there appears to be less beach habitat along the coast of the shoreline to the south of location 2, marsh habitat has increased along the shoreline to the north of the same location. It is difficult to place a value on beach versus marsh in these locations. However, it should

be noted that the historic trend away from beach habitat along the shoreline in general is liable to have had some sort of physical and/or ecological impact that is as of yet not fully understood. Both beach and marsh habitats possess the ability to attenuate destructive forces from storm surge and are susceptible to sediment budget considerations (Ganju, 2019).

Ragged Point/Red Bluff Figure 4.32 depicts erosion of sandy beaches near Ragged Point (#3). This could be attributed in part by decreased sediment due to diminished farmland practices and development upstream. The Red Bluff area of Montrose (roughly from Sibley Street south to Rock Creek) consists of steep slopes that have experienced large erosion problems. The location where this erosion is most visible and severe is shown as location 4, where a slope failure that is half a century old has enlarged to cover approximately half an acre. These steep slopes immediately south of this location have numerous erosion control and shoreline protection measures consisting of a combination of bulkheads, retaining walls, riprap, groins, and vegetation stabilization measures. The Rock Creek shoreline (location 5) also has shoreline reinforcement at its terminus into Mobile Bay with riprap and bulkhead protection.

Fly Creek Figure 4.33 displays the largest man-made alterations along the shore of the Fly Creek Watershed in the area known as Devils Hole. Areas of excavation and dredging of the marina, along with shoreline protections that include bulkheads, jetties, and riprap, are all generally represented by points 6, 7, 8, and 9 of the figure. Point 9 shows the loss of a peninsula with a possibly a man-made widened turning basin. Location 10 depicts shoreline protection with bulkhead. Location 11 shows stream widening and narrowing of the peninsula. Since 1955, the Fly Creek Marina has increased by 6.5 acres to its current size of 10 acres. While this is a very rough calculation (due to the 1955 imagery resolution and the accuracy of the georeferenced product) it is an indication of the amount of excavation and dredging that has taken place over time. The calculation includes areas upstream to the point of the peninsula by point #9.

Fairhope Pier Figure 4.34 shows some erosion changes at the mouth of UT-5 (location 12) and man-made shoreline reinforcements/fill for the Fairhope Pier where a pier has been since 1895. While less prominent, there is still a significant area of sand beach to the north of Fairhope Pier (location 13) that is part of the park and used recreationally by the community. To the south of the pier, beaches that were present in 1955 are strikingly absent. The absence of beaches in this area is due in large measure to the presence of shoreline hardening.

Point Clear Figure 4.35 displays all man-made alterations to the Bay shoreline as well as to Point Clear Creek. The 1954 imagery shows the area of the Grand Hotel reinforced by bulkheads and pocket beaches along its beaches and a marina (#14, #15). Changes to these areas include additional shoreline reinforcement with added bulkheads, jetties, and excavation of a larger marina. Point #16 shows added excavation and shoreline reinforcement of a private marina with jetties. Stream widening of Point Clear Creek east of Scenic Highway 98 shows how the development of the Lakewood Golf Club changed the area from wooded to grassland, adding some wetland habitat along the mouth of the Creek where it drains into the marina.

Pelican Point Figure 4.36 displays loss of beaches at location 18 where breakwater protection was installed in 2013 by The Nature Conservancy. Man-made alterations to the shoreline due to the development of the boat launch include excavation and bulkheads/riprap for shoreline protection.

Figure 4.24 Bay Front Park/Village Point Historical Comparison

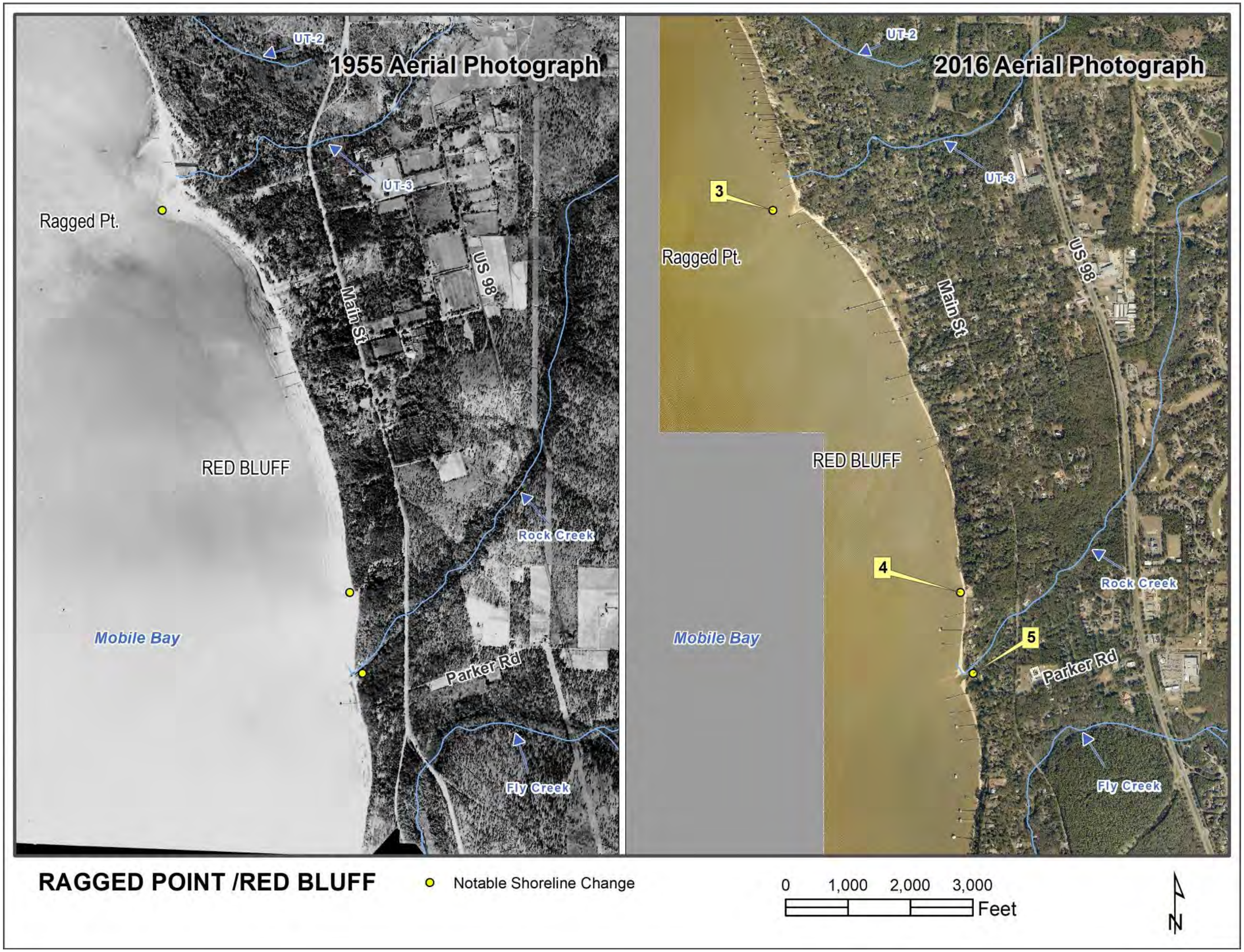

Figure 4.25 Ragged Point/Red Bluff Historical Comparison

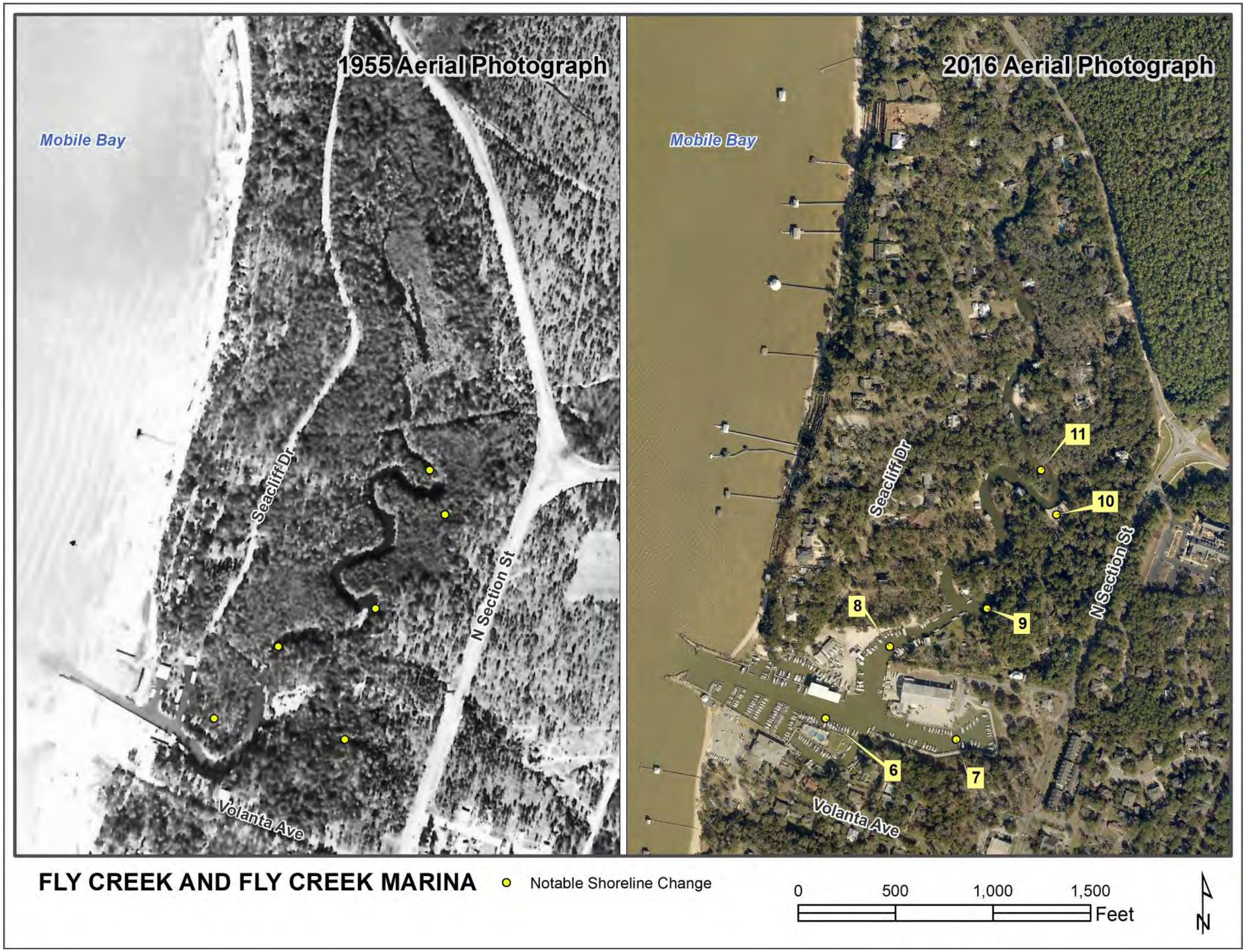

Figure 4.26 Fly Creek and Fly Creek Marina Historical Comparison

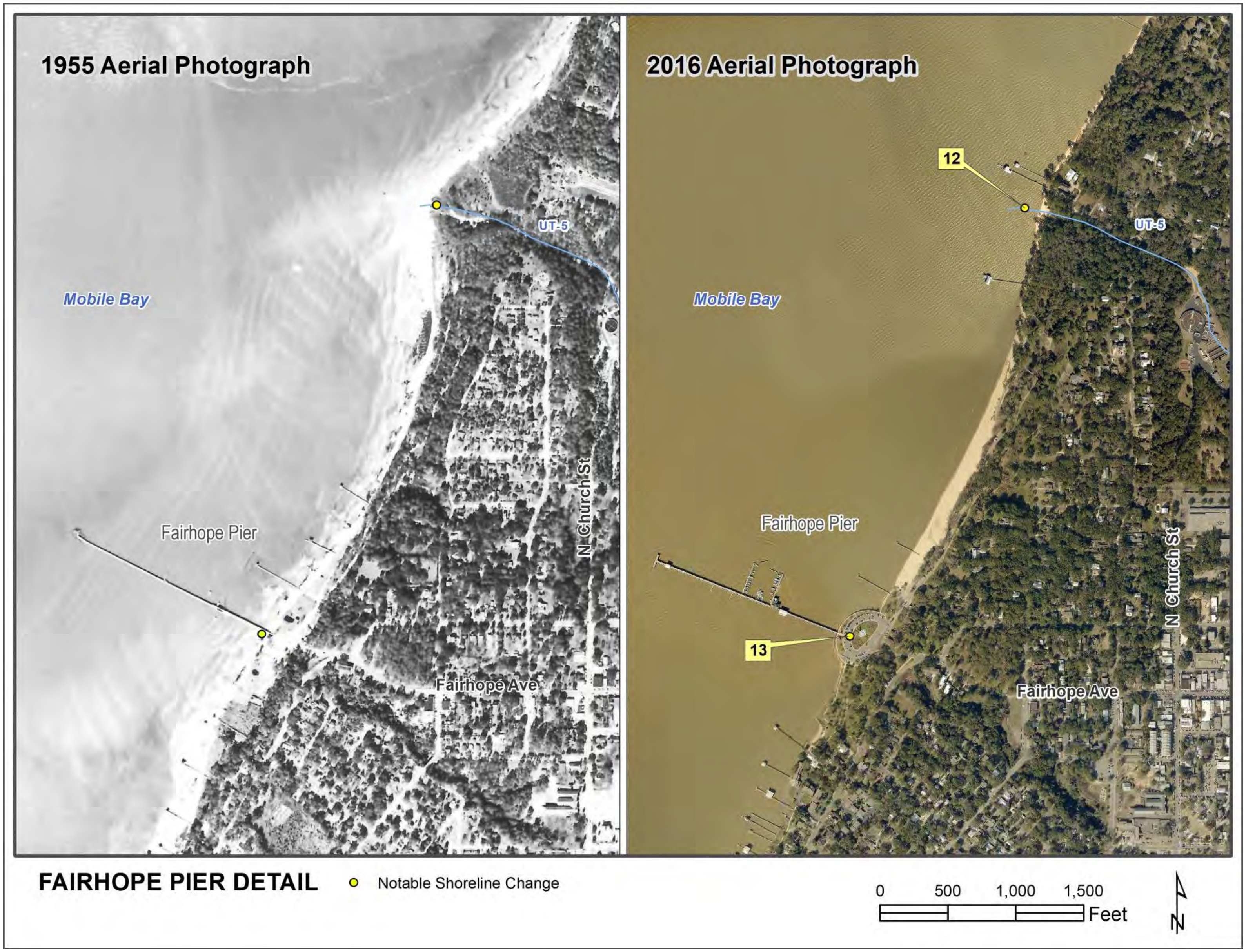

Figure 4.27 Fairhope Pier Historical Comparison

Figure 4.28 Point Clear Historical Comparison

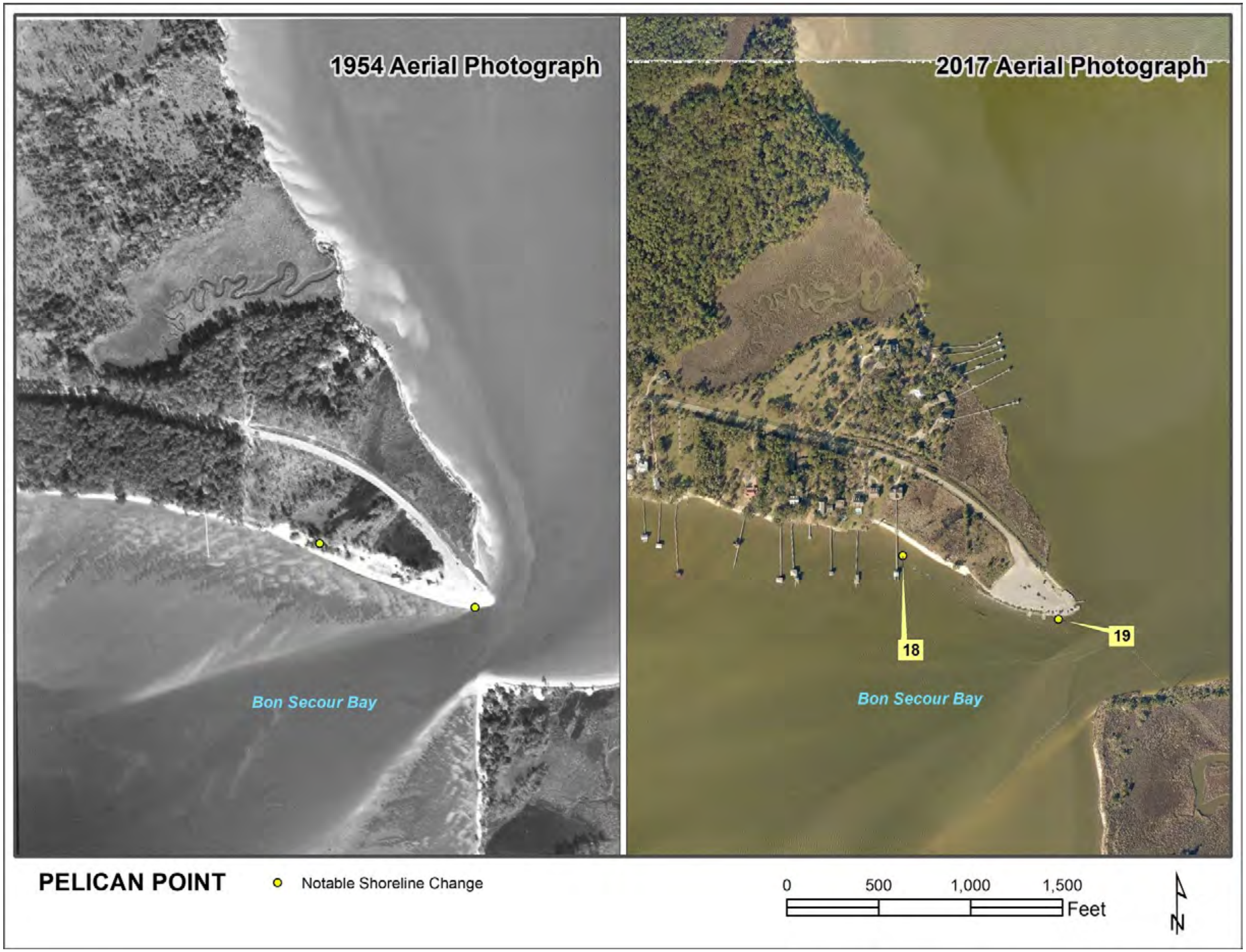

Figure 4.29 Pelican Point Historical Comparison

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5.0 Climate Vulnerability

Human emissions of carbon dioxide and other greenhouse gas (GHG) emissions are important drivers of global climate change. GHGs trap heat in the atmosphere, resulting in warming over time. This atmospheric warming leads to other changes in the earth systems, including changing patterns of rainfall and snow, melting of glaciers and ice, and warming of oceans. Climate change is projected to cause an increase in temperatures, a permanent rise in ocean water levels, and changes in weather patterns. Rising sea-levels may present increased physical risks to the Eastern Shore watershed, including shoreline erosion and degradation, decreased beach widths, amplified storm surges, and inundation of coastal areas.

This chapter provides an overview of climate hazards and the Eastern Shore Watershed's vulnerability to each. Additionally, further analysis and discussion of the potential effects of sea-level rise is presented in section 5.2.

A community's vulnerability depends on its potential exposure to hazards and the consequences of that exposure (higher exposure or consequences results in higher vulnerability), the sensitivity of the asset (higher sensitivity results in higher vulnerability), and the adaptive capacity of the asset (lower adaptive capacity results in higher vulnerability).

Exposure to hazard and the consequences are evaluated based on the type of hazard a community would potentially be subject to under future conditions and the timing at which this hazard is expected to potentially occur. An example of low consequence would be infrequent storm flooding of a parking lot. An example of high consequence would be tidal inundation of an emergency response facility or hospital.

Sensitivity to hazard is defined as a community's level of impairment during a hazard. Highly sensitive assets would lose their primary function if exposed to any degree of flood or heat whatsoever. Assets with low sensitivity would not be majorly impacted by the hazard.

Adaptive Capacity is the community's ability to change and respond to a hazard. Low adaptive capacity communities would take a long time to be operational, once impacted. High adaptive capacity communities would bounce back more quickly.

5.1 Climate Hazards

This section provides an overview of the potential effects of climate change and the hazards that could affect the Eastern Shore Watershed.

5.1.1 Temperature Rise and Extreme Heat Days

Annual average temperatures in the United States have increased by 1.2°F (0.7℃) over the last few decades. Relative to the beginning of the 1900s, temperatures have increased by 1.8°F (1℃). Over the next few decades, the annual average temperature is expected to increase 2.5°F (1.4℃) above average temperatures for the period 1901-1960 regardless of future emissions. By the end of the century, increases ranging from 3°F to 12°F (1.6℃ − 6.6℃) are expected depending on how the world acts to reduce emissions according to the United States Global Change Research Program (USGCRP, 2018).

The Southeast Region of the United States is one of the few regions in the world that has experienced little overall warming since 1900. However, since the 1960s, the Southeast has been warming at a similar rate as the rest of the United States. This is causing warmer winters and more hot days during the summer (MBNEP 2017).

Alabama currently experiences about 15 extreme heat days per year, which are defined as days with temperatures above 95°F. By 2090, the state is expected to experience up to 30 to 60 days per year with extreme heat (EPA 2016). Figure 5.1 shows how the number of warm nights with temperatures above 75˚F have increased since the 1970s, while Figure 5.2 shows how the number of warm nights are expected to increase with climate change.

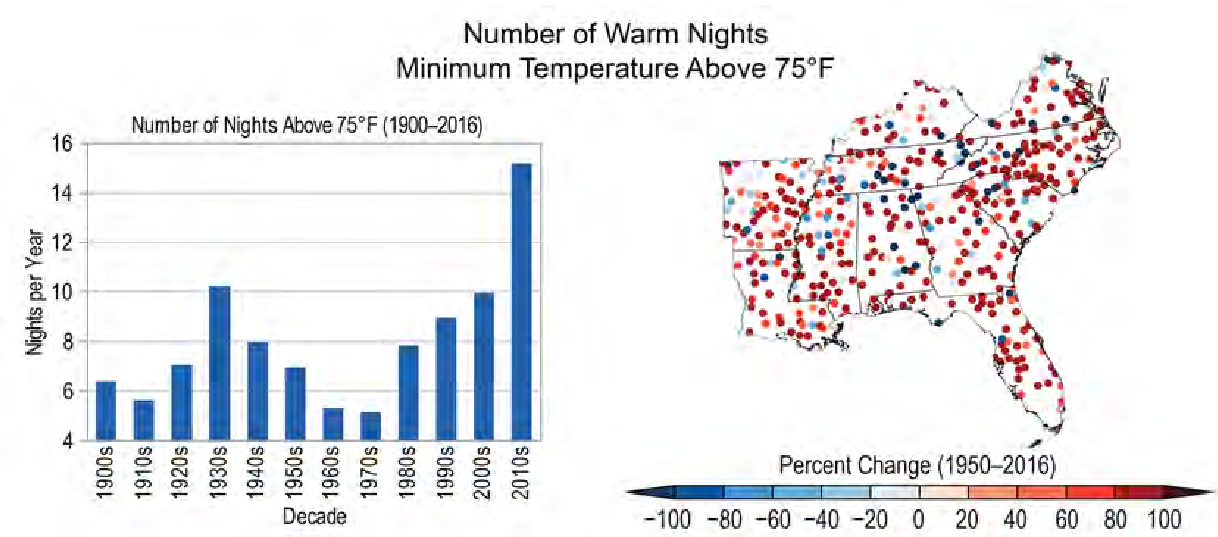

Figure 5.1 Historic Number of Nights Above 75˚F
Source: USGCRP, 2018

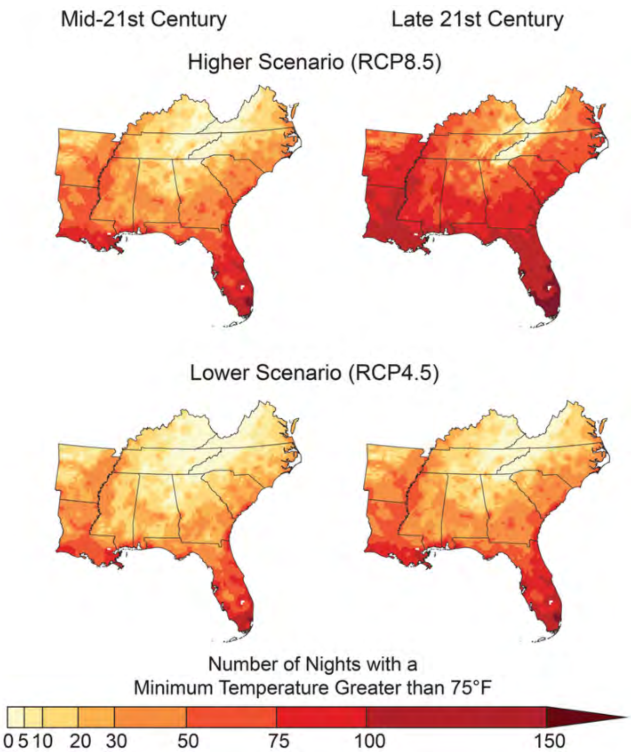

Figure 5.2 Projected Number of Nights Above 75˚F with Climate Change
Source: USGCRP, 2018

For the most vulnerable populations such as homeless, low-income residents, chronically ill, and linguistically isolated groups an increase in extreme heat days can be dangerous, leading to serious illness or even death. In turn, this places additional stress on emergency services and health care systems. Extreme heat events can also strain the electrical grid and result in power outages, creating particularly dangerous conditions for individuals who rely on electricity for medical devices, air conditioning, or fans and increasing costs to cool homes. The "Higher Scenario (RCP8.5)" is a higher emission (or business as usual) scenario where emissions continue to rise, along with population growth through 2050 and plateau around 2100. The "Lower Scenario (RCP4.5)" is a lower-emissions scenario where emissions peak around mid-century then decline

5.1.2 Sea-Level Rise

The global sea level has risen by about 7-8 inches since 1900. It is projected to rise another 1-4 feet by the end of the century. By 2100, a rise exceeding 8 feet is physically possible due to higher scenarios such as the Antarctic ice sheet stability (USGCRP, 2018). However, some areas, such as Mobile Bay (including along the eastern shore of Mobile Bay), have seen greater amounts of relative sea-level rise due to subsidence of the land. Sea levels at the Dauphin Island tide gage, which is the closest NOAA tide gauge with historic data to the Eastern Shore Watershed, are estimated to have increased by 1.35 feet in the last 100 years as shown in Figure 5.3 (NOAA Tides and Currents Station #8735180). However, the rate of sea-level rise is expected to increase over time due to the effects of climate change and global warming (Figure 5.4).

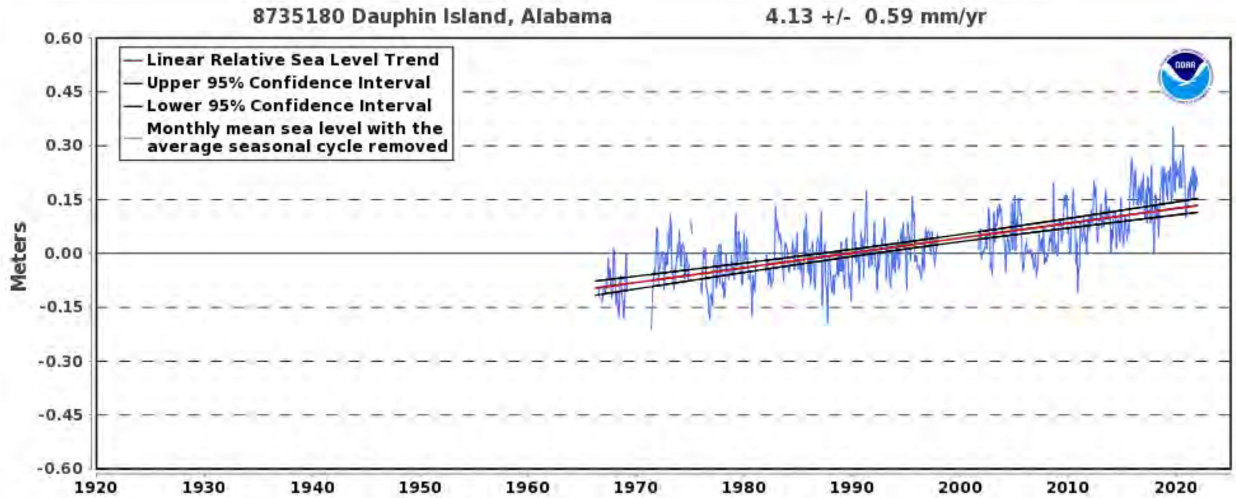

Figure 5.3 Relative Sea Level Trend at Dauphin Island Tide Gage (NOAA Tides and Currents)

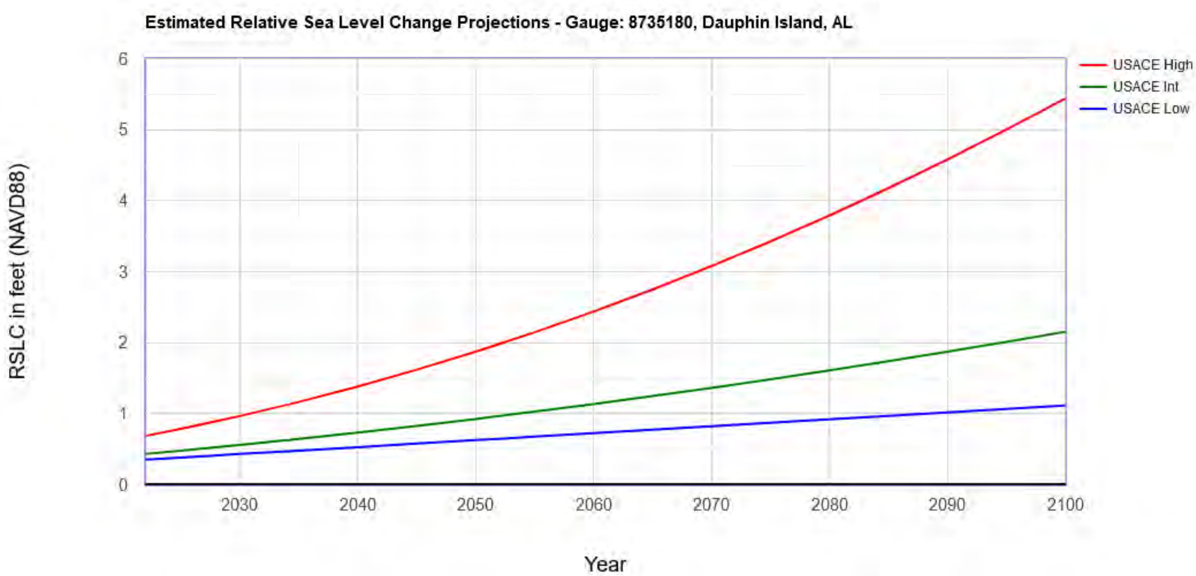

Figure 5.4 Relative Sea Level Change (RSLC) at Dauphin Island Tide Gage
Source: USACE Sea-Level Change Curve Calculator

Sea-level rise not only increases typical tidal water levels, but it also raises storm water levels (Figure 5.5). The flood extent due to storm surge and waves is made worse by sea-level rise and flooding can occur further inland. Additionally, higher sea levels combined with riverine flooding or water coming from a stormwater outfall can increase flooding by backing up water into the channel or pipe such as the pipes shown in Figure 5.6. Higher water levels can increase saltwater infiltration into groundwater aquifers, which may impact the water system. Sea-level rise is also expected to impact natural resources through inundation and drowning of marsh habitats and other important riparian systems, loss of inhabitable uplands, increased stress of less resilient species of plants and animals, and increased salinity in freshwater surface waters. These impacts are discussed in more detail in Chapters 6, 7, and 8.

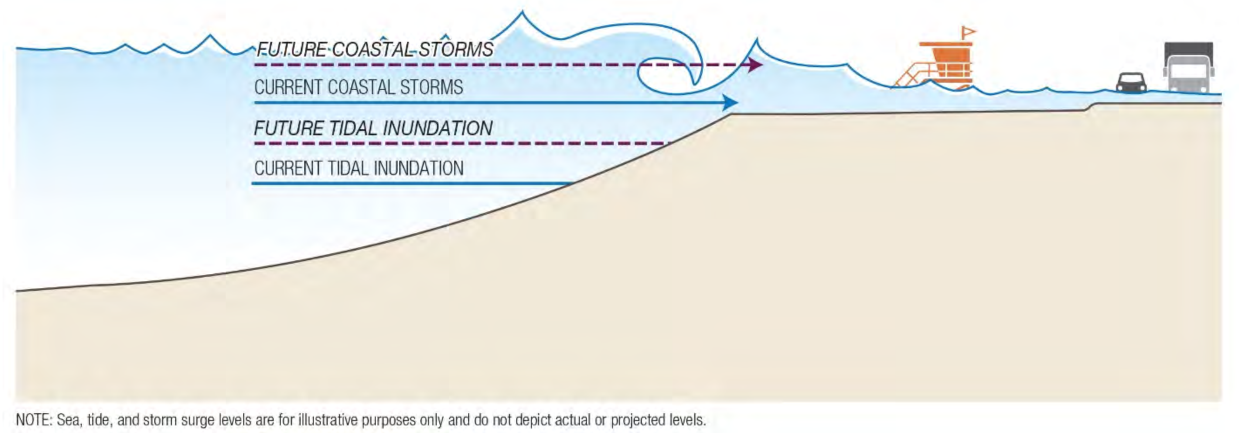

Figure 5.5 Conceptual Shoreline Cross-Section Showing Tidal Inundation and Storm Surge Flood Hazards

Figure 5.6 Example of Storm Drain that Could be Impacted by High Tail Waters

5.1.3 Changes in Weather Patterns and Occurrence of Extreme Weather

Across the nation, there have been changes in some types of extreme weather events over the last several decades. Whether it is an increase in the duration of droughts in the Western States, or an increase in heavy precipitation in most of the United States, it is causing significant changes. In general, heat waves have become more frequent and intense across the nation, while cold waves have become less frequent and less intense.

5.1.3.1 Longer and More Severe Droughts

In an index by States at Risk (SAR, 2015), it was noted that Alabama's severity of widespread summer drought is average and ranks below half of the 36 states assessed for drought (SAR Index). However, with climate change, drought conditions are expected to become more common and could impact the energy supply and forest productivity, or cause crop failures. According to the Regional Multi-Jurisdictional Hazard Mitigation Plan (RHMP), the probability of an impactful drought in Baldwin County is classified as low. Southern Alabama experiences more high, subtropical temperatures that lead to more common droughts.

More droughts could reduce forest productivity and cause an increase in the damage from insects and diseases. For the region's forests, toppled trees and widespread plant mortality can create conditions that support the spread of large and destructive wildfires (Baldwin County EMA 2016). Large wildfires often require a coordinated regional response to protect property and human health and safety. Rural volunteer fire departments with limited resources often cannot handle firefighting demands when multiple fires break out. Most wildfires in Baldwin County are caused by lightning strikes, after hurricane activity, or unpermitted burns (Baldwin County EMA 2016). Additionally, droughts can lead to recreation and navigation issues along main rivers and streams.

5.1.3.2 Hurricanes

Eastern Shore residents have endured many severe storms throughout history (see Figure 5.7) and the 2020 hurricane season impacted local communities with Hurricane Sally making landfall nearby in Gulf Shores. This storm made landfall in the same place and on the same day (September 16) as Hurricane Ivan did 16 years earlier in 2004. Some of Sally's impacts can be attributed to its slow speed – sometimes only moving 2-3 miles per hours which brought sustained winds and dumped extensive amounts of rain across the Eastern Shore Watershed. Many communities lost power for an extended time and suffered extensive and widespread damage. With 2020 being an extremely active hurricane season with a record-breaking 30 named storms and 11 landfalling storms (NOAA 2021) in the continental United States, residents of the Eastern Shore Watershed were still recovering from Hurricane Sally when Zeta arrived in the area. The two storms combined are reported to have caused billions of dollars in damages to Alabama.

Figure 5.7 Gulf Coast Hurricane Strikes Between 1950 and 2021
Source: NOAA 2022

The intensity, frequency, and duration of North Atlantic hurricanes, as well as the frequency of the strongest (Categories 4 and 5) hurricanes, have all increased since the early 1980s. As shown in Figure 5.8, the Mobile Bay area can expect a hurricane to make landfall approximately every 10 years and a major hurricane (winds 111 mph or higher) to make landfall approximately every 28 years. By the late twenty-first century, scientists have projected an increase in the frequency of the strongest (Categories 4 and 5) hurricanes. For example, data collected during the 2017 Atlantic hurricane season showed two aspects as to why the warming climate is the cause of the severity of the storms: ability to rapidly reach and maintain very high intensity, and the intensity of the precipitation. Examples of the specific hurricanes demonstrating the effects of a warming climate are Hurricane Harvey, Irma, Jose, and Maria in 2017. All reached intense precipitation and maintained very high intensity. Therefore, Hurricane-associated storm intensity and rainfall rates are projected to increase as the climate continues to warm. (USGCRP, 2018).

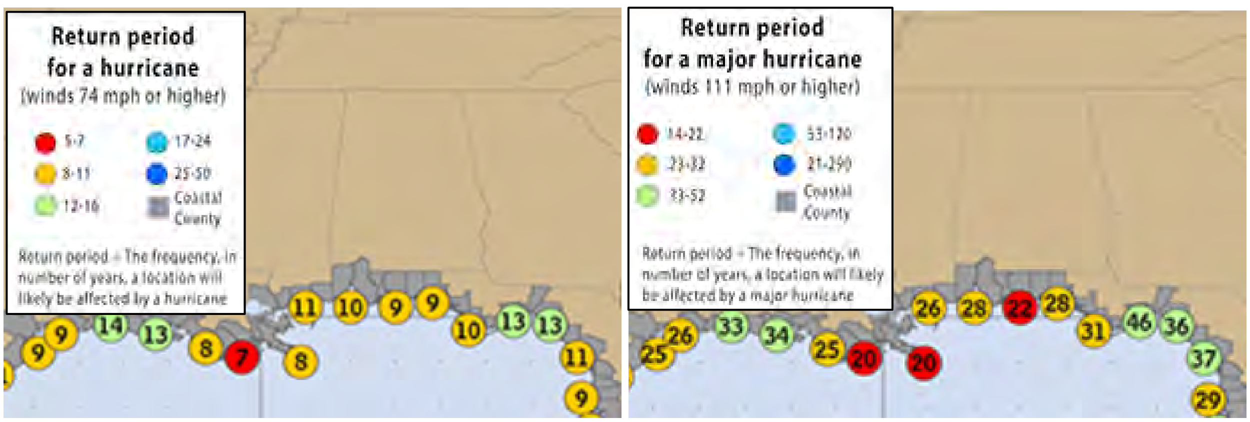

Figure 5.8 Return Periods for Minor and Major Hurricanes
Source: NOAA 2018

5.1.3.3 Severe Storms

Winter storms have increased in frequency and intensity since the 1950s, and their tracks have shifted northward over the United States. Other trends in severe storms, including the intensity and frequency of coastal waves, tornadoes, hail, and damaging thunderstorm winds, are uncertain and are being studied intensively. Modeling has been conducted to analyze the connection of these storms with climate change, however, the confidence in the model projections is low. (USGCRP, 2018).

5.1.3.4 Extreme Precipitation Events/Flooding

In the coming decades, winter storms are expected to become less frequent but more intense when they do arrive. Flash flooding events are expected to increase in frequency and intensity (RHMP). The "atmospheric river" phenomenon, where massive streams of moisture deliver intense precipitation over several days, can result in damaging floods. These events are expected to exacerbate flooding along the western boundary of the Eastern Shore Watershed and in low-lying areas.

The Eastern Shore already experiences extreme precipitation, with Mobile often ranked as the rainiest city in the U.S. (World Population Review 2022). On April 28-30, 2014, a historic flash flood event dropped over 20 inches of rain in Baldwin County over a 2-day period, with one-hour rainfall totals reaching 5.68 inches. This represented between a 200- and 500-year event. Figure 5.9 shows the radar image depicting total rainfall over the storm.

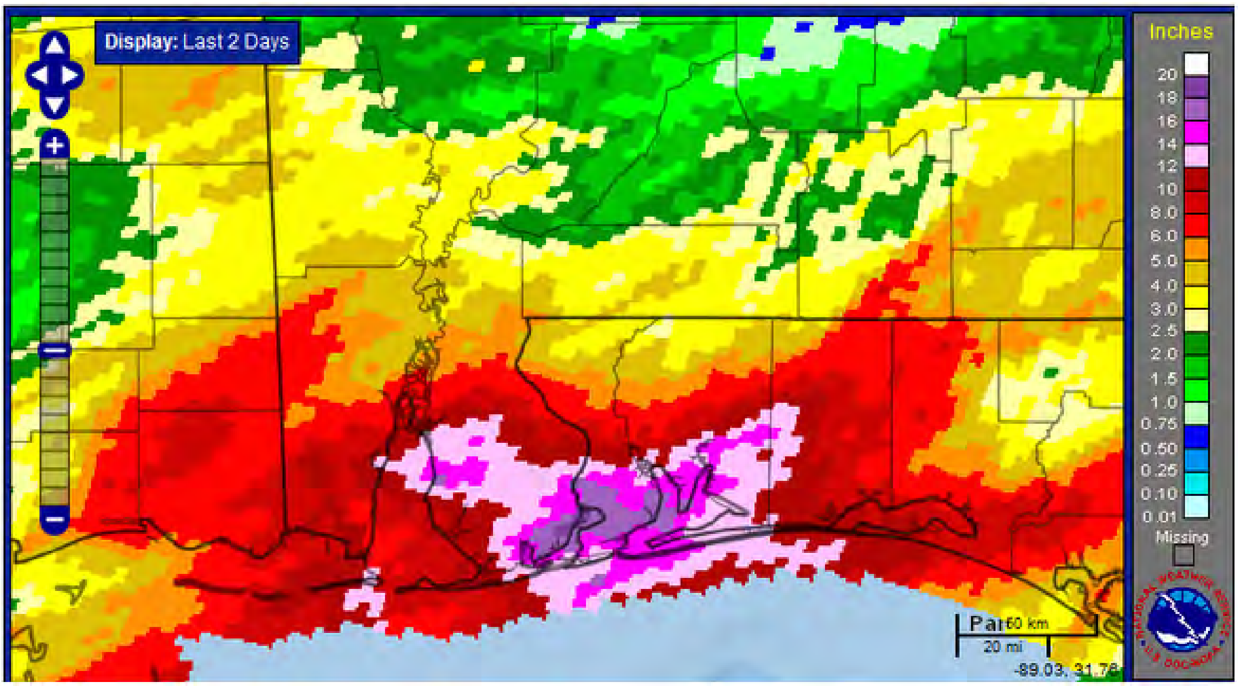

Figure 5.9 Radar Showing Inches of Rainfall during April 28-30, 2014 Flash Flood Event
Source: National Weather Service

An increase in the number of flood events will impact homes and businesses in low-lying areas resulting in property damage, injuries, and displacement. Vulnerable populations such as homeless individuals, low-income households, or people living in poor quality housing will face greater impacts of flooding as they have a reduced ability to respond to damage from flood events Additionally, linguistically isolated households and households without access to transportation will face additional difficulties in the event of evacuations. Flooding may also impact emergency response facilities and other critical infrastructure that is below grade and can temporarily interrupt key access roads for emergency responders or evacuation routes.

5.1.3.5 Increased Air Pollution

Poor air quality negatively impacts human health through allergens and by causing respiratory diseases. Air pollution from the Southeast is largely from vehicle and power plant emissions, as well as wildfires and allergens. In the Southeast region, a warmer climate signifies more days with stagnant air masses, higher levels of fine particulate matter ($PM_{2.5}$), and higher ozone concentrations. Although, the levels of precipitation and wind trajectories are increasing, warmer weather is still projected to result in increased periods of ozone exposure.

5.2 Climate Vulnerability

5.2.1 Infrastructure and Land Loss

The City of Fairhope conducted a Community Resilience Index Report, that assessed how prepared the City is in regard to coastal hazards and climate change. The report analyzed the following critical infrastructure and facilities:

- Wastewater treatment system – new sewage treatment plant is within the floodplain, certain neighborhoods flood during heavy rain events.
- Power grid – dependent on number of downed trees and broken poles; power grid relies on the distribution point located under the causeway, which may be vulnerable.
- Water treatment system – some vulnerability in distribution, but system is groundwater-sourced, so more resilient.
- Transportation and evacuation routes – identified opportunity to share pet shelter availability to encourage residents to evacuate during major events; need better communication on evacuation options for vulnerable populations.
- City hall, police station, fire station – one fire station is adjacent to floodplain but other facilities are at higher elevations; facilities may not be prepared for wind damage or up to code.
- Communications – risk of losing cell distribution towers during high wind events.
- Hospital – facility may not be prepared for wind damage beyond the 1997 standards of 90 mph winds.
- Critical record storage – currently, no plans to address this; identified opportunity to have interns scan important records.

Regional-scale evaluations of infrastructure risk under future sea-level rise scenarios have also been developed for the wider Mobile Bay area. The US Army Corps of Engineers (USACE) modeled structural damage by census tract under current and future sea-level rise scenarios for Mobile and Baldwin Counties, as part of the Alabama Coastal Comprehensive Plan (ACCP), which was commissioned by the State of Alabama's Department of Conservation and Natural Resources. The USACE led and completed the ACCP study through 2015. As part of the ACCP, an online web tool (Storyboard) was created so that stakeholders could view storm surge scenarios, structure risk, and habitat and climate resiliency assessment outcomes for their areas of interest. The model results show structural damages for the 10-year, 50-year, and 100-year extreme event under existing conditions and 0.5 m and 1.0 m of future sea-level rise (Figure 5.10). In the Eastern Shore Watershed, infrastructure located between Point Clear and the mouth of Weeks Bay are most susceptible to flooding due to low elevations, with upwards of 800 structures predicted to be damaged under the 100-year storm surge and 1.0 m of sea-level rise.

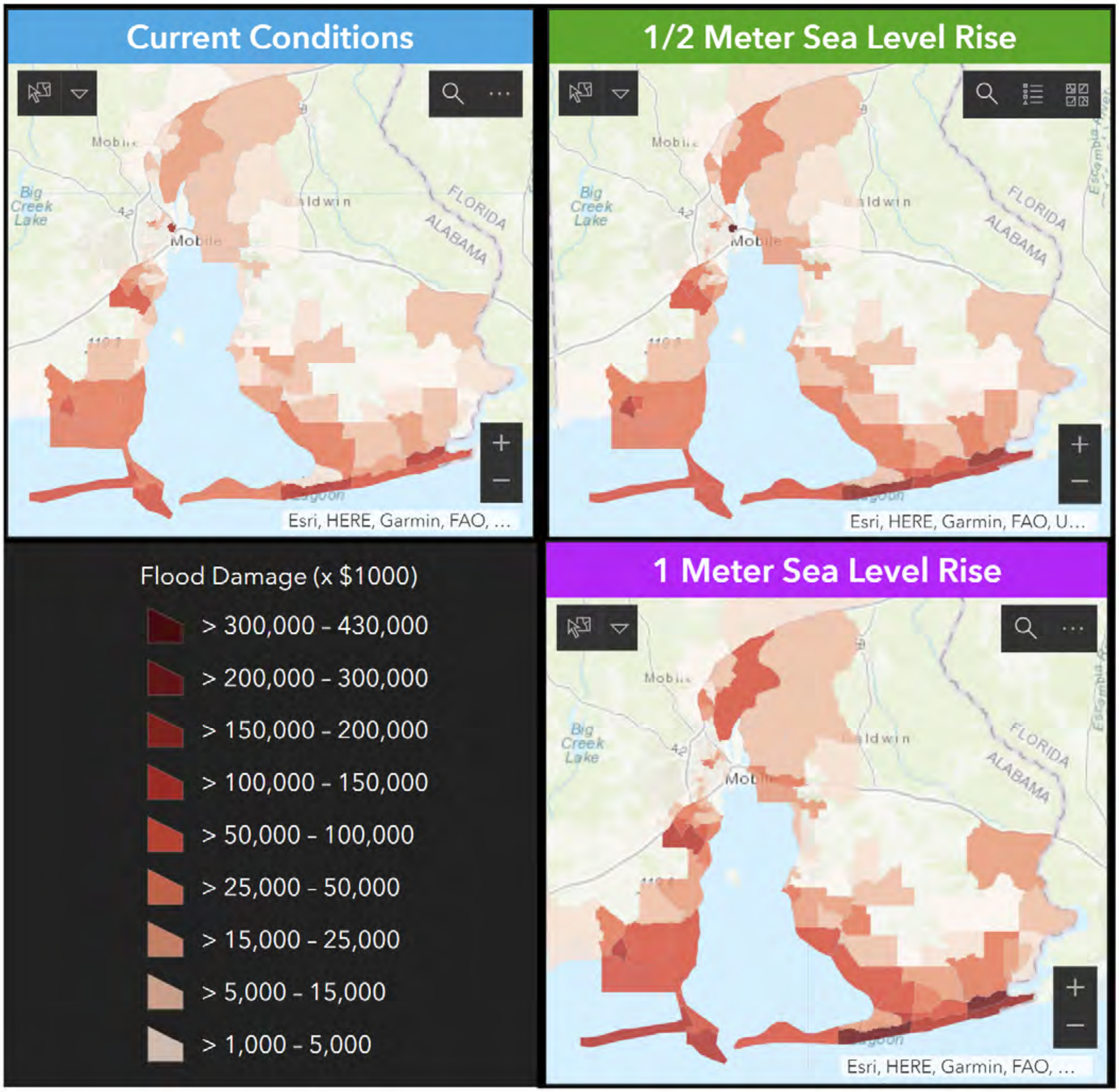

Figure 5.10 Structural damage by census tract for 100-year extreme event and 0, 0.5m, and 1.0 m of sea-level rise.
Source: Alabama Coastal Comprehensive Plan Storyboard, 2021

The RHMP also identified vulnerabilities in Baldwin County. These include:

- Fairhope has a population with over 20% aged 65 and up- older individuals are generally more vulnerable to hazards.

- Flooding and flash flooding due to nonexistent, undersized, or deteriorated drainage infrastructure and coastal development.

- Important industries such as tourism, which could be devastated by flooding.
- A significant number of critical facilities that do not have backup power generation, which increases vulnerability to all hazards.
- Limited funding to support mitigation efforts to address hazard vulnerabilities.
- Limited cellphone service, which makes individuals more vulnerable to flash flooding events.

5.2.2 Habitat Impacts

Coastal habitats, like salt marshes, change over the long-term in response to multiple processes, including tides, sediment accretion, freshwater inputs from the watershed, ecology, and sea-level rise. Salt marsh and intertidal habitats establish within zones corresponding to tidal inundation. The elevation of an area determines the frequency of tidal inundation, which in turn determines soil moisture and salinity. These factors affect the type of vegetation that can establish and persist. If the topography changes due to accretion (or restoration/grading), the habitat types change in response. Additionally, habitats will evolve when the tides rise due to sea-level rise.

Given sufficient space, marshes will migrate inland to higher elevations over time. However, in many areas, development limits the areas marshes can migrate to and these habitats can be "pinched-out" and drowned with sea-level rise. Figure 5.11 demonstrates this "pinch-out" effect.

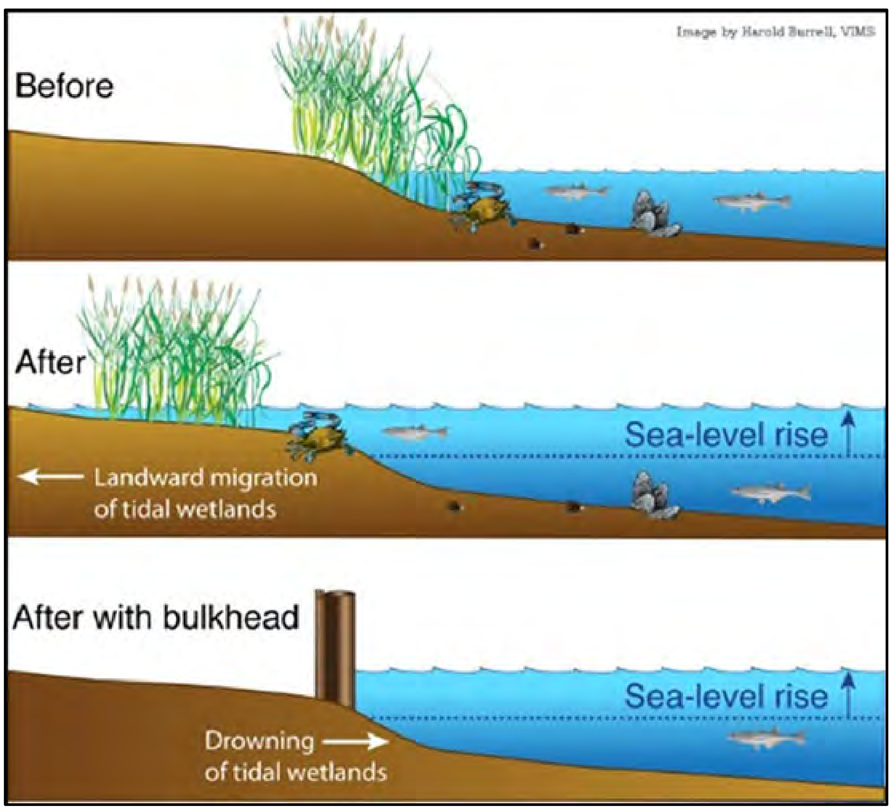

Figure 5.11 Sea-level Rise "Pinch-out" Effect
Source: NOAA 2021 from Harold Barrell, VIMS

5.2.2.1 Wetland Evolution

The ACCP included recent habitat assessments for Mobile Bay, including predicted wetland succession and oyster habitat suitability under future sea-level rise. The wetland succession tool illustrates the range of wetland community types under existing conditions and how changes in salinity corresponding to 0.5 m of sea-level rise will alter wetland extent and species composition. Generally, where salinity increases, wetland composition will shift to more salt-tolerant species or convert to open water habitat (Boesch et al. 1994; Brock et al 2005; Berkowitz et al 2019). The tool is based on community types and salt tolerances established in a prior aquatic resources studies that were part of the Mobile Harbor General Reevaluation Study. The modeling does not consider additional variables such as groundwater interactions, nutrients, and/or marsh accretion.

The wetland succession modeling results are generally focused on wetlands north of the Eastern Shore Watershed, although some results are provided for the area by Village Point Park Preserve. The proximity of these study results may provide a good proxy for habitat succession in the Eastern Shore Watershed. Under 0.5 m of sea-level rise, the potential salinity change drowns out a number of plant species, including: bald cypress, black willow, chinese tallow, black needlerush, and others. The vegetation type "bottomland mix" is predicted to be stable at this amount of sea-level rise.

Previous modeling by Warren Pinnacle Consulting (WPC, 2015) looked at wetland evolution across the entire Gulf Coast. WPC used the Sea Levels Affecting Marshes Model (SLAMM) to analyze habitat changes under 0.5, 1.0, 1.2, 1.5, and 2.0 m of sea-level rise and assumed habitats were allowed to migrate into developed areas. Table 5.1(a-b) shows the habitat change for each Subwatershed with 1.5 m of sea-level rise by 2100.

Table 5.1a Habitat Acreage in Eastern Shore Watershed

	Yancey Branch			Rock Creek			Fly Creek			UT5/UT6		
Habitats[1]	2002	2100	Change	2002	2100	Change	2002	2100	Change	2002	2100	Change
Developed Dry Land	1,019	1,006	-13	1,710	1,692	-18	898	890	-8	1,128	1,118	-9
Undeveloped Dry Land	1,263	1,212	-52	2,291	2,264	-27	4,246	4,226	-20	671	649	-22
Freshwater Swamp	117	104	-13	135	134	-1	113	109	-4	26	26	0
Freshwater Marsh		41	41	5	20	15	38	47	9	3	14	11
Salt Marsh	6	2	-5	3	11	8		9	9		13	13
Beach	20	4	-17	15	9	-6	1	0	0	1	1	0
Tidal Flat		27	27		3	3		2	2		5	5
Open Water	12	44	32	24	50	26	119	131	12	30	33	3
Inland Shore				2	2	0	24	24	0			
Total	2,439	2,439		4,186	4,186		5,438	5,438		1,859	1,859	

[1] *SLAMM habitats have been combined into simplified categories.*
Source: WPC SLAMM analysis by Subwatershed

Table 5.1b Habitat Acreage in Eastern Shore Watershed

	Point Clear			Bailey Creek			UT12			Full Watershed		
Habitats[1]	2002	2100	Change	2002	2100	Change	2002	2100	Change	2020	2100	Change
Developed Dry Land	893	825	-67	272	246	-26	208	108	-101	6,128	5,885	-243
Undeveloped Dry Land	2,134	2,066	-68	1,797	1,736	-60	735	626	-109	13,136	12,778	-358
Freshwater Swamp	300	276	-24	761	739	-22	1,197	707	-490	2,649	2,095	-554
Freshwater Marsh	6	68	62	10	48	38	154	388	234	217	627	410
Salt Marsh	2	46	44		21	21	2	355	353	13	457	444
Beach		5	5		21	21	4	17	12	42	56	14
Tidal Flat		14	14		6	6		17	17	0	75	75
Open Water	56	89	33	33	56	23	22	104	82	297	508	211
Inland Shore										26	26	0
Flooded Forest								1	1	0	1	1
Total	3,390	3,390		2,873	2,873		2,323	2,323		22,508	22,508	

[1]. SLAMM habitats have been combined into simplified categories.
Source: WPC SLAMM analysis by Subwatershed

The most significant changes are projected to occur in and around Village Point Park Preserve (Yancey Branch Subwatershed), Point Clear Creek, Bailey Creek, and Gum Swamp (UT12 Subwatershed), as shown in Figure 5.12. At Village Point Park Preserve, almost all of the beach area is expected to drown out and convert to open water. The existing freshwater swamp and undeveloped dry land is expected to convert to tidal flat and freshwater marsh.

If habitat is allowed to migrate into developed areas, the area south of the mouth of Point Clear Creek would evolve to freshwater marsh, salt marsh, and tidal flat, with a larger area of open water. Additional areas along the river would convert from freshwater swamp to freshwater and salt marsh.

At the mouth of Bailey Creek and to the south, areas of developed and undeveloped dry land as well as freshwater swamp could convert to freshwater and salt marsh and tidal flat. By 2100, the model predicts a thin line of beach would form along this stretch of the bay shore.

At Gum Swamp, which includes a large area of freshwater swamp today, habitat could convert to largely freshwater and salt marsh with 1.5 m of sea-level rise, based on the model results. As shown in Table 5.1b, 490 acres of freshwater swamp would be lost across the UT12 Subwatershed. The model shows the area of development along Hwy 1 converting to marsh and tidal flat.

The model results indicate that the existing freshwater swamp in the Eastern Shore Watershed is expected to decrease by 554 acres, a 20% loss of habitat with 1.5 m of sea-level rise. However, the model results also show that the areas along the existing creeks and around freshwater swamp habitat could provide restoration opportunities in the future.

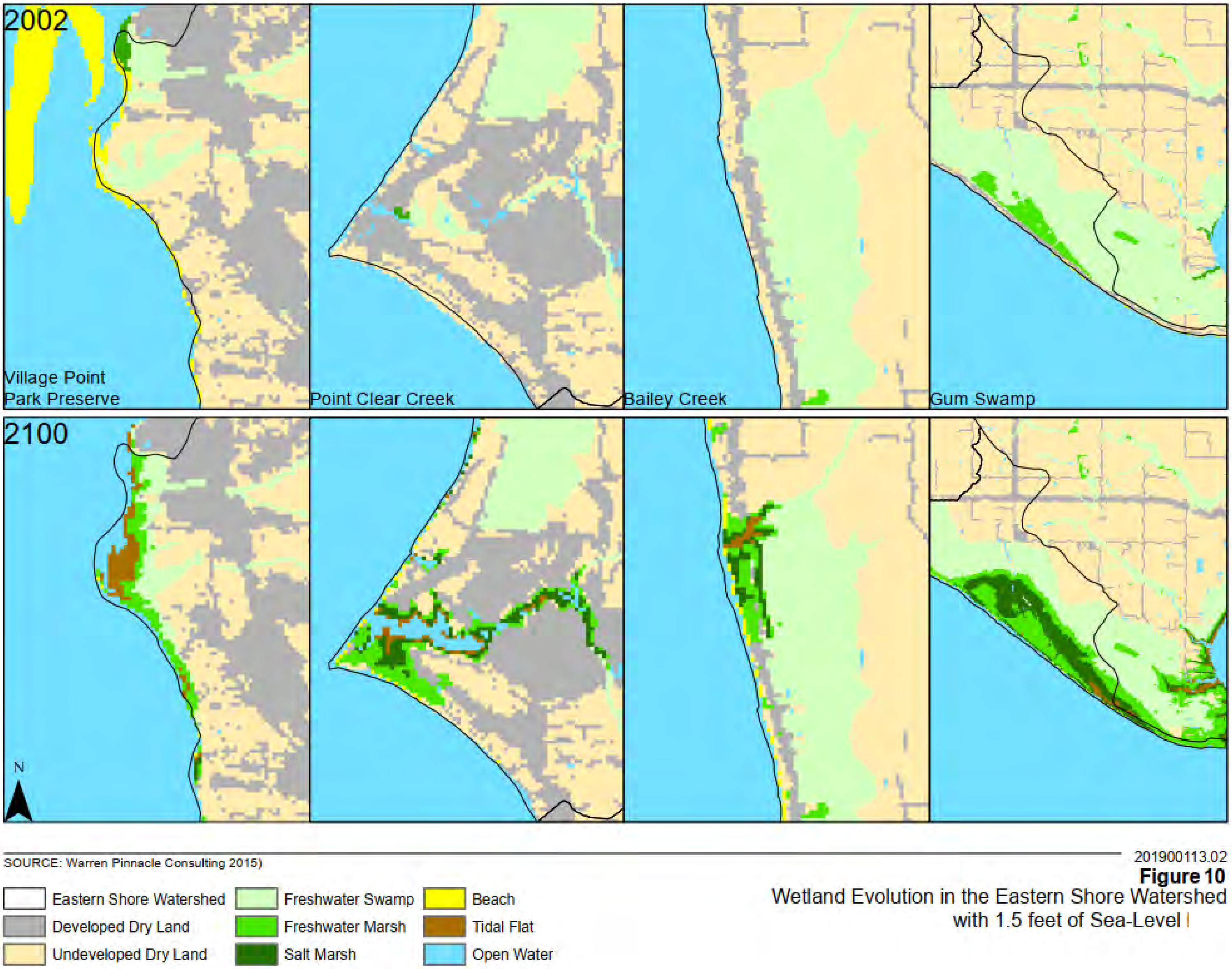

Figure 5.12 Wetland Evolution in the Eastern Shore Watershed with 1.5 feet of SLR
Source: WPC 2015

In The Nature Conservancy's *Resilient Coastal Sites for Conservation in the Gulf of Mexico* report (Anderson and Barnett 2019), they ranked the resiliency of the Eastern Shore Watershed habitats as "slightly above average." This indicates that the habitats have better ability to support biological diversity and ecological functions even in response to sea-level rise, when compared to other areas in the Gulf of Mexico.

5.2.2.2 Oyster Habitat Evolution

Oyster habitat suitability under existing and future conditions (0.5 m of sea-level rise) were evaluated and mapped for the eastern Mississippi Sound and Mobile Bay by the United States Geological Survey (USGS) National Fish and Wildlife Foundation (NFWF) Alabama Barrier Island Restoration Assessment Study (Enwright et al 2019). Key water quality parameters for oyster growth and survival, such as salinity, temperature, dissolved oxygen (DO), local water depth, and total suspended solids (TSS), from existing hydrodynamic and water quality modeling efforts were assessed in the region and used to create rankings of habitat quality from Highly Suitable to Unfavorable.

Presently, the Eastern Shore Watershed is considered to be unfavorable for oyster recruitment. Under 0.5 m of sea-level rise, the suitability of the region improves and is predicted to be more hospitable for oyster growth (Figure 5.13).

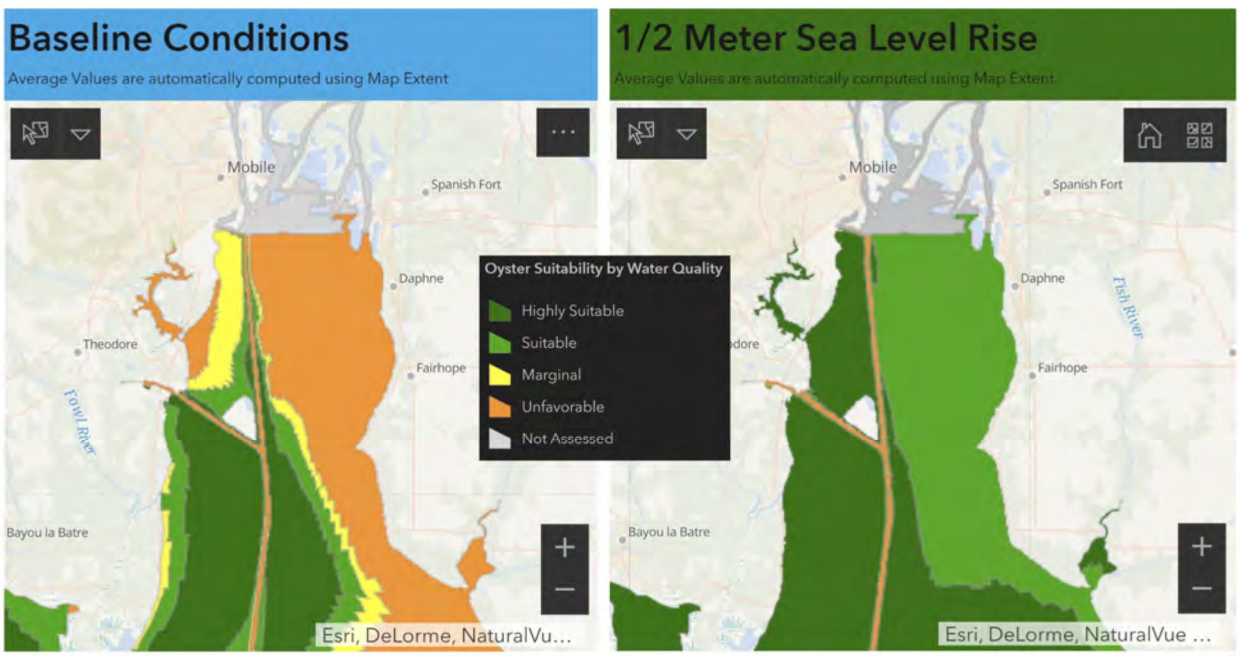

Figure 5.13 Oyster Habitat Suitability by Water Quality in Eastern Shore Watershed Study Area
Source: Alabama Coastal Comprehensive Plan Storyboard, 2021

6.0 Critical Issues and Areas

6.1 Development Issues

A substantial increase in development is anticipated in all subwatersheds, with an average 34 percent increase projected resulting in a 29 percent reduction in native land-use types, as noted above in Chapter 4.0. Land-use has a direct impact on pollutant loads. Cook (2021) reported that the majority of streams with increased urban development reported higher than average turbidity values. Identification of areas where stormwater can be mitigated in addition to areas in need of stabilization measures is paramount to attenuation of increased volumes and velocities of stormwater due to urbanization. Along with increased urban runoff, the sanitary sewer infrastructure is under increasing strain from year to year as the population of the area continues to increase. The implementation of best management practices to reduce sediment and nutrient loadings to Mobile Bay is recommended to prevent continued degradation of water quality within the Eastern Shore Watershed as well as receiving waters.

6.2 Litter Issues

Litter is an increasing problem in urban areas. Humans are the primary vector for litter. The Covid-19 pandemic and the urgent need for disposable of personal hygiene products and disposable supplies has intensified the plastic pollution problem (Tesfaldet et al., 2022). In the United States, medical plastic waste increased by six-fold to 8.85 million tons at the end of 2020 (Shams et al., 2021). Litter in an urban setting is unsightly and impacts property values as well as human health and wellbeing. Furthermore, litter can be transported via stormwater infrastructure to sensitive habitats in the Bay, affecting estuaries and fisheries.

It is more important than ever as populations increase to have a comprehensive education and litter abatement plan to preserve the wellbeing of the watershed. The system of gullies in the Eastern Shore watershed presents a unique opportunity to assess, collect, and control litter issues. Potential litter projects, including post-storm clean up, will be discussed further in Chapter 7: Management Measures.

6.3 Human Health and Wellbeing

The human population is facing significant challenges through the loss of multiple ecosystem services due to anthropogenic stressors that include land-use change, invasive species, and increasing human population (Whitmee et al., 2015). An assessment of peer-reviewed articles by Kosanic and Petzold (2020) determined that the primary drivers of change were demographic, climate change, and land/sea use change. See Figure 6.1 below.

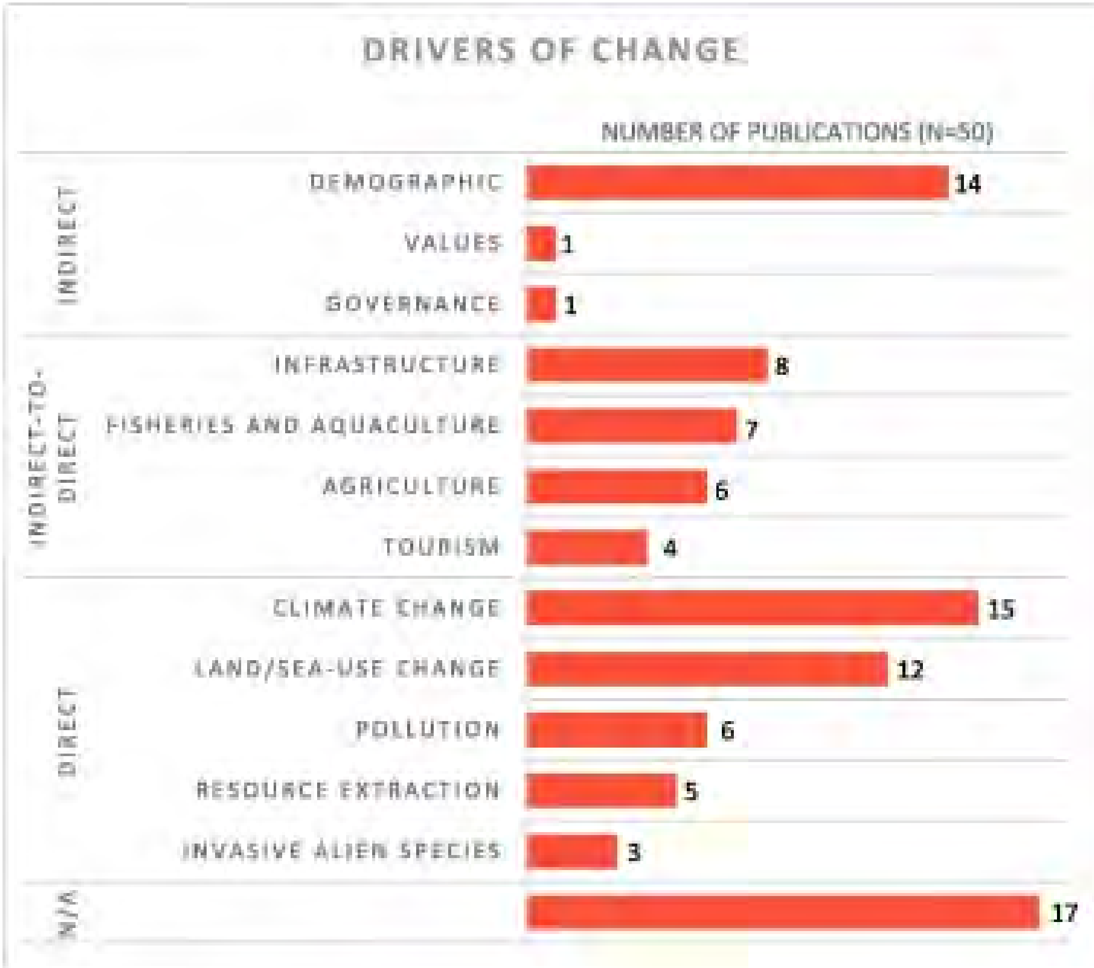

Figure 6.1 Primary Drivers of Change
Source: Kosanic and Petzold 2020

The effects of land-use change and climate change on ecosystem services are projected to have unprecedented consequences for human wellbeing (IPBES, 2019). Sustainable environmental management and a variety of conservation strategies could be critical to offsetting these consequences.

6.4 Water Quality Issues

Sediment transport continues to be one of the largest water quality issues on the Gulf Coast. As discussed in Chapter 4.0, sediment load evaluation found that the largest sediment contributors in the Eastern Shore Watershed were the following stream/creek reaches: Red Gully, Tatumville Gully, Rock Creek, and Fly Creek Tributary at Woodland Drive. Other documented water quality issues include pathogens such as *E. coli* and *enterococci*. Additionally, during the community engagement process, citizens expressed an interest in ensuring other pollutants such as carcinogens and microplastics are also monitored and mitigated going forward.

Water Quality issues overlap with other issue categories in this watershed in some form or other. Intensive anthropogenic land uses, including both urban areas and agricultural lands, can be detrimental to water quality, and changes in land cover have been recognized as the leading cause of water quality degradation (Mello *et al*. 2020). Projects in categories including development, litter, habitats, and erosion will all support water quality in the Eastern Shore Watershed Management Plan. Tracking and assessing current water quality trends in the watershed is difficult due to a lack of existing data. In the next chapter, Management Measures, a recommendation for robust and comprehensive data collection regarding water quality is outlined.

6.5 Habitat Issues

Estuaries, river floodplains, wetlands, and forests are among the most valuable ecosystems in terms of the level of services and benefits they provide (Costanza et al., 2006; Costanza et al., 2014). In 2009 the Mobile Bay National Estuary Program (MBNEP) partnered with Coastal Services Center and Office of Habitat Conservation of the National Oceanic and Atmospheric Administration (NOAA) and The Nature Conservancy (TNC) to update local habitat conservation priorities in Alabama (TNC, 2009). The partnership worked with MBNEP's local stakeholder group, the Coastal Habitats Coordinating Team (CHCT), which included over 60 state and local representatives concerned with habitat protection in coastal Alabama. The project focused on developing criteria for prioritizing habitat patches for conservation and restoration in Mobile and Baldwin counties to guide and inform the efforts of these organizations.

Priority habitats in the Eastern Shore Watershed include subtidal waters, SAV, beaches, tidal marshes and flats, freshwater wetlands, and streams and riparian buffers. Riparian zones filter pollutants and provide critical habitat and climatic refugia for wildlife (Graziano et al., 2022). Types of freshwater wetlands include tidal wooded swamp, seepage swamp and baygall, cypress-tupelo swamp, and wet pinewoods, including areas of pine savanna and emergent marsh.

Figure 6.2 Typical Priority Habitat on the Eastern Shore

Enhanced protection and management of high-quality habitats are accomplished through fee simple land acquisition and conservation easements. Fee simple acquisition is the direct purchase of a land parcel, including all the rights to it. Conservation easements offer an alternative to fee acquisition that can also be ecologically effective, and in some cases more financially feasible. An easement is a non-possessory interest in a portion of real property, where ownership remains with the landowner. There is typically a permanent restriction on the use of land within the designated easement. There are potential opportunities in the Watershed for conservation of significant habitat tracts. Potential projects for habitat preservation and restoration are outlined in Chapter 7.0: Management Measures.

6.6 Environmental Health and Resilliance

The Eastern Shore Watershed is vulnerable to multiple climate hazards, especially along the coast where sea-level rise and changes in weather patterns will result in increased flooding and erosion. With anticipated sea level rise, the Eastern Shore's current vulnerabilities to coastal flooding and erosion are projected to increase in frequency, intensity, and extent. As discussed in section 5.1.3, hurricanes have caused significant damage along the Eastern Shore's coastline, even without significant amounts of sea level rise. Future sea level rise is projected to create a permanent rise in ocean water levels that will increase erosion of beaches and result in more damaging coastal storm events. Higher water levels at the coast and increased rainfall may also impact the storm drainage system during extreme rainfall events by backing up water into the system and delaying drainage until low tide. The findings of this vulnerability assessment can be used to identify adaptation strategies that will address the impacts of climate hazards and reduce the Eastern Shore's vulnerabilities. The adaptation planning process should include working with the community to discuss their priorities and to develop guiding principles that will help guide future adaptations choices.

6.7 Erosion and Sedimentation Issues

Erosion and sedimentation issues cross over into several of the critical issues outlined above as either one of the causes or one of the results. The gully system in the Eastern Shore Watershed presents a unique set of conditions. These areas are considered of historical importance to the local communities and much has been written of their lore. According to a placard posted at Thomas Hospital:

"An important environmental gift was the colonists' decision to purchase, set aside and protect the extensive gully system that they found throughout Fairhope. These open sores in the landscape were the result of the callous clear cutting of trees in the area. The colonists' solution was to set aside these areas to heal and evolve as effective watershed management areas."

As mentioned in the water quality section above, there are several gullies contributing to sediment loading in the watershed. Potential projects to stabilize the gullies in addition to potential stream stabilization projects can be found in Chapter 8.0: Implementation Strategies

7.0 Management Measures

The critical issues and challenges facing the Eastern Shore have been defined in previous chapters. In this chapter, management measures are identified to address these critical issues and achieve the previously described goals. An extensive list of potential management measures was compiled throughout the Watershed management planning effort by the project team, Steering Committee members, area stakeholders, and community members. Management measures are defined as the potential opportunities or actions that can be implemented to target these critical issues and mitigate their impact to the overall health of the Watershed. As defined in the Coastal Zone Act Reauthorization Amendments of 1990, management measures are economically achievable measures to control the addition of pollutants to coastal waters. These measures reflect the greatest degree of pollutant reduction achievable by applying the best available nonpoint pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives. Management measures outlined in this chapter will help achieve the goals of this WMP in light of the project vision, which include (i) improving water quality, (ii) protecting and restoring critical habitats, (iii) improving resilience, and (iv) improving access. In this chapter, management measures addressing each of the critical issues identified in the previous chapter will be discussed. The critical issues for Eastern Shore fall into the following categories:

- **Development** – identifies strategies to mitigate potential effects of overdevelopment on multiple environmental stressors.
- **Litter** – identifies areas where litter abatement could be useful to enhance water quality and quantity.
- **Human Health and Wellbeing** – characterizes existing opportunities for public access, recreation, and ecotourism through access to open spaces and waters within the Watershed. Also identifies customary uses of biological resources and identifies actions to preserve culture and heritage.
- **Water Quality** – identifies actions to reduce point and non-point source pollution (including stormwater runoff and associated sediment, nutrients, and pathogens) and notes remediation efforts for past environmental degradation.
- **Habitat Loss** – identifies actions to reduce the incidence and impacts of invasive flora and fauna and improve habitats necessary to support healthy populations of fish and wildlife.
- **Environmental Health and Resilience** – identifies vulnerabilities in the watershed from increased sea level rise, storm surge, temperature increases, and precipitation and methodology for improving watershed resiliency through planning and management.
- **Shoreline Erosion and Sedimentation** – assesses shoreline conditions and identifies strategic areas for shoreline stabilization and fisheries enhancements.

7.1 Development

As stated previously, the Eastern Shore Watershed is located within one of the fastest growing areas of Alabama. This rapid growth has been identified as a major concern of citizens and stakeholders who have first-hand experiences of adverse impacts to water quality. The fear is that conditions will continue to degrade without some intervention to more strategically regulate growth. Understanding that growth is an essential part of a community’s economic development and will continue, one effective way to minimize impacts is by adopting Best Management Practices (BMPs) for urban development and incorporating Low Impact Development (LID) and Green Infrastructure (GI) practices.

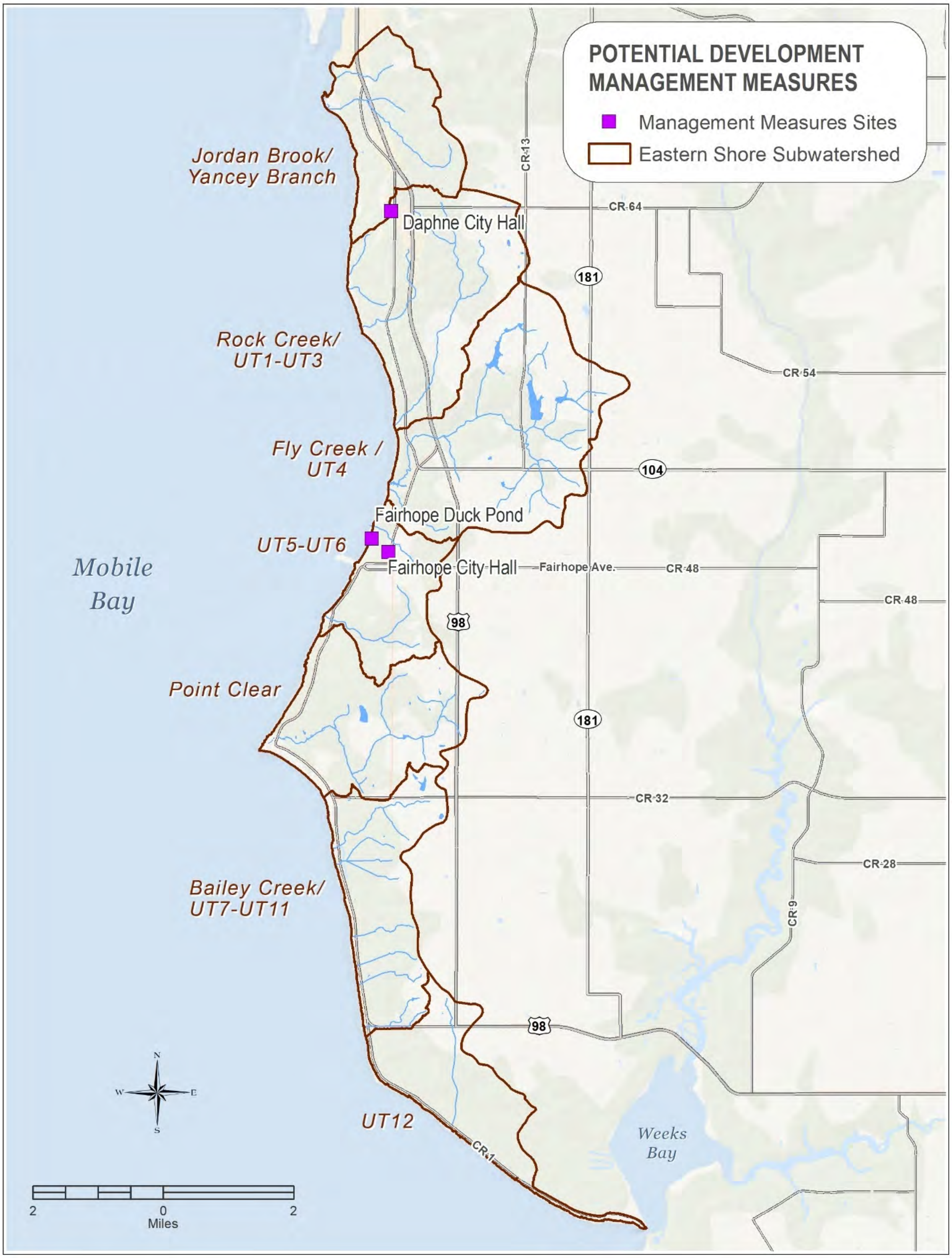

Figure 7.1 Location of potential development management measures in the Watershed

7.1.1 Best Management Practices for Urban Development

As development increases within the Watershed, so does potential for sediment inputs from poorly managed construction sites. Relative to size, the erosion and sediment input potential from construction sites is greater than that of any other land use due to the amount of exposed and disturbed sediment combined with the high land gradient and rainfall totals observed in this region throughout the year. Post-construction stormwater management is arguably more important than "during construction" phases of a project, since potential stormwater impacts will continue for the life of the completed project. Therefore, consistent stormwater management policies and regulations that control for both water volume and quality are necessary. Some recommendations to achieve this are below:

- A watershed-wide inventory of pre- and post-construction stormwater BMPs is important to ensure that proper and routine maintenance and inspections are conducted on BMPs.
- The inventory should include the type of BMP, date of installation, responsible party for maintenance, and an inspection of each BMP to ensure they are functioning properly.
- The proposed comprehensive inventory of post-construction BMPs should be used as part of a watershed-wide assessment of BMP needs to include retention basins, detention basins, and other types of BMPs that would provide long-term water quality benefits in the Watershed.
- Post-inventory Baldwin County and the cities of Fairhope and Daphne should consider revisiting and enhancing post-construction stormwater regulations to ensure any potential impacts from development and resulting increased imperviousness do not result in long-term adverse impacts to water quality.
- Watershed-wide inventory and restoration needs assessment of public and private stormwater retention/detention ponds.
    - This would include updated educational materials on the importance of and BMPs for stormwater pond maintenance that are specific to public and private users (Homeowners Associations).
    - Demonstration sites are also crucial to educating the general public on the importance of maintaining these areas (Example, Duck Pond at Fairhope Public Beach – details in Chapter 8).
    - Developer and contractor education are important management measures recommended for the Watershed.
- Informational brochures on construction BMPs should be provided early in the development process by the jurisdictional authority to educate individuals on the benefits of properly implementing and maintaining these practices.

A more detailed list of BMPs specific for development on the Eastern Shore are included in Chapter 8.

7.1.2 Low Impact Development (LID) practices

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 and recommended retrofits for existing developed areas are presented in Chapter 8 and in the Low Impact Development Handbook for the State of Alabama (ADEM 2014).

Municipalities within the Eastern Shore Watershed have adopted (or are adopting) ordinances to require or encourage LID and GI practices, but these ordinances have different provisions and can be inconsistent. Also, the unincorporated Watershed areas of Baldwin County outside of municipal jurisdiction have either no provisions or limited provisions for LID and GI. It is recommended that municipalities and the County promote and encourage LID and GI throughout the Watershed and promote consistency of those measures within the various jurisdictions. Successful implementation of LID and GI practices at the Watershed scale will require communication and coordination among the multiple local jurisdictions.

Comprehensive land use plans to manage continued development are currently in development for the cities of Fairhope and Daphne as well as Baldwin County. These groups are encouraged to coordinate when developing recommendations, policies and/or ordinances based on those comprehensive plans.

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 appropriately qualified engineering firms, several types of demonstration projects using The Alabama LID Handbook recommendations (identified in Chapter 8) could be completed. This would encourage, through education and outreach, the use of LID practices that could greatly enhance Watershed protection.

7.2 Litter

Litter in the watershed comes from a variety of sources. Whether intentionally discarded on the ground, illegally dumped, or improperly handled at some point after containment, litter often makes its way into streams and other receiving waterbodies via overland flow or through the municipal drainage systems within the Watershed. Litter is the most visibly noticeable of all watershed impairments and has a direct impact on water quality, wildlife habitat, and recreational enjoyment.

Reduction of litter begins with education and awareness among those who live, recreate, work, and even pass through the Watershed. Making people aware of how trash eventually enters surface waters should be a continuous effort. Outreach to schools, businesses, homeowner associations, construction workers, and recreational users can pay dividends in educating people on how their actions can have a direct and noticeable impact on the health of the Watershed. Signage strategically placed where trash accumulates like roadways, boat launches, and fishing locations, is useful in raising awareness about the proper disposal of refuse. Potential locations for placement of signage designed to raise awareness about human impacts to the Watershed will be identified in Chapter 8.

Efforts should also be made to curtail illegal dumping in rural areas and impose harsh fines for violations. Additionally, community “clean-ups” among citizens and user groups can promote a sense of stewardship of the Watershed in addition to providing an immediate improvement on the landscape. Each year on the 3rd Saturday in September, the Alabama Coastal Cleanup is held. The current check-in sites in the Watershed are located at Fairhope Public Pier and Beach and Mayday Park in Daphne. This community event is anchored by volunteers from multiple public and private groups.

Additionally, a comprehensive litter plan identifying actual litter issues and prioritizing litter abatement strategies should be created. The plan should include;

- Baseline data collection to determine type and potential source of litter. Include gullies, stormwater drainage basins, detention ponds, and potential high traffic roadway crossings.
- Establish comprehensive litter plan based on actual litter issues and prioritize litter abatement efforts accordingly.

- Assess the possibility of creating a post-storm municipal impact fee program for vulnerable areas
- Identification of roadways where anti-litter educational signage would be beneficial (some sites have been identified within the City of Fairhope and are listed in Chapter 8).

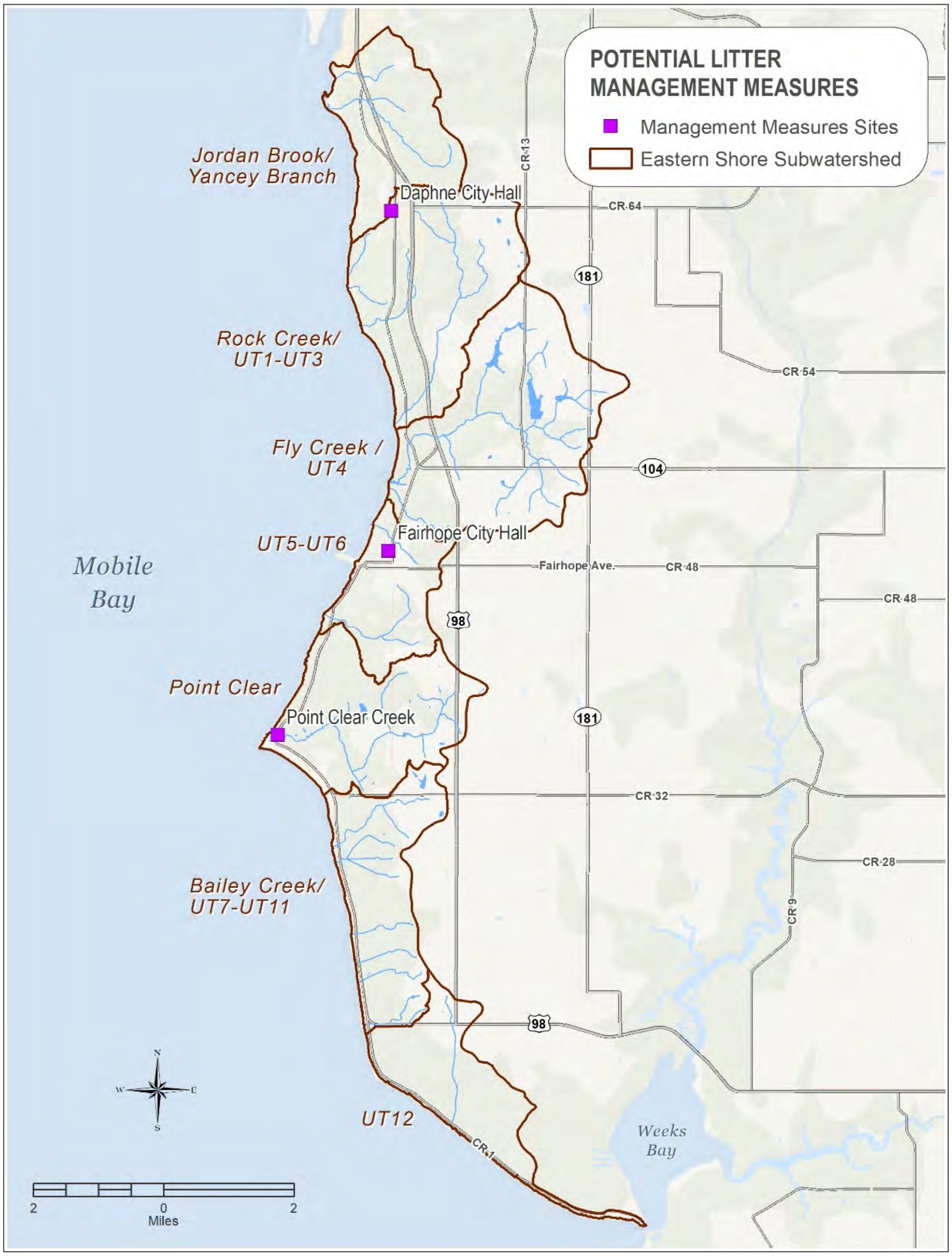

Figure 7.2 Location of potential litter management measures in the Watershed

7.2.1 In-Stream Post-Storm Debris

During the planning process stakeholders repeatedly mentioned the waterways along the Eastern Shore still have downed debris following Hurricane Sally in September 2020. The debris is limiting water flow through the waterways and contributing to increased flooding. Point Clear Creek in Fairhope is one example where residents along the Creek have cleaned up as much debris as they can. Heavy equipment will be needed to clear the remaining debris and will incur a significant cost. To avoid citizens having to find the resources on their own, Baldwin County and the Cities of Daphne and Fairhope should create a post-storm debris monitoring and clean-up program. This should be a coordinated effort with a main agency or municipality identified as the main point of contact. The plan should assess the feasibility of creating a municipal impact fee program for vulnerable areas. It could also identify funding sources to help establish a tactical team that can go out immediately after storms and assess damage on municipal properties. The team should be comprised of citizens, homeowner volunteers or local municipal staff or a combination of both. A list of vetted contractors who can help with post-storm clean up should be developed and advertised. Any storm generating sustained winds of 40 miles per hour or greater would be considered a threshold event, triggering field reconnaissance to determine the extent of damage and nature of cleanup.

7.3 Polyfluoroalkyl Substances (PFAS) and Microplastic Assessment

PFAS are widely used, long lasting chemicals which break down very slowly over time. Many PFAS are present at low levels in a variety of food products and in the environment. They can be found in water, air, fish, and soil at locations across the nation and the globe. Scientific studies have shown that exposure to some PFAS in the environment may be linked to harmful health effects in humans and animals. There are thousands of PFAS chemicals that are found in many different consumer, commercial, and industrial products which makes them challenging to study and assess the potential human health and environmental risks (EPA). Given the emergent nature of these pollutants, there are no well v etted methodologies of removing them from potable water sources. At present, it is recommended to develop a monitoring protocol and a task force focused on "emergent pollutants" that can stay abreast of changing regulations and remediation methods.

7.4 Human Health and Well-being

Human health and well-being are intimately linked to the health of the environment. The Eastern Shore Watershed can provide citizens with good quality natural environments to provide basic needs, in terms of clean water and fertile land for food production. Green and blue spaces and green infrastructure serve to regulate climate and prevent flooding as well as provide important opportunities for recreation that support well-being. The culture, heritage, and history of people are inextricably tied to the resources provided by the Watershed. It is important to preserve and enhance the rich culture and heritage while also protecting the natural resources as well as creating new opportunities for outside visitors to experience and enjoy the uniqueness of the communities located within the Watershed. Listed below are some general recommendations for ways to increase preserve and increase human health and well-being (more detailed projects are listed in Chapter 8):

- Increase green spaces throughout the watershed. The Cities of Fairhope and Daphne are in the Comprehensive Land Use Planning process. Included in these plans is the identified of green spaces for multi-purpose uses (ie; hiking, biking, recreation, habitat and wildlife preservation, etc.). One example of identified green space for muti-use recreation and preservation is the Dyas Triangle in Fairhope. This has been identified as a priority project and funded through GOMESA. It is recommended that the municipalities coordinate with Baldwin County to link the identified green spaces into useable corridors for people and wildlife. Many of the local community user groups (ie; Fairhope Environmental Advisory Board, City of Daphne Environmental Advisory Committee, City of Fairhope Biking and Pedestrian Committee, Baldwin County Trailblazers, etc.) have participated in several of the local efforts and have the abilities to help make those connections.

- Increase public access to Mobile Bay. Recommended access points include waterfront 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 along the Eastern Shore of Mobile Bay is privately owned. Several locations have been identified through the planning process.
- Increase community signage in historic communities (ie; Twin Beech, Barnwell, Historic Downtown Daphne, Historic Downtown Fairhope, Point Clear, Montrose, Daphmont)
- Develop a series of oral histories for significant historical communities including those above. Oral history is a technique used for generating and preserving original, historically interesting information from personal recollections through planned recorded interviews. The Eastern Shore has a rich history that is often overlooked due to the large number of new residents in the area. Oral histories can be hosted on a variety of social media outlets, local print media, and local municipality print and social media.

Figure 7.3 Location of potential human health and well-being management measures in the Watershed

7.5 Water Quality

As discussed in previous chapters, water quality is a broad term that reflects a combination of several parameters that are directly tied to the overall health of a watershed. The factors influencing water quality also affect the ability of stakeholders to utilize those waters for any number of uses. It is important to not only maintain water quality within the Watershed, but also to ensure future actions and land uses do not degrade the system. The Eastern Shore Watershed study identified several specific water-related activities that need to be undertaken to help address these issues including the following:

- Address lack of water quality data.
- Assess the health and functionality of the gully systems along the Eastern Shore.
- Strategically acquire land for habitat preservation, wetland protection, and riparian buffers.
- Assess stormwater infrastructure.
- Assess sanitary sewer infrastructure.
- Assess flooding causes and determine potential remedies in the underserved community of Twin Beech.
- Assessment and restoration of impairments to major tributaries (including Fly Creek).

7.5.1 Water Quality Monitoring

As described in Chapter 6 of this report, the temporal, spatial, and parametric coverage of water quality data is inconsistent throughout the Eastern Shore. Changes in environmental indicators occur on decadal time scales; therefore, consistent long-term monitoring over decades is necessary to detect any significant differences in water quality parameters. Few existing or historical stations have been monitored consistently. The lack of available baseline water quality data has limited our ability to assess and understand the quality (condition) of water and environmental health and function in the Watershed and our ability to track trends over time and recommend specific water quality improvement management measures. To adequately address water quality issues, a proper level of characterization is required, which is why many of the management measures recommended are related to data collection. The first step to properly characterizing the Watershed is to develop a comprehensive monitoring program to specifically address existing data gaps. Chapters 8 and 11 of this document provide a detailed monitoring program that will address data gaps and establish a long-term monitoring plan. A comprehensive long-term monitoring program is recommended to detect significant changes in watershed conditions over time, and to determine if trends indicate improving watershed conditions from management measures proposed throughout this chapter. A comprehensive watershed monitoring and sampling plan is necessary to continue to characterize the overall health of the Watershed, track the success or failure of the implemented management measures, and determine where additional measures are necessary. The monitoring plan should encompass the greatest possible portion of the Watershed with the least number of samples while providing sufficient detail to identify probable source areas for elements of concern. It is recommended as a management measure that additional water quality data collection be conducted (at constant and consistent locations) under a long-term monitoring program. Permanent sample locations should be established to assure consistency over the life of this WMP and will allow for better analyses (identification of trends, significant changes to data output, etc.). A map and list of potential locations are included in Chapter 11.

A vital element of the Watershed Monitoring Program will be citizen participation through volunteering as an Alabama Watershed Watch (AWW) monitor. With the help of volunteers, the Watershed Monitoring Program will enable successful implementation and establish a sense of community ownership within the watersheds. Efforts should be made to recruit as many volunteer monitors as possible.

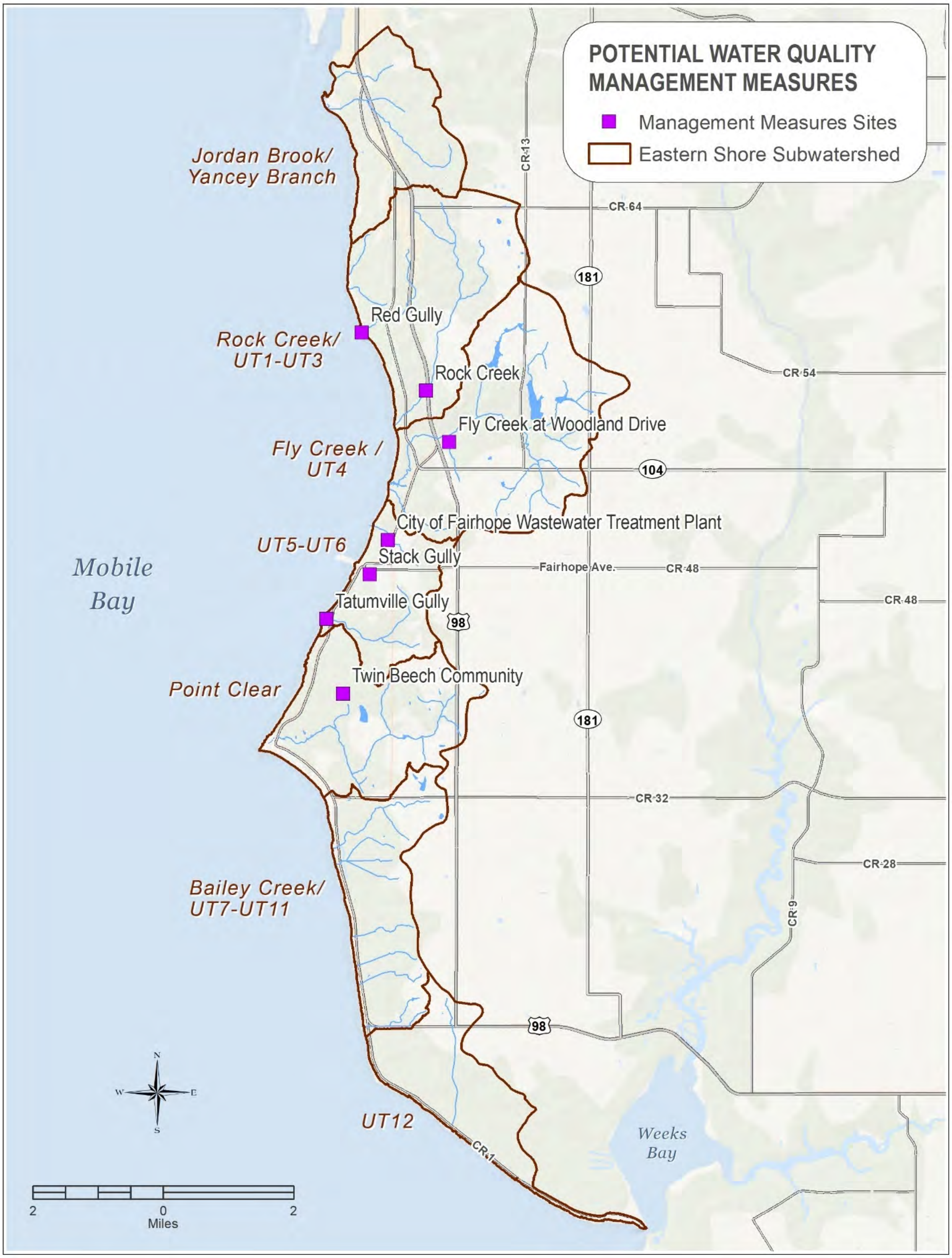

Figure 7.4 Location of potential water quality management measures in the Watershed

7.5.2 Gully Assessment and Restoration

According to a study done by the MBNEP, one of the most important roles of gullies, especially as natural landscapes are "hardened" by development, is conveyance of stormwater from land surfaces into Mobile Bay (MBNEP, 2012). Among the problems threatening these natural channels are erosion, debris, and invasive species. We recommend doing a comprehensive gully assessment of all the gullies along the Eastern Shore (map and gully names in Chapter 8*)*. The cities of Daphne and Fairhope should partner with Baldwin County to evaluate the overall health of the gully systems by assessing the top three concerns for gully health:

- Erosion: Erosion can occur due to a number of issues. The assessment would assign a grade for the severity of erosion in each individual gully. The causes of erosion should be documented and assessed for potential restoration. The assessment should also document the percent of impervious surfaces along the length of the gully that are potentially limiting rainwater from infiltrating into the ground as well as adequate/inadequate protective buffers along the gully reach.
- Debris: Litter, yard waste, appliances, and other trash that get into gullies ruin the view, block stormwater conveyance, promote mosquito breeding, and create health concerns. The study should assess the physical debris as well as the less obvious "non-point source pollutants" like fertilizer, pesticide, sediments, oil, grease, toxic chemicals, and pet waste, which are carried along with stormwater runoff.
- Invasive species: While invasive plants currently protect gully walls from the same forces that created them, they also outcompete native plants that provide vital ecological services to native wildlife. Replacing invasive vegetation with native plants is a good course of action, but it will require thoughtful planning and gradual implementation.

This gully health assessment should be combined with the Water Quality monitoring program outlined above to understand how the health of the gullies are impacting the quality of the water being discharged into Mobile Bay. A rating system could be established to appropriately direct restoration work to those areas in most need and help identify the appropriate course of restoration. More detailed methods of restoration are included in Chapter 8.

Finally, an educational campaign should be created by the cities of Fairhope and Daphne as well as Baldwin County to educate the public (particularly homeowners, businesses, etc. who own property along a gully reach) about the history and importance of the gully systems. Printed and electronic materials should be developed to provide information on best management practices for those who live or play along the gullies.

7.5.3 Stormwater Infrastructure and Management

As discussed in Section 4.1.2.2, the stormwater runoff within approximately 99% of the Eastern Shore Watershed is covered under the NPDES MS4 Program. The following discussion provides a general overview on addressing stormwater management and are being addressed by the MS4 programs. Effective stormwater management must utilize a combination of planning and regulations, infrastructure, and BMPs. The recommendations below are intended to supplement those existing programs that were started in 1999.

7.5.3.1 Develop a Stormwater Master Plan

Developing a Stormwater Master Plan for the Eastern Shore will provide the framework for implementing structural BMPs and planning to accommodate future development. The first aspect of a Stormwater Master Plan is to assess the condition and effectiveness of existing stormwater infrastructure. This would include performing an inventory of all existing structures and mapping sub-basins to prioritize the replacement/repair of structures in poor condition and to identify areas of local flooding where existing infrastructure is inadequate.

Mapping drainage structures and associated sub-basins will provide a guide to the collection of stormwater and the locations of discharges and allow problem areas to be targeted and improved. Developing a GIS model of the existing infrastructure will provide a useful tool for storing the data produced in the Stormwater Master Plan. A GIS model can be maintained and modified to include new infrastructure as the municipal systems develop and change.

The Stormwater Master Plan will also compare feasibility and costs of implementing stormwater management measures to identify appropriate BMPs for each subbasin along the Eastern Shore.

7.5.3.2 Retrofitting Stormwater Discharges

Baldwin County and all municipalities in the Watershed are recommended to conduct an inventory and assessment of stormwater detention systems (HOA owned and business owned). Methods to incentivize maintenance, as well as retrofitting of HOA stormwater detention systems should be explored. Regional alternatives to multiple HOA systems should be considered. The details of a recommended project to inventory, map, assess existing stormwater ponds, and construct several demonstration projects with retrofits designed to improve water quality flowing from these ponds are provided below.

Stormwater pond retrofits should be designed to not adversely impact flood protection but to provide substantial benefits for improving water quality. The project should consist of in-depth mapping and data collection of the stormwater basins within the Watershed. The size, location, and type (wet or dry detention or retention) should be documented. Site visits should be performed to document the status of the ponds, their functionality during storm events, and potential for retrofitting projects. At the end of the project timeline, a map should be created to show any new basins that have been created during the project time and the site location of the selected pilot retrofitting projects. The project should also include outreach to provide information to HOA groups or businesses on inspection and management activities to ensure the long-term functionality of their stormwater basins, including maintenance recommendations. Retrofit treatment options for the demonstration sites may include:

- extended detention
- conversion of dry ponds to wet ponds
- constructed wetlands within ponds
- bioretention
- additional filtering practices, including native grass plantings
- swales
- other (roof runoff treatment using rain gardens, rain barrels, planters, etc.)

The option selected for each site will be based on the major issue with that site, such as flow rate, retention time, sedimentation within the pond, or invasive plant pressure.

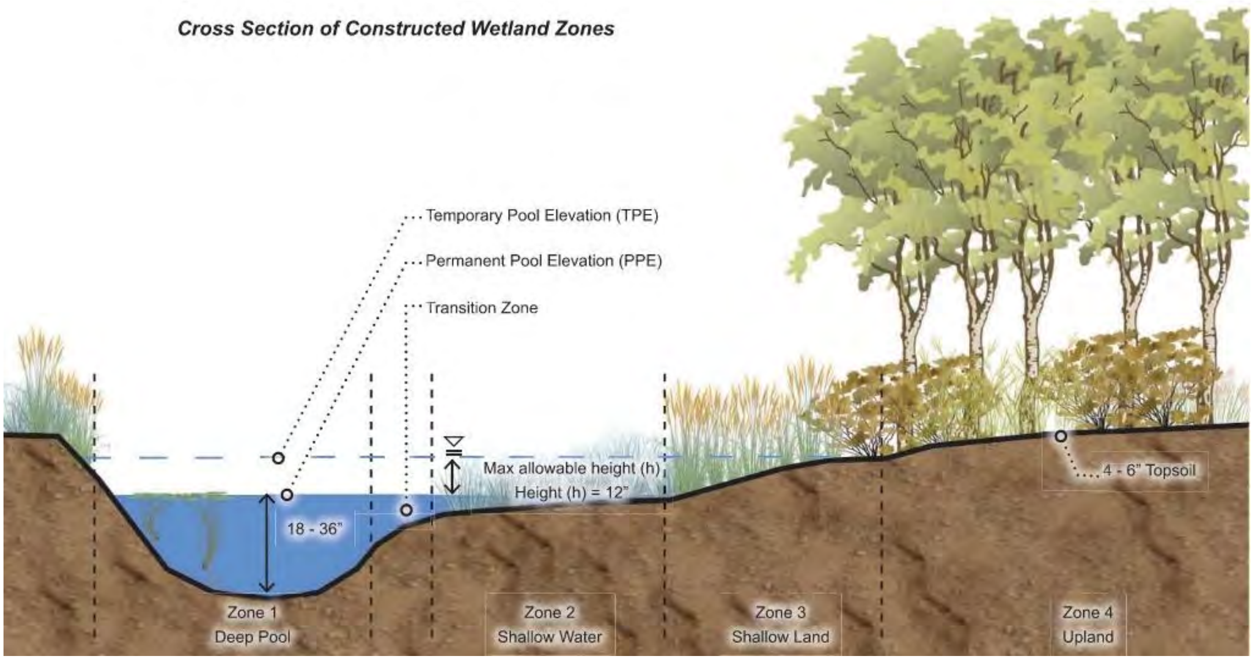

Figure 7.5 Cross Section of Constructed Wetland Zones
Source: *https://adem.alabama.gov/programs/water/waterforms/LIDHandbook.pdf*

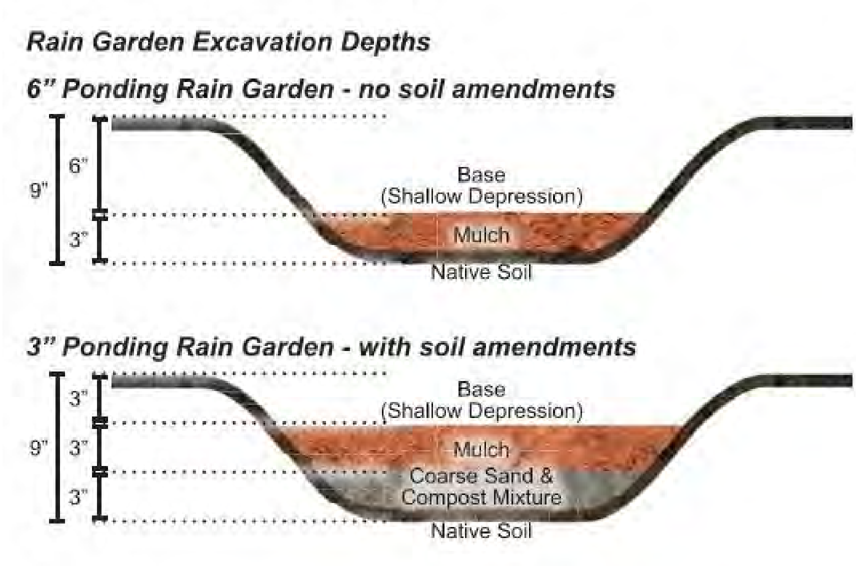

Figure 7.6 Rain Garden Excavation Depths
Source: *https://adem.alabama.gov/programs/water/waterforms/LIDHandbook.pdf*

7.5.4 Improve the Condition of Degraded Riparian Buffers

Streamside riparian zone vegetation has important functions, providing thermal cover to prevent water temperature extremes, trapping sediment and taking up excess nutrients in stormwater runoff, and as wildlife habitat. Riparian buffers in poor condition throughout the Watershed are associated mostly with urban areas and agricultural and pasture lands. Among the highest priority conservation actions in the SWAP (ADCNR, 2015) is riparian restoration to improve water quality and habitat quality throughout the

Mobile Basin. These actions include BMPs for agriculture to restore and maintain protective buffers with native streambank vegetation composition and structure.

Streams are highly susceptible to degradation when the surrounding upland landscape is altered. One management priority is the maintenance or restoration of riparian corridors near headwaters, which are lands in proximity to the uppermost reaches of streams. Stormwater runoff from altered land can exceed the absorption capacity of small streams and degrade natural water quality, causing additional degradation downstream. Key criteria for identifying potential riparian buffer restoration areas in the Watershed include:

- Proximity to headwater areas;
- Former drainageways and wetlands on crop land with marginal production;
- Locations identified as nutrient or sediment loading hotspots; and
- ADEM 303d listed streams (i.e., Fly Creek).

Riparian areas meet priority habitat criteria for restoration that include intact 30-m (~100-ft) wide riparian buffers bordering both sides of streams, and at least 500-m (1,640-ft) stretches of impaired or intact habitat (MBNEP and TNC, 2019). Based on the wetland and riparian buffer condition analyses, field observations, MBNEP and TNC prioritization criteria, and key criteria for identifying riparian buffer restoration areas in the Watershed, potential restoration sites are listed in in Table 7.1 and present in Figure 7.1. Maps for each of potential riparian buffer restoration sites are contained in Appendix H.

Table 7.1 Potential riparian buffer restoration sites.

Riparian Buffer Segment	Subwatershed	Stream Distance	Acres
RB-FC1	Fly Creek-UT4	769 m (2,524 ft)	11.5
RB-FC2	Fly Creek-UT4	515 m (1,689 ft)	6.5
RB-PC1	Point Clear Creek	537 m (1,761 ft)	7.0
RB-PC2	Point Clear Creek	1,500 m (4,923 ft)	21.5
RB-BC	Bailey Creek-UT7-UT8-UT9-UT10-UT11	1,206 m (3,958 ft)	18.5
RB-UT7	Bailey Creek-UT7-UT8-UT9-UT10-UT11	675 m (2,214 ft)	10.0
RB-UT11	Bailey Creek-UT7-UT8-UT9-UT10-UT11	522 m (1,714 ft)	6.0
RB-UT12	UT12	534 m (1,753 ft)	8.5

Acres are based on a 200-ft-wide buffer.

Establishing vegetated riparian buffers at these locations would enhance stream conditions by decreasing flow velocity to moderate stormwater runoff and reduce nonpoint source pollution concentrations of sediments and nutrients. In addition, natural buffer habitats enhance streamside use by a variety of wildlife to enhance local biodiversity. Riparian buffer habitats overlap with other habitat types, including uplands and freshwater wetlands. It recommended that a spatial zone 100 feet wide on both sides of the target stream reaches be established as riparian zones for buffer restoration. Narrower buffers may be identified for restoration, depending on site-specific conditions and property owner preferences.

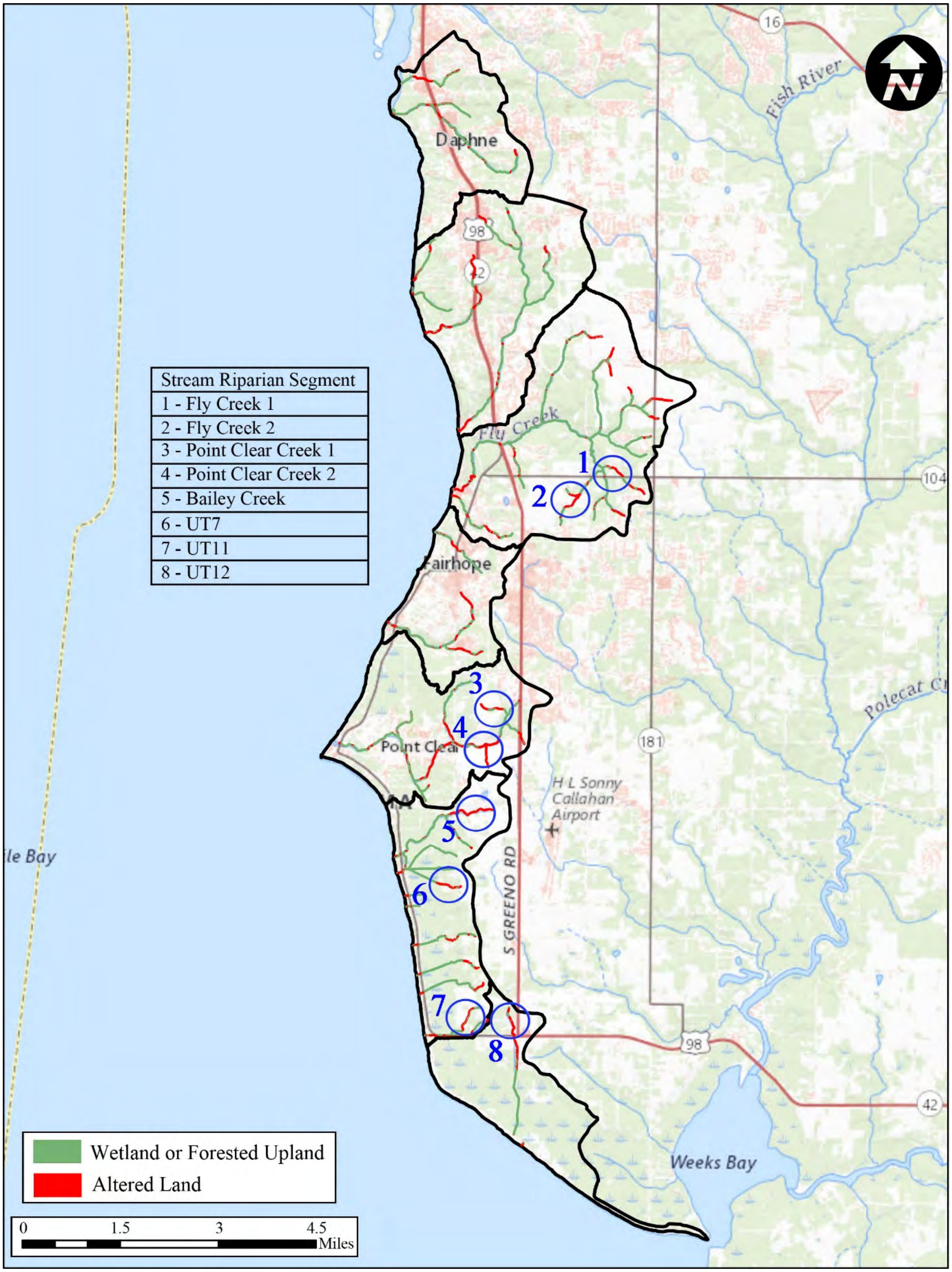

Figure 7.7 Location of potential riparian buffer restoration projects in the Watershed

7.5.5 Sanitary Sewer Infrastructure

7.5.5.1 Septic to Sewer Conversion

Many of the residents on the Eastern Shore utilize the sewer service provided through a utility company; however, there are still residents with septic tanks (including the Fly Creek subbasin and Twin Beech community). Poorly maintained septic systems can leak effluent into surface waters. Conversion from septic tanks to a sanitary sewer requires first an inventory of the systems to be upgraded, public education about the benefits of converting these systems, identification of funding to convert to sanitary sewer, and finally implementation of the construction phase to abandon existing septic systems and tie into sewer lines.

7.5.5.2 Sanitary Sewer Overflows

Sanitary sewer overflows during extreme rain events (due to inflow and infiltration of stormwater and/or groundwater into leaking sewage collection systems) is a typical occurrence in aging wastewater infrastructure. Mobile Baykeeper has tracked SSOs in the greater Mobile Bay area for over a decade. Figures 7.1 and 7.2 show the location and relative magnitude in terms of volumes released from SSOs in the Eastern Shore Watershed in 2021 and in 2022, respectively (Mobile Baykeeper 2022). To address this issue, an inflow and infiltration analysis is recommended, including smoke testing, to detect the areas within the collection system where leaks are occurring. Prioritizing and planning for replacement of this infrastructure can greatly reduce the frequency of sanitary sewer overflows and consistently reduce levels of pathogens present in surface waters throughout the Watershed. In addition to rehabilitation or replacement of collection lines, rehabilitation of sewer manholes may also be necessary. An analysis of the overall wastewater system to include projected growth and future demands is recommended. Upgrading existing lift stations to accommodate greater pumping capacities will reduce the risk of sanitary sewer overflows both in the current conditions and as well as meet the requirements of future pumping demands.

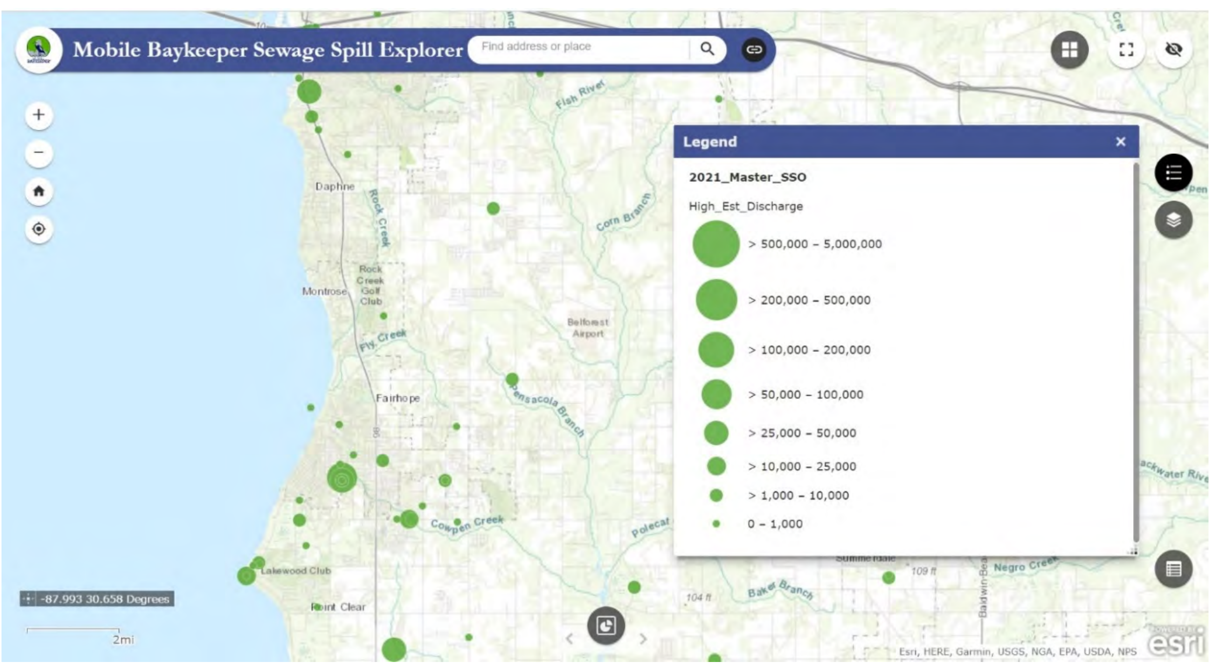

Figure 7.8 Location and relative magnitude of SSOs occurring in 2021
Source Mobile Baykeeper (2022)

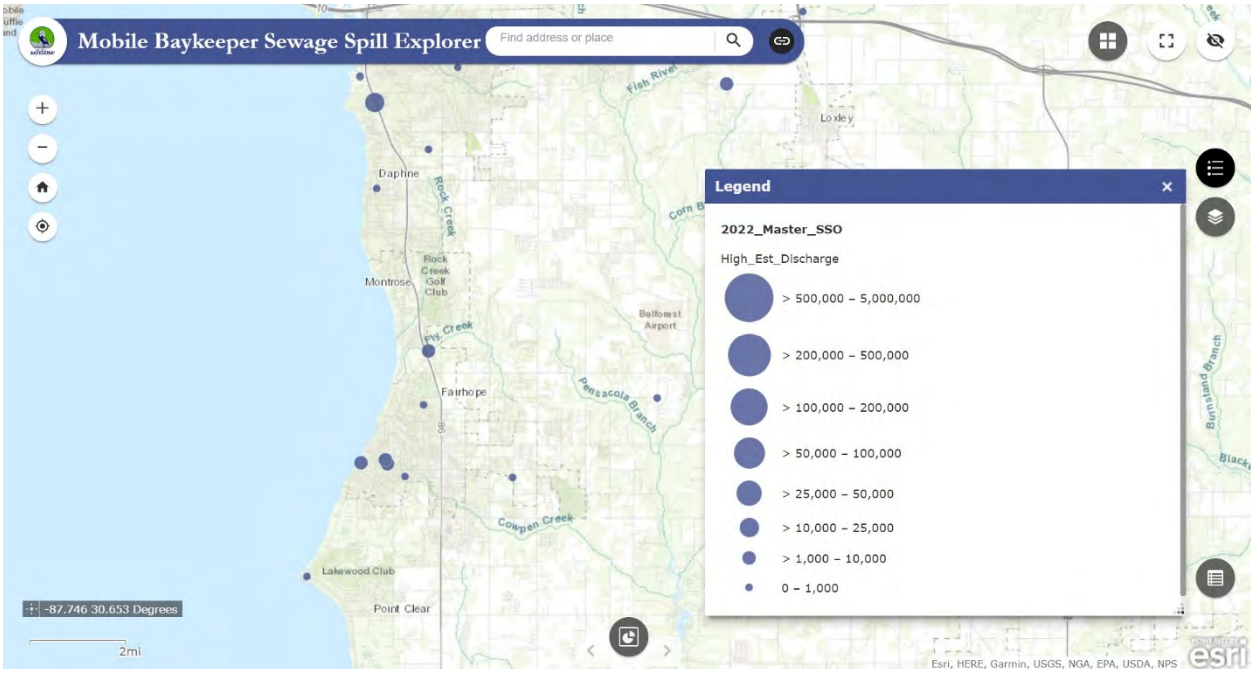

Figure 7.9 Location and relative magnitude of SSOs occurring in 2022
Source Mobile Baykeeper (2022)

7.5.5.3 Unpermitted Discharges from Septic Systems

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 municipal systems 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. Additionally, an inventory of septic systems that predate the existing ADPH inventory should be developed as well as implement an effort to quantify the contribution of septic systems to both the pathogen and nutrient loadings within stream segments having water quality issues. Once the inventory is complete, a GIS analysis should be implemented to identify "hot spots" where septic system locations are in poor soil types for such facilities and are in close proximity to streams, wetlands, and surface water conveyances.

7.5.6 Assess flooding causes and determine potential remedies in the underserved community of Twin Beech

At least two different studies have been completed in the Twin Beech Community, located in the city of Fairhope, that involved engagement from stakeholders in the community to identify the issues and develop potential solutions/designs. In 2018, the Gulf Coast Design Studio completed the *South Fairhope Community Action Plan* and in 2021 DesignAlabama in conjunction with Baldwin County Commission completed a community concept design *Twin Beech: Preserving and Celebrating our Community*. During both studies the enlisted groups held multiple community meetings and charettes to hear from residents what the fundamental issues are in their community and then identify ways to address these concerns. In both studies, flooding and stormwater management were paramount and addressing increasing frequency and intensity of flooding is a high priority throughout the community. Along with the direct (localized) effects associated with persistent flooding, confusion around the Tatumville gully stormwater system further complicates the matter so that it is not always clear who is responsible for causing and/or solving drainage problems (Gulf Coast Design Studio).

Baldwin County and Planning District 8 is encouraged to follow the strategy identified in the Gulf Coast Design Studio's report:

1. Organize an outreach campaign to inform residents what is being done to address ongoing drainage and flooding issues.
2. Develop campaign to inform the public about the stormwater/gully system as it relates to public and private property.
3. Review current policy and enforcement mechanisms of stormwater management to reduce the impact of future development.
4. Identify ways to fund stormwater management.
5. Identify key stormwater holding areas to put into conservation.

7.5.7 Tributary assessment and restoration

The documented accelerated growth along the Eastern Shore can compound existing water quality issues and increase stormwater runoff along with excessive rainfall events. Impacts from rapid runoff and erosion have resulted in increases in nutrient runoff, sediment transport, and loss of biological habitat in downstream streams. Sediment can be generated from upland sources in the form of sheet, rill, or gully erosion and transported to nearby waterbodies during stormwater runoff events. Sediment can also be generated from stream scour and bank erosion due to increases in stream flow (velocity and/or volume) often caused by increases in stormwater runoff associated with development or agricultural practices. Excessive sediment delivery to bay waters can cause several biological and physical impacts, including significant losses in water clarity, a key factor contributing to the loss of SAV in Mobile Bay.

Fly Creek is highly incised downstream of US Hwy 98 and exhibits significant wetland impacts as well as erosion and head cutting along its main stem and tributaries. The results of a pre-restoration baseline assessment (Cook, 2021) indicate Fly Creek is delivering significant sediment loads to Mobile Bay. The eroded streambed of Fly Creek at the west side of Highway 98 has been targeted for restoration as it not only poses a threat to stream habitat fragmentation, but also endangers the long-term stability of the highway's culvert drainage infrastructure which could lead to a catastrophic roadway failure during major storm events such as a hurricane. Many other tributaries are experiencing similar conditions and need to be assessed for possible restoration. A region-wide sediment reduction analysis is recommended for four major tributaries (Fly Creek, Point Clear Creek, Yancey Branch, and Rock Creek) to Mobile Bay in addition to the gully systems noted above.

7.6 Habitat Loss

Habitat loss due to overdevelopment was noted throughout the planning process. Most notable is the loss of pristine upland and wetland habitats. Invasive species are also abundant and exacerbate loss of native biological communities.

7.6.1 Land acquisition for habitat preservation, wetland protection, and riparian buffers

This management measure is intended to develop a coordinated plan regarding acquisition of property or establishing new conservation easements to protect existing significant habitat tracts through agreements with willing landowners. Key criteria for strategic parcel acquisition include; identifying lands with important natural resources, lands in proximity to or adjacent to existing easements and protected open space areas, and parcels of sufficient size to warrant protection and justify the expense involved to protect high quality wetland and stream habitats.

7.6.2 Habitat Preservation and Wetland Protection

Existing protected lands are mostly located in the large areas of low, flat, freshwater wetlands south of Point Clear, east CR 1 and Scenic 98 (Figure 7.3). Total protected wetland acreage in the UT12 Subwatershed is 755 acres, mostly in tracts belonging to the ADCNR State Lands Division and the Forever Wild Land Trust. Protected wetland acreage in the Bailey Creek Subwatershed is 152 acres. Large areas of these wetland systems remain unprotected.

The Habitat Conservation and Restoration Plan for Coastal Alabama (MBNEP and TNC 2019) included a review and update of the 2009 habitat prioritization criteria developed by TNC and the CHCT, based on new knowledge from completed watershed plans or work in the field. Criteria included priority for all unprotected riverine freshwater wetlands from 2.5 to 25 acres in area and greater than 1,000 m (3,281 ft) from medium-to-high intensity developed areas.

A total of 44 individual parcels are identified as conservation priorities in the Watershed, with wetland areas by parcel ranging from 3.9 to 85.5 acres (Table 7.2). A list of these parcels and locator maps are contained in Appendix I.

Table 7.2 Number of priority conservation parcels by Subwatershed, including total acreage, wetland acreage, and feet of stream.

Subwatershed	Number of Priority Parcels	Total Parcel Acreage	Total Wetland Acreage	Total Feet of Stream
Fly Creek -UT4	4	389.8	47.9	5,664
Point Clear Creek	5	178.0	166.7	0
Bailey Creek-UT7-UT8-UT9-UT10-UT11	20	555.1	431.1	7,150
UT12	15	325.3	322.7	0

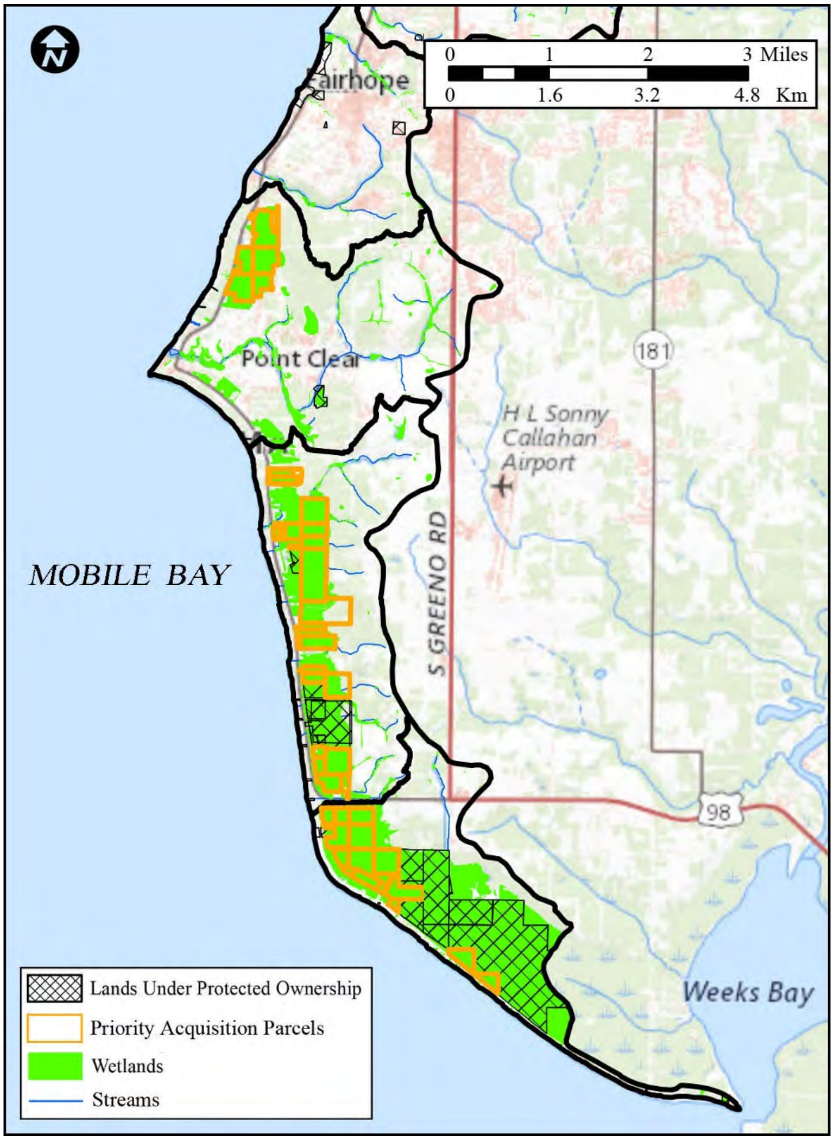

Figure 7.10 Priority conservation parcels in the Watershed

Inclusion in the priority parcel list does not imply that all are targeted for acquisition or new conservation easements, only that they comprise freshwater wetlands in whole or part and meet the minimum acreage criterion for prioritization (MBNEP and TNC 2019). Most of the identified parcels are located entirely or partly in the Alabama coastal zone (below the 10-ft elevation contour) and are afforded enhanced regulatory protection restricting wetland fill and development. ADEM may provide coastal consistency certification for residential and commercial projects that involve placement of up to 0.1 acre (4,356 ft^2) of fill in non-tidal wetlands for each of the platted parcels. This certification applies to all coastal area properties platted prior to August 14, 1979, which cannot be subdivided to increase allowable wetland fill. Regulatory limits on the use of the lands comprising these properties may afford opportunities for acquisition or establishing new conservation easements. Parcels with amenable owners should be inspected to verify the occurrence of priority conservation habitat and document its extent and ecological condition, prior to pursuing acquisitions or establishment of new conservation easements.

Four parcels in the Fly Creek-UT4 Subwatershed are mostly upland forest, with intact wetland and riparian buffers (Figure 7.4). These areas meet habitat criteria for priority conservation streams which include intact 30-m (~100-ft) wide riparian buffers bordering both sides of streams, and at least 500-m (1,640-ft) stretches of intact habitat (MBNEP and TNC, 2019).

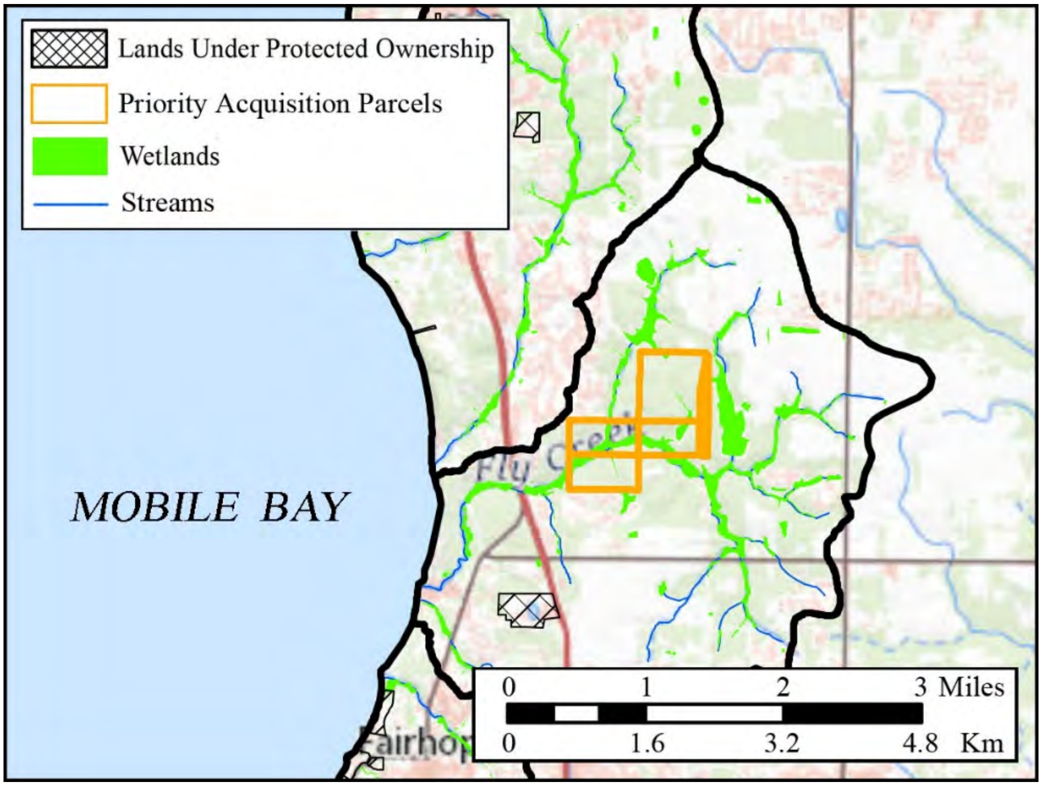

Figure 7.11 Priority conservation parcels along Fly Creek

7.6.3 Invasive Species Management

There are many infestations of invasive plants within the Watershed, causing adverse impacts to native plant and animal communities. The most impactful invasive species as well as the priority habitats affected in the coastal area are generally known, as are the methods and techniques designed to control infestations.

Known locations of invasive plant infestation include Village Point Preserve Park and Fairhope Municipal Pier Park. Both sites are infested with numerous invasive exotic plants and are recommended for ecosystem management through invasive plant eradication and post-treatment monitoring.

Other public protected lands not surveyed as part of this watershed planning effort are candidates for invasive plant inventory assessment and potential management. These properties owned by the cities of Daphne and Fairhope comprise natural green spaces in the urban landscape, many of which envelop or are adjacent to watershed streams. Potential survey locations are shown in Figures 7.5 and 7.6 and listed in Table 7.3. Plant community assessment of these sites would identify the location and extent of targeted species and provide accurate estimated costs to remove or control target invasive plants, as well as develop a monitoring plan for measuring program results. After prioritizing problem locations and the most environmentally damaging invasive species, eradication policies and procedures could then be implemented with the goal of restoring natural ecosystem functions.

Table 7.3 Potential locations for invasive exotic plant surveys and management.

Map ID (Figures 7.5 and 7.6)	Owner - Location
1	City of Daphne - Bayfront Park
2	City of Daphne - Bayfront Park
3	City of Daphne - Village Point Preserve
4	City of Daphne - Village Point Preserve
5	City of Daphne - Village Point Preserve
6	City of Daphne - Daphne Sports Complex
7	City of Daphne - Daphne Sports Complex
8	City of Daphne - Yancey Branch
9	City of Daphne - Rock Creek tributary
10	City of Daphne - UT2
11	City of Daphne - Rock Creek
12	City of Fairhope - Fly Creek
13	City of Fairhope - Dyas/Triangle
14	City of Fairhope - UT5
15	City of Fairhope - UT5
16	City of Fairhope - UT5
17	City of Fairhope - Fairhope Municipal Pier and Park
18	City of Fairhope - Fairhope Municipal Pier and Park

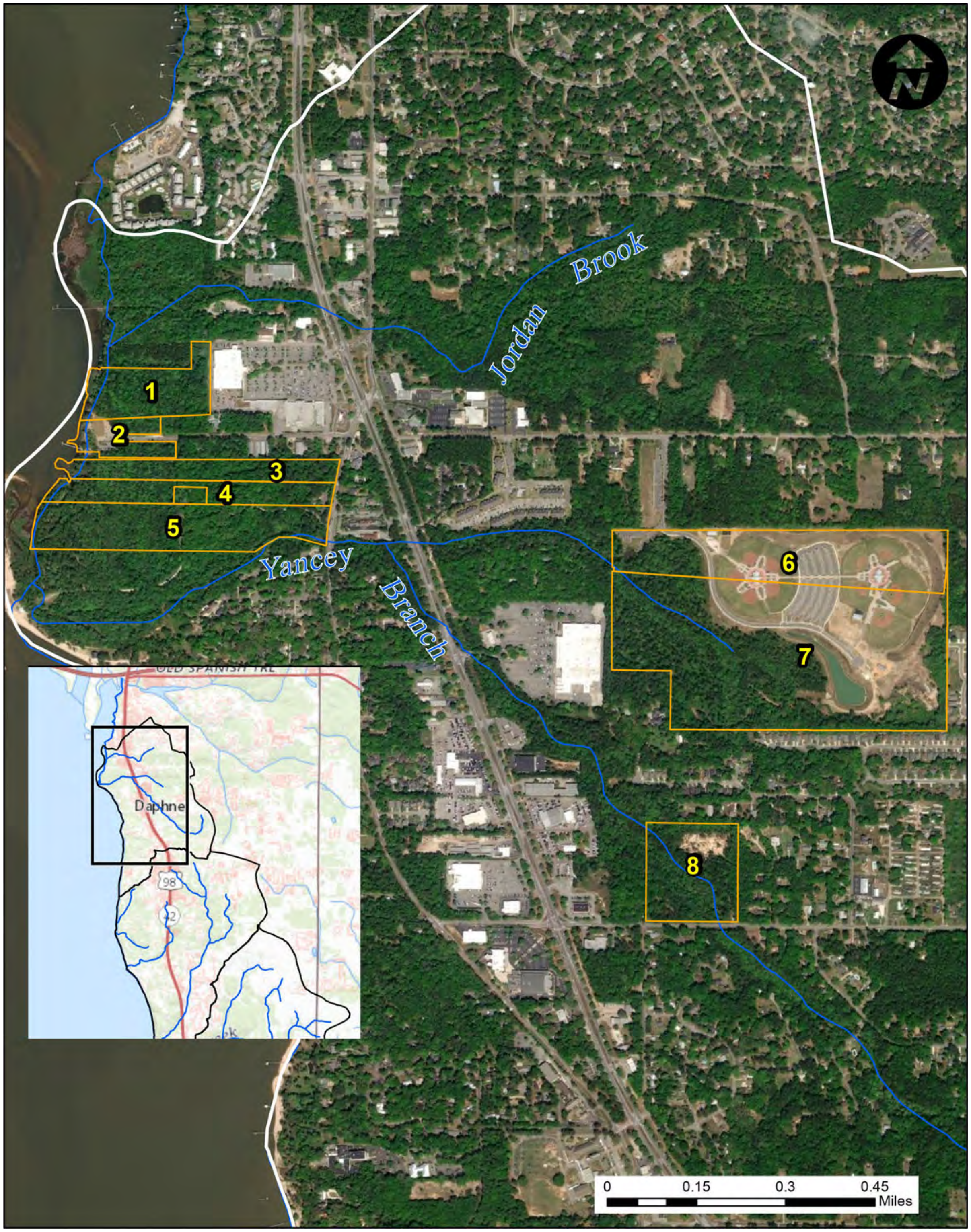

Figure 7.12 Potential parcels for invasive exotic plant inventory surveys and treatment.

Figure 7.13 Potential parcels for invasive exotic plant inventory surveys and treatment.

7.7 Environmental Health and Resilience

Results of the SLR models described in the Climate Vulnerability Chapter 5.0 provide some indication of the Watershed's vulnerabilities as they relate to SLR, storm surge, and resiliency. Infrastructure located between Point Clear and the mouth of Weeks Bay are most susceptible to flooding due to low elevations, with upwards of 800 structures predicted to be damaged under the 100-year storm surge and 1.0 m of sea-level rise.

7.7.1 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. 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 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 - 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 – "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 - 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.

7.7.2 Land Use Planning and Zoning

All the municipalities in the Eastern Shore are prone to flooding and present the highest risk to residents and infrastructure. Municipalities can 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.

7.7.2.1 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 the municipalities to identify areas within the Watershed that are at highest risk and identify alternative locations to minimize risk. As mentioned previously, the cities of Fairhope and Daphne as well as Baldwin County are currently undergoing Comprehensive Land Use Planning efforts and should include this type of analyses in their planning efforts.

7.7.2.2 Create Future Land Use Map

After identifying areas of vulnerability, Future Land Use Maps, that are consistent with the Comprehensive Land Use Plans, should be developed. The Future Land Use Maps should address risk minimization as well as follow the overall vision for how and where development should occur within the Watershed. For instance, the City of Fairhope should explore alternative locations for critical infrastructure including a wastewater treatment plant and fire station, which are currently located within the floodplain. Land use and accompanying zoning is a tool that local governments can use to ensure that development within the most vulnerable and flood prone areas is restricted. By doing so, it will encourage the development of new residential and commercial endeavors by limiting the uncertainty developers might encounter.

7.7.2.3 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 the cities of Daphne and Fairhope 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 National Flood Insurance Program (NFIP) standards. Additionally, FEMA provides several funding opportunities for technical assistance and Hazard Mitigation Assistance to help communities fund projects to reduce flood impacts.

7.7.2.4 Participate in the Coastal Resiliency Index Program

The Coastal Resilience Index (CRI) 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's resilience to coastal hazards and weaknesses that need to be 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). The City of Fairhope completed the CRI in 2016 and gained some valuable information. City staff are currently in discussions to redo the CRI after having endured significant impacts from Hurricane Sally in 2020 as well as having completed several infrastructure upgrades. Fairhope is also considering entering into the Community Rating System updating their CRI will assist them towards that goal.

7.8 Shoreline Erosion

As the population has increased in coastal Alabama, the amount of armoring to protect against erosional forces has increased. With increased modification of the natural system, the littoral drift system has been compromised. The sand that once naturally bypassed tidal inlets and nourished neighboring coastal segments has become minimized (Boyd and Pace 2012). The shoreline along the Eastern Shore of Mobile Bay has experienced significant erosion which has resulted in an increase in man-made alterations such as seawalls, bulkheads, and rip-rap with the most significant man-made alterations including excavation for marinas, jetties, and fill. Areas that have experienced significant changes over time are Bay Front Park/ Village Point, Ragged Point/Red Bluff, Fly Creek, Fairhope Pier, Point Clear, and Pelican Point**.**

7.8.1 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 2015). However, the natural shoreline habitats in the Eastern Shore Watershed have experienced losses and degradation. Therefore, management measures should focus on protecting, conserving, preserving, or restoring shorelines and natural shoreline habitats. Some specific recommendations are outlined below and described in more detail in Chapter 8:

- Comprehensive study of dilapidated piers to include; GIS inventory of damaged piers and a feasibility assessment of repair or removal along with natural shoreline stabilization.
- Updated assessment of stormwater outfalls along Mobile Bay. The last study was conducted in 2012 and many storms, extreme high tide events, and Hurricane Sally could have created significant damage to outfall infrastructure and surrounding shoreline. The assessment should include evaluation of the outfall pipes as well as feasibility of creating natural infrastructure around the outfall for future protection and reduction of sediments.
- In coordination with the Mobile Bay National Estuary Program, local municipalities on the Eastern Shore should coordinate and participate in the development and implementation of a comprehensive coastline/shoreline management plan for the entirety of Mobile Bay.

7.8.2 Implement Living Shorelines

Vertical bulkheads degrade habitat at their toes and reflect wave energy to nearby unprotected shorelines, causing erosion. Much better alternatives involve the use of living shorelines, or nature based, 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 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 7.7 (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, seeks to maintain the sustenance, and improve biodiversity of the ecosystem.

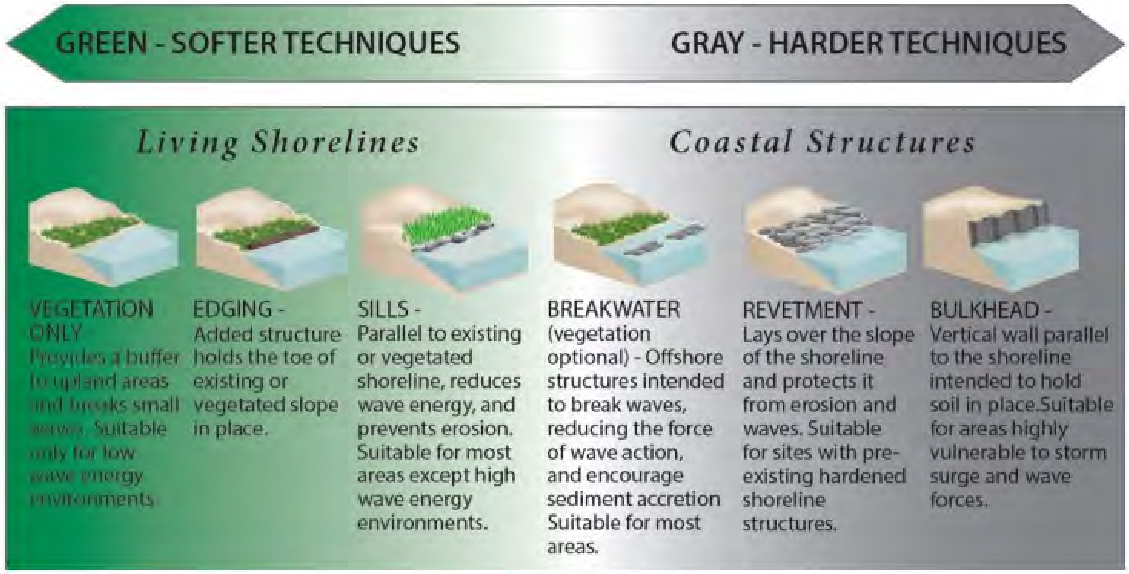

Figure 7.14 Green (soft) to gray (hard) shoreline stabilization techniques
Source: NOAA 2015

For living shorelines to be a cost-effective, understandable, and viable alternative for public and private property owners several measures will need to be implemented. Those measures are outlined below:

- Update and broadly distribute the MBNEP's "Living Shorelines: A Guide for Alabama Property Owners" manual. The manual is a comprehensive approach for coastal property owners on the importance of living shorelines, how they can be used to protect their property, and implementation guide. The initial manual was produced in 2014 and was updated by Mississippi Alabama Sea Grant Consortium in 2021. This document should be updated periodically as new standards and regulations occur. Once updated, it should be promoted by local municipalities and distributed broadly to coastal property owners.
- Work with property owners, municipalities, and others to develop living shoreline demonstration sites that are accessible to the public and can be followed as a step-by-step guide on how to design, implement and permit a living shoreline project. Potential demonstration sites have been identified and are listed in Chapter 8.
- Work with local, state, and federal permitting agencies to streamline permitting processes for living shorelines and residential properties. Currently, certain challenges exist with permitting living shorelines including coastal property rights, disruption or removal of natural vegetation, placement of rock or shell on submerged state lands, etc. To streamline the process of permitting these projects, agencies will have to accept a certain degree of impact for these projects to be implemented in a more expedited manner. The Coastal Alabama Living Shorelines Policies, Rules, and Model Ordinance Manual developed for the MBNEP with a grant from the Alabama Department of Conservation and Natural Resources, State Lands Division, Coastal Section with funding from the NOAA Office of Ocean and Coastal Resources Management details these potential impacts agencies may need to accept (Boyd and Pace, 2012).

7.9 Intergovernmental Coordination

Throughout the planning process the Planning Team heard from stakeholders that coordination among County and municipal governments is vital to advancing any recommendations and projects that have been identified in the Watershed. Baldwin County has been proactive in starting to coordinate among these groups and there is real value in continuing to support this effort and expanding to include different groups as needed for different issues.

7.10 Projects Previously Submitted to Deepwater Horizon Oil Spill Portals

Table 7.4 presents a compiled list of proposed projects within the Eastern Shore Watershed area that have been generated from various lists developed after the Deepwater Horizon Oil Spill by local resources management agencies and nongovernmental organizations. This list is only proposed projects that would directly affect improvements in water quality or ecosystem function. Sources for this list include:

- **AL Portal** - Projects submitted to the Alabama RESTORE Council Portal for funding consideration (http://www.alabamacoastalrestoration.org/View-Projects)
- **NOAA Project Portal** - Projects submitted to NOAA for Natural Resource Damage Assessment consideration (http://www.gulfspillrestoration.noaa.gov/restoration/give-us-your-ideas/view-submitted-projects)
- **Deepwater Horizon Project Tracker** – Provides a comprehensive list of projects submitted to various funding agencies. Projects from this source appear in previous sections of this chapter so are no included in the table. (https://dwhprojecttracker.org/).

Table 7.4 Water Quality and Ecosystem Restoration Project List Submitted on Deepwater Horizon Spill Portals

Portal Information Link	Project Number and Name	Contact	Type	Cost
https://www.outdooralabama.com/alabama-coastal-restoration-program/alabama-coastal-restoration-single-project-lookup	412, Eastern Shore SSO Prevention Plan	Fairhope	Water Quality	$1M
https://www.outdooralabama.com/submit-your-project-idea/alabama-coastal-restoration-project-map	88 - City of Fairhope - Fairhope Area Community-Based Comprehensive Land Use Plan, S1P17-FACP	Fairhope	Planning	Unknown
https://www.outdooralabama.com/submit-your-project-idea/alabama-coastal-restoration-project-map	68 - City of Fairhope - Working Waterfront and Greenspace Restoration Project, M1A14-FHWW	Fairhope	Planning	Unknown
https://www.outdooralabama.com/submit-your-project-idea/alabama-coastal-restoration-project-map	83 - Marsh Restoration in Fish River, Weeks Bay, Oyster Bay & Meadows Tract	NOAA, State of AL	Restoration	$3.2M
https://www.outdooralabama.com/submit-your-project-idea/alabama-coastal-restoration-project-map	106 - Fairhope Sewer System Upgrades Phase I, S1P25-FSU1	Fairhope	Infrastructure, Water Quality	$10M
https://www.outdooralabama.com/submit-your-project-idea/alabama-coastal-restoration-project-map	398, Fairhope Sewer System Upgrades Phase II	Fairhope	Infrastructure, Water Quality	$30M
https://www.outdooralabama.com/alabama-coastal-restoration-program/alabama-coastal-restoration-single-project-lookup	106, Lower Fly Creek Reach Project	Fairhope	Ecological & Water Quality	$14.7M
https://www.outdooralabama.com/alabama-coastal-restoration-program/alabama-coastal-restoration-single-project-lookup	126, Coastal Environmental Education Network	Fairhope	Ecological & Water Quality	$49M
https://www.outdooralabama.com/alabama-coastal-restoration-program/alabama-coastal-restoration-single-project-lookup	165, Yancey Branch Watershed Restoration	Daphne	Ecological Restoration	$5.5M
https://www.outdooralabama.com/alabama-coastal-restoration-program/alabama-coastal-restoration-single-project-lookup	236, Wastewater Reuse Project	Daphne	Infrastructure	$950K

Portal Information Link	Project Number and Name	Contact	Type	Cost
https://www.outdooralabama.com/alabama-coastal-restoration-program/alabama-coastal-restoration-single-project-lookup	509, Red Gully Stream Bank Stabilization	Baldwin County	Restoration	$2.5M
https://www.gulfspillrestoration.noaa.gov/restoration/give-us-your-ideas/view-submitted-projects	Predicting landscape-level impacts to in-stream sediment and nutrient flux to coastal waters	WBNERR, SALT	Water Quality	$350K
https://www.outdooralabama.com/alabama-coastal-restoration-program/alabama-coastal-restoration-single-project-lookup	528, Fairhope Storm Water Infrastructure Inventory	Fairhope	Water Quality	$670K
https://www.gulfspillrestoration.noaa.gov/restoration/give-us-your-ideas/view-submitted-projects	Fly Creek Restoration, NOAA (Triangle)	Fairhope	Land Acquisition	$19M
https://www.gulfspillrestoration.noaa.gov/restoration/give-us-your-ideas/view-submitted-projects	Fairhope Public Beach's Water Quality Treatment	Fairhope	Water Quality	$4.5M
https://www.gulfspillrestoration.noaa.gov/restoration/give-us-your-ideas/view-submitted-projects	Titi Swamp Wetland Purchase and Preserve	Fairhope	Land Acquisition	$500K
https://www.gulfspillrestoration.noaa.gov/restoration/give-us-your-ideas/view-submitted-projects	Restoration of Tidal Flow to Meadows Tract	WBNERR; SALT	Restoration	$1M
https://www.gulfspillrestoration.noaa.gov/restoration/give-us-your-ideas/view-submitted-projects	Eastern Mobile Bay and Bon Secour Bay Coastal Resiliency and Habitat Restoration	WBNERR, ADCNR, Fairhope	Restoration	$16.5M ($610K available)

8.0 Implementation Strategies

8.1 Introduction

This chapter provides a strategy to address the critical issues identified for the Eastern Shore Watershed by implementing recommended management measures presented in Chapter 7.0, identifies associated costs, and presents a two-phased implementation approach (short-term phase and long-term phase) to achieve success for those management measures.

The issues and problems threatening the health of the Eastern Shore occur throughout the entire Watershed and extend across political boundaries. Large portions of the Watershed fall within the Cities of Fairhope and Daphne while others are within unincorporated areas of Baldwin County. Therefore, the responsibility for site inspections and enforcement of management ordinances are spread across those various jurisdictions. The MBNEP PIC is an established group comprising many of the agencies and/or entities represented on the Steering Committee and can provide a broad geographic support base dealing with coastal Alabama issues in Baldwin as well as Mobile Counties.

8.2 Phase One Implementation Strategies: Short-Term Measures (0-2 years)

Feedback gained through the stakeholder outreach efforts stressed the need for short-term wins or tangible successes promptly following WMP adoption to gain the confidence of the stakeholders and build on the momentum generated through WMP development. Parallel with this need to capture early successes is the need to foster and harness interest in environmental stewardship of the Watershed. With these considerations in mind, management measures were grouped into two phases. The short-term management measures were chosen based on their likelihood of successful implementation within the next two years. Some facets of implementation of these short-term measures will likely extend longer than the two years, but are included since substantial progress is anticipated over this two year period.

Table 8.1 lists each short-term measure and provides a rough order-of-magnitude cost estimated to implement the measure. It should be noted that preparation of detailed cost estimates was not possible due the conceptual level of planning that guided development of this WMP. The cost estimates are intended for preliminary budgetary considerations. Additional descriptions of each recommended management measure are provided in Chapter 7.0. The following are the recommended management measures that fall into the short-term category. Measures that should be implemented expeditiously upon release of the Plan are in **bold**:

- **Tributary assessment and restoration (Fly Creek, Point Clear Creek, Yancey Branch, and Rock Creek)**
- **Assess flooding causes and determine potential remedies in the underserved community of Twin Beech**
- **Assess the health and functionality of the gully systems along the Eastern Shore**
- **Establish and initiate a water quality monitoring program**
- **Clean Marina Program**
- **Community Resilience Index**
- Develop a stormwater master plan
- Septic to sewer conversion plan (priority: Fly Creek)
- Comprehensive litter abatement plan, including; strategically placed street signage
- Post-storm in-stream debris removal plan
- Increase green spaces throughout the watershed

- Increase community signage in historic communities (ie; Twin Beech, Barnwell, Historic Downtown Daphne, Historic Downtown Fairhope, Point Clear, Montrose, Daphmont)

Table 8.1 Short-Term Management Measures

Measure	Area	Unit	Cost Per Unit	Total Cost
Tributary Assessment and Restoration	Fly Creek	Linear foot	-	Assessment = $500/linear foot Restoration = $1,200/linear foot
	Point Clear Creek	Linear foot	-	Assessment = $500/linear foot Restoration = $1,200/linear foot
	Yancey Branch	Linear foot	-	Assessment = $500/linear foot Restoration = $1,200/linear foot
	Rock Creek	Linear foot	-	Assessment = $500/linear foot Restoration = $1,200/linear foot
	Jordan Brook	Linear foot	-	Assessment = $500/linear foot Restoration = $1,200/linear foot
Assess Flooding in Twin Beech Community	Fairhope	-	-	
Gully Systems Assessment and Restoration	Volanta Gully	Linear foot		Assessment = $500/linear foot Restoration = depends on severity
	Tatumville Gully	Linear foot		Assessment = $500/linear foot Restoration = depends on severity
	Stack Gully	Linear foot		Assessment = $500/linear foot Restoration = depends on severity
	Big Mouth Gully	Linear foot		Assessment = $500/linear foot Restoration = depends on severity
	Red Gully	Linear foot		Assessment = $500/linear foot Restoration = depends on severity
Long-Term Water Quality Monitoring Program	ESW	-	-	Initial Plan - $85,000 Program - $125,000/year
Develop a Stormwater Master Plan	ESW	-	-	See Note 1
Stormwater Conveyance Ditch	Lake Forest, Daphne	-	-	See Note 1
Septic to Sewer Conversion Plan	ESW	-	-	See Note 1

Measure	Area	Unit	Cost Per Unit	Total Cost
Litter Abatement Plan	ESW	Municipality	$57,000/yr	$114,000
Litter Signage Plan	ESW	-	-	See Note 2
	Fairhope: Fairland Avenue (Twin Beech), US 98 near Parker Road (Fly Creek), and US 98 near 104 (Fly Creek)	-	-	See Note 2
Post-storm In-stream Debris Monitoring and Clean-up Plan	ESW	-	-	See Note 1
Increase Green Spaces	ESW	-	-	See Note 1
	Dyas Triangle - Fairhope	-	-	$1M (GOMESA)
Increase Historic Signage in Historic Communities	Twin Beech, Barnwell, Daphmont, Montrose, Point Clear	Sign	$2,500	$25,000
Clean Marina	Fairhope Marina and Docks	-	-	See Note 3
Community Resilience Index	City of Fairhope (Update January 2023)	Municipality	-	No cost

Note: ESW=Eastern Shore Watershed
Note 1: Cost TBD by determined based on funding, scope and project sponsor
Note 2: Cost to be covered by ADEM through local municipalities
Note 3: Cost to be absorbed by internal administrative costs of participating organizations, municipalities, county, and agencies

Red Gully (a treatment): The most recent Red Gully Stream bank stabilization effort occurred over two decades ago. While the areas previously restored are still stable, there are other areas that have continued to degrade over time due to the erosive forces of stormwater runoff. This stream has been reported many times carrying dense red sediment loads and causing large plumes in Mobile Bay, resulting in sediment deposition in the stream and in the bay. These soils originate from upstream sources, legacy bedloads from past erosional events, and the failure of stream banks within Red Gully itself. An Engineer's assessment of the Red Gully project extents is estimated to cost $500 per linear foot, while construction costs may range upwards of $1,000 per linear foot. Construction will include natural materials derived from on site whenever possible and will implement the latest in stream restoration technologies. Natural plantings should be incorporated for stabilization. A long term invasive species control plan should also be implemented for the project.

Fly Creek Tributary assessment and restoration (a treatment): It is crucial to address the degradation and pollution of tributaries to protect the health and integrity of the main stream. Restoration efforts focused on improving tributary health can help mitigate these impacts and restore the overall ecological functioning and water quality of Fly Creek. Considerations for this project might include: (1) assessment of ecological function including habitat health and biodiversity; (2) consider the broader watershed context in which the tributary exists, assess the impacts of land use practices, stormwater runoff, and other activities; (3) evaluate the hydrological characteristics of the tributary, including its flow patterns, water volume, and potential sources of pollution; (4) identify appropriate restoration techniques based on the specific conditions and goals of the tributary such as habitat enhancement, bank stabilization, riparian vegetation restoration, instream structures, or water quality improvement measures; and (5) implement an adaptive management approach that allows for adjustments and improvements based on monitoring data and changing conditions.

8.3 Phase Two Implementation: Long-Term Measures (> 2 years)

Phase Two projects include a number of projects that could be initiated within two years, but some may require additional time for further analysis, planning, data collection, design, etc., prior to full implementation.

Table 8.2 lists each long-term measure and provides a rough order-of-magnitude cost estimated to implement the measure. It should be noted that preparation of detailed cost estimates was not possible due to the conceptual level of planning that guided development of this WMP. The cost estimates are intended for preliminary budgetary considerations. Additional descriptions of each recommended management measure are provided in Chapter 7.0. The following are the recommended management measures that fall into the long-term category:

- Comprehensive shoreline management plan for entire Mobile Bay
- Inventory and restoration needs assessment of public and private stormwater retention/detention ponds
- Restore degraded wetlands and riparian buffers
- Promote and expand the use of LID practices
- Identify areas for construction of living shoreline or shoreline protection/restoration measures
- Increase public access to Mobile Bay
- Develop a series of oral histories for significant historical communities including those above
- Land acquisition for habitat preservation, wetland protection, and riparian buffers
- Invasive species detection and management program
- Comprehensive study of dilapidated piers along Mobile Bay

8.3.1 Specific Low-Impact Development Components

The examples below are taken from ADEM's *Low Impact Development Handbook for the State of Alabama, (*http://www.adem.state.al.us/programs/water/waterforms/LIDHandbook.pdf) as components that could be incorporated throughout the Eastern Shore as well as some of the benefits to introducing these strategies:

- Adding roadside bioswales, making roads narrower and designing smaller or porous parking lots with on-site runoff retention **saves money by reducing the amount of pavement, curbs and gutters needed**.
- Installing green roofs, disconnecting roof downspouts from impervious surfaces (driveways or streets), and incorporating bioretention areas to capture on-site runoff **saves money by eliminating the need for costly runoff detention basins and pipe delivery systems**.
- Designing more compact residential lots saves money by reducing site grading and building preparation costs, and can increase the number of lots available for sale.
- Preserving natural features in the neighborhood can increase the value and sale price of residential lots.
- Using existing trees and vegetation saves money by reducing landscaping costs and decreasing stormwater volume.

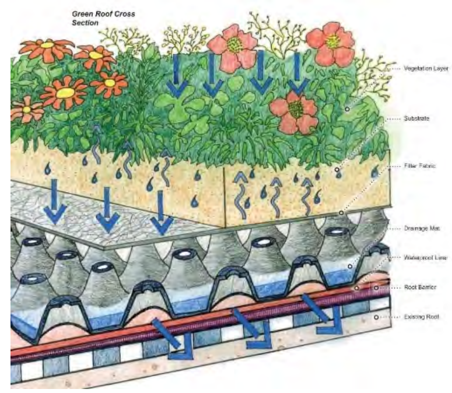

Figure 8.1 Green Roof Cross Section

Source: https://adem.alabama.gov/programs/water/waterforms/LIDHandbook.pdf

Table 8.2 Long-Term Management Measures

Measure	Area	Unit	Cost Per Unit	Total Cost
Promote and expand use of LID Practices	ESW	Municipality	See Note 1	See Note 1
Comprehensive Shoreline Management Plan	Mobile Bay	Bay	See Note 2	See Note 2
Identify areas for construction of living shoreline or shoreline protection/restoration measures	ESW	Linear foot	TBD	TBD
	Daphne - Grays Lane	Linear foot	TBD	TBD
Inventory and restoration needs assessment of public and private stormwater retention/detention ponds	ESW	Municipality	See Note 1	See Note 1
	Daphne - Maxwell Avenue Gully - City owned detention pond	Pond	See Note 1	See Note 1
Increase public access to Mobile Bay	ESW	Municipality	See Note 1	See Note 1
Develop a series of oral histories for significant historical communities	Twin Beech, Barnwell, Daphmont, Montrose, Point Clear	Community	See Note 1	See Note 1
Land acquisition for habitat preservation, wetland protection, and riparian buffers	ESW	Parcel	TBD	TBD

Measure	Area	Unit	Cost Per Unit	Total Cost
Restore degraded wetlands and riparian buffers	ESW	Acres	TBD	TBD
Invasive species detection and management program	ESW	Acres (initial treatment and 25-yr follow-up treatments)	TBD	TBD
Comprehensive study of dilapidated piers along Mobile Bay	ESW	Project	TBD	TBD

Note: ESW= Eastern Shore Watershed
Note 1: Cost to be absorbed by internal administrative costs of participating organizations, municipalities, county, and agencies
Note 2: The Mobile Bay NEP would be regional lead for this project.

LID Practices at Fairhope Duck Pond (a treatment): The duck pond near Fairhope Pier is in and of itself a low impact design feature. However, it has elements/infrastructure that has been added in, piecemeal, over the course of several decades. This project would involve creating a cohesive design with infrastructure that works in tandem with existing elements of the site. This could include restructuring the beach area, treating the water flowing from the east with a bioretention feature, treating water coming off of parking areas prior to entering the pond, etc.

8.3.2 Stormwater Basin Inventory and Assessment

The project would require in-depth mapping and data collection of the basins throughout the Watershed. The size, location, and use (wet or dry) should be documented. Site visits should be performed to document the status of the ponds, their functionality during storm events, and potential for retrofitting projects to achieve water quality improvements. Examples of field data to be collected include: 1) site photographs; 2) physical dimensions of inflow and outfall structures along with condition ratings; 3) observation of overall bank, fill slope, cut slope, pond invert, and vegetative cover; 4) soil probe of pond invert to estimate siltation depth; 5) record visible high water marks; and 6) review any available stormwater pond design plans. The data collected will be utilized to develop a rating scheme to rank the condition of the stormwater ponds, estimated amount of impairment, proximity to downstream sensitive environmental features, or human population density areas, etc. The rating system would be used to rank the ponds and develop a priority list for retrofitting purposes. The mapping data will help the municipalities and county when selecting demonstration retrofitting project sites.

8.3.2.1 Demonstration Projects for Stormwater Basins Retrofits

As a result of the above inventory and assessment project municipalities and HOA/POA organizations will also have the opportunity to learn about demonstration sites throughout the area. In this way, stakeholders will be able to see first-hand how a basin can be made more efficient, functional, and sustainable. Retrofit treatment options for the demonstration sites may include:

- extended detention
- conversion of dry ponds to wet ponds
- constructed wetlands within ponds
- bio-retention
- additional filtering practices, including native grass plantings
- swales
- other (roof runoff treatment using rain gardens, rain barrels, planters, etc.)

The option selected for each site will be based on the major issue with that site. This could be flow rate, retention time, sedimentation within the pond, or invasive plant pressure. After the site selection, the implementation of the retrofits will take approximately six months. Additional information related to retrofitting of existing wet ponds and wetlands are found in the USEPA's "Stormwater Wet Pond and Wetland Management Guidebook" (2009) (Appendix J).

8.4 Evaluation Framework and Milestones

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 ESWMP 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.

8.4.1 Short-Term Milestone Period (0 – 2 years)

- Has the Water Quality Monitoring Program been established, a qualified entity identified to carry out the program identified/funded, and the field monitoring initiated?
- Has a scope of work/cost estimate been developed, and funding sought for stormwater basin inventory and assessment for the Watershed?

8.4.2 Mid-Term Milestone Period (2-5 years)

- Have specific projects and management measures proposed in the WMP been fully implemented and completed?
- Have demonstration projects been designed/constructed for retrofitting of a few stormwater basins for water quality improvements?
- Have living shoreline demonstration sites been designed/constructed?
- Have living shoreline permitting challenge discussions started between the appropriate agencies/partners?
- Have there been reductions in the sediment, nutrient, and bacteria loading rates?
- Have LID/GI practices been increasingly utilized within the Watershed?
- Have LID/GI regulations been adopted by more municipalities and by Baldwin County?
- Have increased invasive species detection and management programs been implemented?

8.4.3 Long-Term Milestone Period (5-10 years)

- Have green spaces increased throughout the Eastern Shore?
- Has the water quality monitoring program continued long-term?
- Have more citizens participated in Alabama Water Watch?
- Has water quality improved in Mobile Bay?
- Have strategic land acquisitions been accomplished?

- Have degraded streams, wetlands, and riparian buffers been restored?
- Have invasive species been eradicated at identified hot spots?
- Did the level of public interest and participation rise to the level of helping to achieve the WMP goals?

8.5 Monitoring

The municipalities and county in the Eastern Shore Watershed should develop success criteria to judge progress towards meeting the overall goals and objectives outlined in Chapter 1.0. These success criteria should be developed with input from stakeholders and the general public and should be evaluated on a routine basis. This evaluation process along with performance monitoring presented in Chapter 11.0, should be used to assess whether specific management measures are addressing the critical issues and areas they were designed to address or whether adjustments are required.

A regular reporting schedule is necessary to archive and track monitoring data and assess the overall success of management actions. Progress reports for the Watershed should be prepared and shared with MBNEP and stakeholders. Reporting should be conducted on at least an annual basis, although interim reporting may be helpful in critical watershed areas or where more frequent monitoring is needed to track success of specific management actions. Annual reports should include at a minimum: a summary of watershed conditions including field results from monitoring and sampling activities, an update on the status of management measures implemented to date, and a summary of anticipated management measures to be implemented during the next twelve months.

All monitoring activities should be conducted in accordance with ADEM and MBNEP SAC protocols, and the municipalities should ensure that all planned projects occurring within the Watershed include a robust monitoring program to prevent adverse impacts and unintended consequences to watershed resources.

A vital element of the monitoring program will be volunteer citizen participation (e.g., Alabama Water Watch) 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 (additional recommendation regarding high priority monitoring sites is found in Chapter 11.0).

8.6 Education Program

Educational programs related to the Watershed issues presented in Chapters 4 and 6 (wetlands, water quality, stormwater management, erosion, living shorelines, flooding, etc.) should be developed and targeted toward all user groups including government officials, residents and property owners, business, and tourists. Outreach and education efforts should develop tailored messages to these different audiences on issues relating to implementation of the WMP. The primary goal should be to provide understanding to the target audiences of the necessity of implementing the management measures outlined in the WMP and gain their buy-in and ownership to the success of the WMP.

Many of the management measures proposed in this WMP are directly related to better informing the community of the role they play in their watershed. To efficiently implement the proposed programs, it is recommended that the Cities of Fairhope and Daphne as well as Baldwin County coordinate with existing entities such as the Create a Clean Water Future organization and the Weeks Bay National Estuarine Research Reserve.

Once the WMP is approved, a variety of outreach techniques should be implemented to keep the public interested, informed, and engaged. Management of any natural resource is enhanced by the understanding, support, and participation of all stakeholders. Successful implementation of the WMP includes public education and outreach, which is one of EPA's nine key elements for watershed planning. Consistent targeted education and outreach will increase awareness of and support for the recommended management measures necessary to protect and improve the health of the Watershed.

The following goals should be considered in the development of public education and outreach plans:

- Inform, educate, and engage key stakeholders and the public to increase awareness of the benefits provided by the Eastern Shore Watershed, issues impacting the Watershed, and potential solutions to address these issues.
- Educate community members so they increasingly value natural resources and recognize the importance of preserving and protecting these resources.
- Explore additional opportunities to engage the public in the restoration and protection of the Watershed.
- Develop a sense of ownership of the Watershed and the success of implementing this WMP.

8.6.1 Targeted Audiences

Specific community stakeholders must become leaders in the WMP implementation process. These targeted audiences and the ways the WMP address the values important to each of those stakeholders are identified in this chapter. The following stakeholder groups have the ability to make changes through regulation or policy, participation in restoration activities, management of stormwater runoff, or communication of the Eastern Shore WMP goals and objectives.

8.6.1.1 Local Government Officials

Local elected officials and their staff are responsible for establishing priorities for local programs, developing policies, and setting annual budgets. These roles can influence the successful implementation of the WMP. This stakeholder group should be informed of the opportunity presented by the WMP to unify the public with the concept of protecting the Watershed with local engagement. Local government officials can vote to support the WMP, develop and implement WMP recommendations, and encourage stricter enforcement of regulations outlined in this plan. Local officials should be encouraged to work with state and federal agencies to facilitate WMP projects. They can also promote a sense of watershed community through community-wide activities such as trash collection and tree planting events.

8.6.1.2 Business and Industry

Success is closely tied to financial support. Support from an active and diverse group of private stakeholders is needed to attract and match sources of federal, state, and local funding. Businesses and industry along the Eastern Shore should be motivated to support the WMP, as all businesses within the watershed will benefit from its restoration. Local residents will enjoy improved surroundings, a better living environment, and increased satisfaction and pride in their community. Businesses can enhance their public image by demonstrating their support for preservation and restoration of a local resource. The WMP recommends engagement opportunities for private business and industry in the implementation of projects to support the surrounding community, local workforce, and economy while promoting their company image and fostering goodwill. Private industry can also seize opportunities to become involved in recommended projects such as installing stormwater retention ponds for their facilities or funding components of other projects and programs throughout the Watershed. Sponsors can be highlighted on signage or plaques.

8.6.1.3 Academia

Local schools and higher education institutions have an opportunity to inform students about issues in their community. Teachers and instructors can introduce students to the WMP goals and objectives. The extensive scientific and technical data presented in the WMP regarding the current status of the Watershed and measures to improve conditions can be utilized as educational tools for all levels of curriculum.

8.6.1.4 Local Resource Managers

Local resource managers provide services related to water supply and wastewater treatment to Eastern Shore residents and can assist in guiding water quality management within the Watershed. The actions recommended in this WMP will improve water quality of the Watershed by reducing stormwater pollutants and trash in waterways and increasing public understanding of human impacts on water resources. Local resource managers can help by getting involved in Watershed preservation and restoration efforts, assisting with outreach and communication, and sponsoring community events.

8.6.1.5 Community Leaders

Community leaders have a vital role in implementing the WMP and its goals. They should be advocates of the WMP and encourage elected officials to prioritize the WMP recommendations. They should participate in education and outreach, litter reduction campaigns, and share restoration ideas. Community leaders should understand that the WMP represents a community-wide approach for protecting water quality, habitats, and living resources of the Watershed through the goals of improving recreational opportunities, beautifying the area, and highlighting historical and cultural aspects of the Watershed. Community leaders can host events, promote recreational and outreach activities, create and launch neighborhood anti-littering campaigns, and educate residents on the benefits of preservation and restoration to their properties. Many leaders and stakeholders have been identified through the process of developing the WMP, and some are already involved. While the MBNEP has led the effort to initiate the work, future efforts and project implementation must be rooted within the community of stakeholders, along with the residents and property owners.

8.6.1.6 Media

Newspapers, television news programs, on-line news sources, social media (Twitter, Facebook, Instagram, etc.), and radio stations are significant sources of information for the public. The WMP sets the stage for a better future for the Eastern Shore and a vision, supported by the public, to preserve the area and provide community-wide access to a beautiful natural resource. Local media can help by publishing stories highlighting the WMP and its recommendations, creating news stories describing accomplishments of the WMP, advertising cleanup or anti-littering events and campaigns, and sharing stories about the involvement of local leaders in the WMP.

8.7 Funding

The Cities of Fairhope and Daphne as well as Baldwin County should evaluate the potential funding sources identified in Chapter 10 and work with MBNEP and grant writers to develop a funding request program that matches specific management measures with funding sources. The progress of this effort will be measured by the number of projects funded and the value of funds secured. Development of capital improvement plans, and education showing the limit in funding has proven to be a useful means of developing citizen support of adequate funding.

8.8 Regulatory Framework

One of the most pressing issues for this watershed is the increase in development. The municipalities and County should develop consistent zoning and design standards to limit development in vulnerable areas and to minimize impervious cover, incentivize low impact design and green infrastructure, conserve riparian zones, and retain stormwater runoff.

Following the approval of the WMP; Daphne, Fairhope, and Baldwin County should consider recommendations presented in this WMP and begin implementing them as appropriate. Local leaders should enhance, strengthen, and enforce land development codes and ordinances focused on stormwater management and resiliency at a watershed scale. This effort should take a holistic view of the Watershed. Additionally, authorities should consider ordinances to specific problem areas within the Watershed where identified problems are documented, and development would further exacerbate the problems. Simply creating ordinances that demonstrate no further harm to nearby neighbors will by itself provide measurable improvements in water quality, habitat management, and resiliency.

8.9 Local Programs

8.9.1 Alabama Coastal Area Management Program

The Alabama Coastal Area Management Program (ACAMP) was approved by NOAA in 1979 as part of the National Coastal Zone Management Program. The ADCNR State Lands Division, Coastal Section is responsible for overall management of ACAMP. The purpose of ACAMP is to balance economic growth with the need for preservation of Alabama's coastal resources for future generations. The program promotes wise management of the cultural and natural resources of the state's coastal areas and fosters efforts to ensure the long-term ecological and economic productivity of coastal Alabama. ACAMP is implemented in the legislatively defined Alabama Coastal Area which extends from the continuous ten-foot contour seaward to the three-mile limit in Mobile and Baldwin Counties.

The ADCNR, State Lands Division, Coastal Section staff works jointly with staff from ADEM to implement the federally-approved program. ADCNR serves as the lead agency responsible for overall management of the program including planning, fiscal management, and education and dissemination of public information. ADEM oversees regulatory, permitting, monitoring, and enforcement responsibilities of the program. Based upon current federal legislation, the State of Alabama continues to administer the ACAMP as its Coastal Zone Management Program under the Coastal Zone Management Act (CZMA) of 1972. The CZMA also requires the state to develop and implement its Alabama Coastal Nonpoint Pollution Control Program (ACNPCP), in order to deter potential impacts and enhance coastal waters, under Section 6217 of the Coastal Zone Act Reauthorization Amendment of 1990 (CZARA). These proposed Watershed Management Plan prioritizations and projects are developed to ensure implementation of the program measures and best management practices that support the ACNPCP and the ACAMP goals.

Annual program activities include Coastal Cleanup, implementation of public access construction projects, planning support for local governments, implementation of the Alabama Coastal Nonpoint Source Control Program measures, and providing grant funds and technical assistance to Alabama's coastal communities and partners. ACAMP's annual grant program supports projects that protect, enhance, and improve the management of natural, cultural, and historical coastal resources and that increase the sustainability, resiliency, and preparedness of coastal communities and economies.

As part of the implementation of this ESWMP, full and continued support of ACAMP is endorsed. More information on the Alabama Coastal Area Management Program can be found on the ADCNR website: http://www.outdooralabama.com/alabama-coastal-area-management-program and ADEM's Coastal Programs website: http://adem.alabama.gov/programs/coastal/

8.9.2 Clean Marina Program

Marinas and recreational boating are recognized as potential sources of nonpoint source pollution in coastal watersheds. The Alabama-Mississippi Clean Marina Program (AMCMP) is a voluntary, incentive-based program developed and implemented by the Mississippi-Alabama Sea Grant Consortium and partners to promote environmentally- responsible and sustainable marina and boating practices (http://masgc.org/clean-marina-program).

This program, created to reduce water pollution and erosion in state waterways and coastal zones, helps marina operators protect the very resource that provides them their livelihood – clean water. The AMCMP promotes boater education, coordination among state agencies, and better communication of existing regulations, as well as offers incentives to creative and proactive marina operators.

The AMCMP focuses on seven management measures identified by marina operators as priorities: (1) marina siting, design, and maintenance; (2) sewage management; (3) fuel management; (4) solid waste and petroleum recycling and disposal; (5) vessel operation, maintenance, and repair; (6) stormwater management and erosion control; and (7) marina management and public education.

Marinas in the Eastern Shore Watershed should be encouraged to participate in the AMCMP. Through participation, marina operators will receive technical assistance and promotional items identifying their facilities as “Clean Marinas.” Studies have shown that the most important criteria in choosing a marina for boat owners is cleanliness, and designated “Clean Marinas” may have an advantage in appealing to more environmentally-conscious consumers.

Additional needs include the establishment of a cost-share program providing incentives to marinas to retrofit existing infrastructures, including stormwater and waste management systems, to meet “Clean Marina” standards.

At the time of writing, the Fairhope Docks, which is owned and operated by the City of Fairhope, has begun the process of being accepted into this program and will be a good example for other marinas along the Eastern Shore.

8.9.3 Alabama Water Watch

An important part of the WMP implementation strategy is to create interest and encourage participation by watershed residents. One way to achieve this is to renew the interest in the local volunteer monitoring program that was established by the WBNERR.
The Alabama Water Watch (AWW) organization is an outstanding example of this type of program. It is a citizen-volunteer water quality monitoring program that has data collection stations located in all of the major river basins in Alabama.

Source: https://aaes.auburn.edu/alabamawaterwatch

The goals of the AWW volunteer monitoring program is to:

- Educate residents on water quality issues and create interest in the health of the Watershed;

- Train citizens to use standardized equipment and techniques to gather water quality information correctly;
- Enable citizens to maintain and improve the health of the Watershed by using their data for environmental education, restoration, protection, and stewardship; and
- Create a database of water quality data that can be used to help evaluate the effectiveness of management measures.

The volunteer monitoring program is primarily intended to collect field parameters as an ongoing reconnaissance to screen water quality for potential problems. Identified issues could then be more thoroughly investigated through in-depth sampling and analyses under the formal monitoring program addressed in Chapter 11.0, particularly with resumed volunteer monitoring at priority sites at several historic volunteer sites.

8.9.4 Community Rating System

The CRS is a Federal Emergency Management Agency (FEMA) program that encourages community flood management to exceed the minimum National Flood Insurance Policy standards and can lead to discounted premiums depending on the level of community participation. The insurance premium rates for policyholders can be reduced as much as 45%. Technical assistance is available for designing and implementing the required activities. Additionally, implementing some of the CRS activities can aid in project qualification for other federal assistance programs.

8.9.5 Alabama Smart Yards

The Alabama Smart Yards (ASY) program is a cooperative alliance by the Alabama Cooperative Extension System, ADEM, Alabama Nursery and Landscape Association, Alabama Master Gardeners Association, and Auburn University's Department of Horticulture (https://www.aces.edu/blog/topics/lawn-garden/smart-yards-online-series/). Its mission is to introduce environmental consciousness to homeowners and neighborhoods. The ASY provides an extensive handbook that contains a host of information including recycling lawn waste, reducing stormwater runoff, managing yard pests responsibly, efficient irrigation practices, etc. The program also includes a "Smart Yards" application for mobile telephones that serves as a pocket guide for environmentally responsible yard maintenance.

8.9.6 Create a Clean Water Future

The Create a Clean Water Future organization, (http://www.cleanwaterfuture.com), seeks to improve the water quality of coastal Alabama through education of the general public and encouragement of the adoption of good stewardship practices. They have an active campaign oriented towards the general public, schools, restaurants, and businesses. Their website features tips to promote easy habits that will improve water quality through the reduction of trash and polluted runoff, and facilitates volunteer community cleanup activities.

Source: https://www.cleanwaterfuture.com/

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9.0 Regulatory Framework

9.1 Introduction

As part of the development of the Eastern Shore WMP in Baldwin County, Alabama, a review of existing regulations at the Federal, State, and local level was conducted.

The geopolitical boundaries of the Eastern Shore Watershed include overlapping jurisdictions and adjacent portions of Baldwin County, the City of Fairhope and the City of Daphne with additional lands under State jurisdiction in the Watershed along Mobile Bay.

The Eastern Shore Watershed drains to Mobile Bay and includes Yancey Branch, Rock Creek, Fly Creek, Point Clear Creek, and Bailey Creek as named tributaries (Figure 9.1).

Figure 9.1 Eastern Shore Watershed Boundary

The past and current status of permitting requirements, developments, ordinances, inspections, and compliance issues were discussed with local government officials, as well as representatives of ALDOT, ADEM, multiple Property Owner's Associations, the U.S. Army Corps of Engineers, and the Eastern Shore WMP Steering Committee.

The laws, regulations, and ordinances reviewed in the WMP focus on water quality, stormwater, erosion and sediment control, coastal zone issues, wetlands, and other Waters of the United States (WOTUS), and land disturbances (Table 9.1).

Table 9.1 Summary of Federal and State Environmental Regulations

Regulatory Requirement	Regulatory Authority/Permitting Agency	Jurisdiction
Alabama Coastal Area Act 534 (1976)	Alabama Department of Conservation and Natural Resources, State Lands Division	State
Alabama Coastal Area Management Program (ACAMP)	ADEM, Alabama Department of Conservation and Natural Resources, State Lands Division	State
Alabama Environmental Management Act (1982)	ADEM, ACAMP, and Alabama Department of Economic and Community Affairs	State
Alabama Water Pollution Control Act	ADEM • Alabama Code Section 22-22-1	State
Clean Water Act: Section 303(d) (1972)	USEPA and ADEM • Impaired Waters List/TMDLs	Federal and State
Clean Water Act: Section 401 (1972)	USEPA and ADEM • State Water Quality Criteria • ADEM Administrative Code 335-6-10	Federal and State
Clean Water Act: Section 402 (1972)	USEPA and ADEM • National Pollutant Discharge Elimination System (NPDES) •ADEM Administrative Code 335-6-6	Federal and State
Clean Water Act: Section 404 (1972)	USACE • "Waters of the U.S."	Federal and State
Clean Water Act: Section 319 (1972)	Non-point Source Pollution Program	Federal and State
	NOAA, USACE, and ACAMP	Federal and State

Regulatory Requirement	Regulatory Authority/Permitting Agency	Jurisdiction
Coastal Zone Management Act (1972)	• Form 166, Coastal Consistency	
Code of Alabama 1975: Title 9, Title 22, Title 35	ADEM, Alabama State Legislature • Title 9, Chapter 7 • Title 22, Chapters 22, 23, 24, 25, 27, 28, 30 (A-F), 34, 35, 36, 37, 38, 40 • Title 35, Chapter 19	State
Construction Site Erosion and Stormwater Management	ADEM • NPDES General Permit Number ALR100000	State
Executive Order Number 43 (2001)	ACAMP and Alabama Department of Conservation and Natural Resources, State Lands Division	State
Federal Water Pollution Control Act (1948, 1972, 1977)	Federal Law	Federal
Rivers and Harbors Act of 1899	Section 10 - 33 U.S.C. 403	Federal

NOTES: ADEM = Alabama Department of Environmental Management; USEPA = U.S. Environmental Protection Agency; NOAA = National Oceanic and Atmospheric Administration; NPDES = National Pollutant Discharge Elimination System; TMDL = total maximum daily load; USACE = U.S. Army Corps of Engineers.

Federal, State, and local governments are all in the process of planning to change, developing proposed changes to, or have changed their existing regulatory procedures.

Examples of such changes to regulations and requirements for compliance during the 2020-2023 WMP period include:

- 2021 Nationwide Permits – USACE modified twelve (12) existing nationwide permits (NWPs) and issued four (4) new Nationwide Permits within this time frame. Sixteen (16) of the Nationwide Permits had a modification to the general conditions and definitions. The revised permits went into effect on March 15, 2021.

    a. Revised permits included: NWP's 21, 29, 39, 40, 42, 43, 44, 50, 51 and 52. These NWPs have been revised to remove the 300-linear-foot limit for losses of stream bed. The limit for losses of WOTUS for each of these permits remains at 0.5 acre. Mitigation General Condition 23 was modified to include a requirement for compensatory mitigation for stream bed losses exceeding 3/100-acre.

i. NWP 48 was revised to provide for greater flexibility in its use for commercial shellfish mariculture activities. This NWP authorizes new operations as well as existing operations where operations are seeking permission to continue on-going shellfish cultivation activities. A preconstruction notification (PCN) has been added to this final NWP for all direct impacts to submerged aquatic vegetation greater than 0.5 acre.

b. New NWPs issued consist of NWPs 55, 56, 57, and 58

   i. NWP 55 – authorizes structures in marine and estuarine waters including structures anchored to the seabed on the Outer Continental Shelf, for the purpose of seaweed mariculture activities. Shellfish production proponents have been integrated in these activities if those actions are on the same structure or a structure that is part of the same project.
   ii. WP 56 – authorizes structures in marine and estuarine waters, including structures anchored to the seabed on the Outer Continental Shelf, for the purpose of finfish mariculture activities. Shellfish and seaweed production proponents have been integrated in these activities if those actions are on the same structure or a structure that is part of the same project.
   iii. NWP 57 – authorizes activities required for the construction, maintenance, repair and removal of electric utility lines, telecommunication lines, and associated facilities in WOTUS. There is a 0.5-acre limit for losses of WOTUS for each single and complete project.
   iv. NWP 58 – authorizes activities required for the construction, maintenance, repair, and removal of utility lines for water and other substances, excluding oil, natural gas, products derived from oil or natural gas, and electricity. Associated utility line facilities, such as substations, access roads, and foundations for above-ground utility lines, in WOTUS, are authorized provided that the activity does not result I the loss of greater than 0.5 acre of WOTUS for each single and complete project.

Tables 9.2 through 9.7 provide a summary of Federal, State, and local permits and ordinances required for certain activities within the Watershed.

Table 9.2 Federal Permits: US Army Corps of Engineers, Mobile District, Nationwide Permit Program – Expires 2026

Permit	Activity
NWP 1	Aids to Navigation
NWP 2	Structures in Artificial Canals
NWP 3	Maintenance
NWP 5	Scientific Measurement Devices
NWP 6	Survey Activities
NWP 7	Outfall Structures and Associated Intake Structures
NWP 9	Structures in Fleeting and Anchorage Areas
NWP 10	Mooring Buoys
NWP 11	Temporary Recreational Structures
NWP 12	Oil or Natural Gas Pipeline Activities
NWP 13	Bank Stabilization
NWP 14	Linear Transportation Projects
NWP 15	US Coast Guard Approved Bridges
NWP 16	Return Water from Upland Contained Disposal Areas
NWP 18	Minor Discharges
NWP 19	Minor Dredging
NWP 20	Response Operations for Oil or Hazardous Substances
NWP 22	Removal of Vessels
NWP 23	Approved Categorical Exclusions
NWP 24	Indian Tribe of State Administered Section 404 Program
NWP 25	Structural Discharges
NWP 27	Aquatic Habitat Restoration, Enhancement and Establishment Activities
NWP 28	Modifications of Existing Marinas
NWP 29	Residential Developments
NWP 30	Moist Soil Management for Wildlife
NWP 31	Maintenance of Existing Flood Control Facilities
NWP 32	Completed Enforcement Actions
NWP 33	Temporary Construction, Access and Dewatering
NWP 42	Recreational Facilities
NWP 43	Stormwater Management Facilities
NWP 45	Repair of Uplands Damaged by Discrete Events
NWP 46	Discharges in Ditches
NWP 48	Commercial Shellfish Mariculture Activities

Table 9.3 Federal Permits: US Army Corps of Engineers, Mobile District, General Permit Program – Expires October 1, 2026

Permit	Activity
ALGP-01	Excavated Boat Slips
ALGP-02	Maintenance Dredging
ALGP-03	New Work Channel Dredging
ALGP-04	Debris Removal
ALGP-05	Piers, Wharves, and their Normal Appurtenances
ALGP-06	Boat Shelters, Gazebos, Hoists
ALGP-07	Boat Ramps and Marine Ways
ALGP-08	Mooring Pilings, Dolphins, and Single-Pile Structures
ALGP-09	Oyster Reefs - reserved
ALGP-10	Living Shorelines
ALGP-11	Shoreline and Bank Stabilization and Protection
ALGP-12	Maintenance Dredging of Man-made Ditches
ALGP-13	Filling of Previously Dredged Area
ALGP-14 through 16	Reserved
ALGP-17	Creation and Maintenance of Firebreaks in Wildlife Management Areas, Refuges, and Parks - reserved
ALGP-18	Clear Areas for Wildlife Management in Wildlife Management Areas, Refuges, and Parks - reserved
ALGP-19	Agricultural Type Activities for the Creation of Habitat or Food Plots in Wildlife Management Areas, Refuges, and Parks - reserved
ALGP-20	Water Management in Wildlife Management Areas, Refuges, and Parks - reserved
ALGP-21-23	Reserved
ALGP-24	Piers, Decks, and their Normal Appurtenances within boundary of Weeks Bay National Estuarine Research Reserve
ALGP-25	Mooring Pilings and/or Boat Hoists within boundary of Weeks Bay National Estuarine Research Reserve
ALGP-26	Shoreline/Bank Protection within boundary of Weeks Bay National Estuarine Research Reserve

Table 9.4 State Permits: Alabama Department of Environmental Management

Permit	Activity	Expiration
ALR100000	Discharges from construction activities that result in a total land disturbance of 1 acre or greater and sites less than 1 acre but are part of a common plan of development or sale	March 31, 2026
ALR040000	Stormwater discharges from regulated small Municipal Separate Storm Sewer System Phase II	September 30, 2026
ALS000006	Stormwater Discharges from Alabama Department of Transpiration's Municipal Separate Storm Sewer System	September 30, 2024
ALG030000	Discharges associated with boat and ship building and repair industries (including offshore oil and gas well drilling and production platforms building and repair) consisting of storm water, non-contact cooling water, uncontaminated condensate, cooling tower blowdown, boiler blowdown, demineralizer wastewater, treated sanitary wastewater, bilge/ballast water, wash water, hydrostatic and pressure test water, hydroblast water (not including wet abrasive blast water), and storm water from fueling, petroleum storage and handling, equipment storage, and maintenance areas	September 30, 2027
ALG060000	Discharges associated with lumber, wood, and paper products industry (not including wood preserving operations) consisting of storm water, process water from wet decking, non-contact cooling water, uncontaminated condensate, cooling tower and boiler blowdown, demineralizer wastewater, exterior vehicle and equipment wash water and storm water from petroleum storage and handling, fueling, and equipment storage and maintenance areas	June 30, 2027
ALG110000	Discharges from concrete batch plants (not including storm water or process wastewater discharges from cement manufacturing)	August 31, 2027
ALG120000	Discharges associated with primary metals, metal finishing, fabricated metal products, industrial commercial machinery, electronic equipment, transportation equipment, measuring and analyzing instruments, and foundries, consisting of stormwater, hydrostatic test water from new containers, non-contact cooling water, uncontaminated condensate, cooling tower blowdown, boiler blowdown, demineralizer wastewater, vehicle and equipment exterior washing operations, and stormwater from fueling, petroleum storage and handling, equipment storage, and maintenance areas	September 30, 2027
ALG140000	Discharges associated with transportation industries and warehousing consisting of storm water; non-contact cooling water; uncontaminated condensate; cooling tower blowdown; boiler blowdown; demineralizer wastewater; vehicle and equipment wash-water; storm water from fueling, petroleum storage and handling, equipment storage, maintenance areas; and wastewater associated with airfield pavement deicing from existing and new primary airports with 1,000 or more annual jet (non-propeller aircraft) departures.	September 30, 2027

Permit	Activity	Expiration
ALG150000	Discharges associated with food and kindred products industries consisting of stormwater, non-contact cooling water, uncontaminated condensate, cooling tower and boiler blowdown, demineralizer wastewater, exterior vehicle and equipment wash-water and stormwater from petroleum and non-petroleum oil storage and handling, fueling, equipment storage and maintenance areas.	May 31, 2027
ALG160000	Discharges of storm water (not containing leachate) from active and inactive landfills, transfer stations, and land disturbance activities associated with opening and closing cells at landfills; discharges of vehicle and equipment exterior wash water; and discharges of storm water from fueling, petroleum storage and handling, equipment storage, and maintenance areas	January 31, 2027
ALG170000	Storm water discharges associated with the manufacturing and storage of paints, varnishes, lacquers, enamels, and allied products; non-contact cooling water, uncontaminated condensate, cooling tower blowdown, boiler blowdown, demineralizer wastewater, vehicle and equipment exterior washing operations; and storm water from fueling, petroleum storage and handling, equipment storage, and maintenance areas	September 30, 2027
ALG180000	Discharges associated with the salvage and recycling industry consisting of storm water, non-contact cooling water, uncontaminated condensate; cooling tower and boiler blowdown, demineralizer wastewater, vehicle and equipment exterior washing operations, and storm water from fueling, petroleum storage and handling, equipment storage, and maintenance areas	September 30, 2027
ALG200000	Discharges associated with the plastic and rubber industry (excluding industries covered under 40 CFR part 414-organic chemical, plastics, and synthetic fiber industries) consisting of storm water, non-contact cooling water, uncontaminated condensate, cooling tower blowdown, boiler blowdown, demineralizer wastewater, vehicle and equipment exterior washing operations; and storm water from petroleum storage and handling, equipment storage, and maintenance areas	September 30, 2027
ALG230000	Discharges associated with the stone, glass, and clay industry consisting of storm water, non-contact cooling water, uncontaminated condensate, cooling tower blowdown, boiler blowdown, demineralizer wastewater, vehicle and equipment exterior washing operations; and storm water from fueling, petroleum storage and handling, equipment storage, and maintenance areas	September 30, 2027
ALG240000	Discharges associated with the textile industry consisting of non-contact cooling water, uncontaminated condensate, cooling tower blowdown, boiler blowdown, demineralizer wastewater, vehicle and equipment exterior washing	September 30, 2027

Permit	Activity	Expiration
	operations; and storm water from fueling, petroleum storage and handling, equipment storage, and maintenance areas	
ALG250000	Discharges of non-contact cooling water, cooling tower blowdown, uncontaminated condensate, and boiler blowdown with and without demineralizer wastewater (steam electric power plants are excluded from coverage under this permit.)	March 31, 2027
ALG280000	Wastewater associated with offshore oil and gas exploration and production activities. Specifically, the permit authorizes the discharge of deck drainage from platform complexes, remote well structures, pigging platforms, temporary rigs, floating construction facilities and waste collection barges; treated sanitary and domestic wastewater of less than 10,000 gallons per day; noncontact cooling water and boiler blowdown; and low volume miscellaneous discharges. The discharge of well treatment, completion, and workover fluids; produced sand; produced water; drilling muds and cuttings; and discharges incidental to the normal and proper operation of a vessel while being used as a means of transportation are not authorized by this permit, nor are any discharges to areas of biological concern	March 31, 2025
ALG340000	Discharges associated with petroleum products or its derivatives consisting of groundwater and/or stormwater incidental to groundwater cleanup operations which has been contaminated with automotive gasoline, aviation fuel, jet fuel, or diesel fuel; storm water runoff from petroleum storage and fueling areas; uncontaminated storm water from fueling, petroleum storage and handling, equipment storage, and maintenance areas; vehicle and equipment exterior washing operations (excluding commercial car washes) that do not use solvents; and hydrostatic test water generated on-site.	January 31, 2027
ALG360000	Discharges associated with cooling water and filter backwash, sumps and drains; oil water separators; treated sanitary wastewater; pretreated drilling supernate; uncontaminated stormwater associated with hydroelectric generating facilities; and wastewater resulting from maintenance and repair activities associated with cleaning, pressure washing, blasting and painting of structures over water.	January 31, 2026
ALG640000	Discharges of filter backwash, sedimentation basin wash water, and decant water from water treatment plants (discharges from water treatment plants that use ion-exchange or reverse osmosis are not covered by this general permit.)	June 30, 2023
ALG670000	Discharges associated with hydrostatic test waters from new and existing petroleum and natural gas pipelines	September 30, 2027

Permit	Activity	Expiration
ALG850000	Discharges from the mining and processing (wet or dry) of construction sand and gravel, chert, dirt, and/or red clay, and areas associated with these activities	May 31, 2027
ALG870000	Discharges from the application of pesticides	October 31, 2026
ALG890000 (<5 Acre Small Mining)	Discharges from small non-coal/non-metallic mining and dry processing and areas associated with these activities.	January 31, 2028

Table 9.5 City of Daphne: Local Ordinances

Ordinance/Resolution	Purpose
Ordinance 2008-054	Ordinance regulating erosion and sediment control for residential dwellings and other land disturbances within the City of Daphne.
Ordinance 2011-54	Land Use and Development Ordinance
Ordinance 2014-14	Construction Best Management Practices Plan (CBMPP). Ordinance regulating construction best management practices for residential dwellings and other land disturbance within the City of Daphne.
Ordinance 2018-08	Appropriation: Invasive Species Control for Bayfront and Village Point Wetland Areas.
Ordinance 2022-19	180-day extension of Ordinance 2022-45 moratorium
Ordinance 2019-21	Flood Damage Prevention Ordinance: Ordinance to promote public health, safety and general welfare and to minimize public and private losses due to flood conditions in specific areas.
Ordinance 2021-45	Moratorium of applications for rezoning or pre-zoning that would result in the development of multi-family dwelling units to include apartments, townhouses, condominiums, duplexes, mid-rise condominiums, and high-rise condominiums.
Ordinance 2022-51	Revisions to the City of Daphne Land Use and Development Ordinances
Ordinance 2022-62	Amendment to Ordinance 2011-54 for Minimum Standards and Required improvements for subdivisions and commercial site developments. Drainage, stormwater, management facilities and erosion/sediment control.

Table 9.6 City of Fairhope: Local Ordinances

Ordinance/Resolution	Purpose
Ordinance 958	Ordinance pertaining to collection and disposal of construction waste and other deposits.
Ordinance 1081	Ordinance making discharge of any pollutant that will have a deleterious impact on the environment into a City of Fairhope municipal separate storm sewer system (stormwater system) unlawful.
Ordinance 1253	Ordinance pursuant to the Comprehensive Plan of the City of Fairhope to 1) lessen congestions in the streets; 2) secure safety from fire, panic, and other dangers; 3) promote health and general welfare; 4) to provide adequate light and air; and 5) prevent overcrowding of land.
Ordinance 1370	Ordinance relating to the issuance of land disturbance permits for activities that may result in the loss, fill or destruction of wetlands within the City limits and the City's building permitting jurisdiction.
Ordinance 1398	Ordinance to codifying that erosion control practices, sediment control practices, and waterway crossings shall meet the design criteria set forth in the most recent version of the *Alabama Handbook* and shall be adequate to prevent transportation of sediment from the site to the satisfaction of the City.
Ordinance 1423	Ordinance to protect the water quality and environmental integrity of the watershed within the Fairhope permitting jurisdiction, specifically by limiting the use of red soil (clay and silt) which may harm aquatic plants or marine life, from being used in critical and coastal areas.
Ordinance 1444	Ordinance to define landscaping regulations and protocols for the City of Fairhope for the purpose of protecting existing vegetation and encouraging the planting and maintenance of additional vegetation within the City. Established the Fairhope Tree Committee to assist the City with recommendations.
Ordinance 1735	Ordinance declaring a moratorium on the filing of subdivision and multiple occupancy project applications outside of the city limits within the planning jurisdiction for 12 months from time of adoption.
Ordinance 1745	Connection fees for metered connections to the water system. Where 100% of the connection fees should be used for Capital replacements and improvements to the water system only.
Ordinance 1962	An ordinance making it unlawful for any person to sweep, rake, throw or otherwise deposit any waste matter or any other substance commonly known as garbage, trash or rubbish into or on the streets, alleys, parks, beaches, sidewalks or other public places in the city, or on the property of another without the consent of the property owner.

Note: The City of Fairhope is undergoing a Comprehensive Land Use Plan update.

Table 9.7 Baldwin County: Local Ordinances

Ordinance/Resolution	Purpose
Baldwin County Master Plan 2013*	Guidance document for elected and appointed officials, staff and citizens in efforts to manage growth and development in the county with regards to land uses and zoning in particular, as well as the development of public improvements and infrastructure.
Land Disturbance Ordinance for Flood Prone Areas or Territories with Probable Exposure to Flooding in Unincorporated Baldwin County	To promote the public health, safety and general welfare and to minimize public and private losses on land with probable exposure to flooding, pursuant to Alabama Code 11-19-4, by land use provisions designed to: 1) control filling, grading, dredging and similar land disturbance activities which may increase flood damage or erosion; 2) prevent or regulate the construction of flood barriers which will unnaturally divert flood waters or which may increase flood hazards to other lands; and 3) control the alteration of natural floodplains, stream channels, and natural protective barriers which are involved in the accommodation of flood waters.
Baldwin County Subdivision Regulations, October 2021	To establish procedures and standards for the development of subdivisions or proposed additions to existing subdivisions within the subdivision jurisdiction of Baldwin County in an effort to regulate the minimum size of lots, the planning and construction of all public streets, public roads, drainage structures, and to require the proper placement of public utilities.
Baldwin County Zoning Ordinance, October 2022	Ordinance to encourage the use of lands and natural resources in Baldwin County in accordance with their character and adaptability; to limit the improper use of land; to provide for the orderly development and growth of Baldwin County; to reduce hazards to life and property; to establish the location and size of and the specific uses for which dwellings, buildings and structures may hereafter be erected or altered, and the minimum open spaces and sanitary, safety and protective measures that shall be required for such buildings, dwellings, and structures; to avoid congestion on the public roads and streets; to provide safety in traffic and vehicular parking; to facilitate the development of an adequate system of transportation, education, recreation, sewage disposal, safe and sufficient water supply and other public requirements; to conserve life, property and natural resources and the expenditure of funds for public improvements and services to conform with the most advantageous uses of land, resources and properties, for the general good and benefit to the people of Baldwin County. Copies of informative pamphlets regarding zoning are included in Appendix C.

**Currently undergoing revision as of February 2023 (link for draft plan https://www.baldwinourvision.com/)*

9.2 Overview of Laws, Regulations and Ordinances

Actions, permitting, restrictions, studies, and funding, even the watershed planning process, are all driven by legal authorities (sometimes several layers thick), legal documents (rules, regulations, ordinances, RFPs, studies, management plans, case law/rulings/judgments, notice and rulemaking procedures, etc.), legal criteria and legal rights (private, public, government, political, riparian, littoral). Although the following descriptions and details of specific laws, rules, regulations, and permits will be separated for convenience they overlap with much interplay, imposing various conditions and requirements and creating conflicting situations from time to time. The level of jurisdictional authority and interagency cooperation varies across each category.

This chapter provides a general overview of what standards apply in the Watershed. It does not include a comprehensive list of accounting for every relevant statutory provision. For more specific information, please reference the regulatory requirements listed in Table 9.1. Keep in mind that governing procedures related to federal oversight, state coastal management programs, and surface water protection, including wetlands, are periodically updated over time. You can also read more about the South Alabama Regulatory Review at www.mobilebaynep.com/assets/pdf/Final-South-AL-Stormwater-Regulatory-Review-Update_w-appendicies.pdf.

9.2.1 Federal Authorities

The Federal Water Pollution Control Act and the Clean Water Act (CWA) amendments provide the basis for the primary federal regulatory and permitting procedures relating to stormwater management within the Eastern Shore Watershed. The following specific CWA sections are particularly pertinent to controlling stormwater runoff, erosion, and sedimentation problems within the Watershed.

Federal Water Pollution Control Act. The Federal Water Pollution Control Act (FWPCA) was enacted in 1948 and was significantly reorganized and expanded in 1972. In 1977, when the amendments were added, the FWPCA became known as simply the CWA. The CWA establishes the basic structure for regulating discharges of pollutants into the WOTUS 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 water quality, stormwater management, and the discharge of dredge and fill materials into jurisdictional WOTUS. The most applicable sections of the CWA related to controlling stormwater runoff and erosion and sedimentation within the Watershed are listed below.

Clean Water Act Section 303(d). Under CWA Section 303(d) of the 1972 CWA, states, territories, and authorized tribes are required to develop lists of impaired waters. These impaired waters are waters that do not meet the 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 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 stream or stream segment has been classified as impaired (i.e., listed on the State's 303(d) list) for the contaminant identified, EPA and ADEM must inspect and sample the water to determine the amount or limit of the loading to the stream. The Alabama Section 303(d) list is required to be updated every two years. The most current list can be accessed at https://adem.alabama.gov/programs/water/303d.cnt. Waterbodies within the Watershed that are listed on the Alabama Section 303(d) list are identified and discussed in Chapter 3.0.

Clean Water Act Section 401 (33 USC Section 1341) and Clean Water Act Section 401(a). All CWA Section 404 permit applications, pursuant to CWA Section 401(a), 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 outlined in ADEM Administrative Code R. 335-6-10.

Clean Water Act Section 402. Section 402 of the CWA authorizes permitting under the NPDES program with EPA having primary permitting authority. The NPDES program requires dischargers to obtain permits before discharging pollutants into WOTUS (40 CFR 122). The NPDES program covers point source discharges from the following:

- 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)
- Construction
- Non-coal/non-metallic mining and dry processing less than five acres, other land disturbance activities, and areas associated with these activities

EPA has delegated the authority to administer the NPDES program to ADEM, who by ADEM Admin. Code Reg. 335-6-6 regulates and permits certain point source discharges. By ADEM Admin. Code Reg. 335-6-12, ADEM regulates discharges from construction sites and land clearing; imposes requirements for erosion and sediment control and the use and maintenance of best management practices, and imposes requirements for inspections, reporting, and enforcement. In December 2009, EPA issued a Final Rule addressing a phased-in program for numeric and non-numeric effluent limits on sediment/erosion control at construction sites, focusing on stormwater discharge turbidity. (74 Fed. Reg. 62996; 40 CFR 450).

The EPA promulgated the *Effluent Limitations Guidelines and Standards for the Construction and Development Point Source Category* rule in December 2009 and amended May 2015 (EPA, 2015). These regulations cover stormwater discharges from construction sites and are implemented in the NPDES permit program. Through the NPDES permit program, discharges from construction sites and land clearing are regulated by the ADEM Construction General Permit, ALR100000 (effective April 1, 2016). This permit applies to construction activities resulting in land disturbance of one acre or more (and smaller sites that are part of a common plan of development or sale). It also imposes requirements for erosion and sediment control, BMPs, inspections, reporting, and enforcement. The 2009 Rule requires owners and operators of permitted construction activities to adopt certain requirements, as follows:

- Implementing erosion and sediment controls
- Stabilizing soils
- Managing dewatering activities
- Implementing pollution prevention measures
- Providing and maintaining a buffer around surface waters
- Prohibiting certain discharges
- Using surface outlets for discharges from basins and impoundments

Clean Water Act Section 404. The U.S. Army Corps of Engineers (USACE) and the EPA administer CWA Section 404 (33 USC Section 1344) to regulate activities resulting in the discharge of dredged or fill material into navigable waters or WOTUS, including wetlands. The USACE and EPA, through rulemaking procedures, have proposed, noticed, and issued rules and regulations to CWA Section 404 (USACE 33 CFR 320; EPA 40 CFR 230). The agencies also issue other interpretive writings intended to guide how the law is implemented and enforced. These writings include Regulatory Guidance Letters, Interpretive Guidance (usually following a lawsuit and judicial opinion, Executive Order, or Congressional Act), Standard Operating Procedures, and Memorandum of Agreements or Understanding. The law states that no dredge or fill material can be discharged by anyone or any entity, including governmental entities, agencies, and programs, without a permit (or an exemption) into jurisdictional WOTUS, including jurisdictional wetlands, floodplains, streams, rivers, bays, estuaries, or other aquatic sites.

There are several types of permits that can be issued, including an individual CWA Section 404 permit, a letter of permission, a general permit, a regional permit, a nationwide permit (NWP), and even an after-the-fact permit. Permits may also impose general, regional, or local conditions or criteria, including but not limited to CWA Section 401 water quality certification conditions and coastal program consistency certification conditions. The permits can also require approvals from Alabama Department of Conservation and Natural Resources (ADCNR) (submerged lands lease or riparian easement if in State waters or on State water bottoms). Permit applications are reviewed and evaluated by USACE based on the environmental criteria outlined in the CWA Section 404(b)(1) guidelines and regulations promulgated by EPA. The permits must also meet State water quality standards and coastal area requirements and must be consistent with each program.

Coastal Zone Management Act (P.L. 92-583; 16 U.S.C. Section 1451 et seq). The Coastal Zone Management Act is administered by the National Oceanic and Atmospheric Administration (NOAA) and provides coastal states an opportunity to develop and implement coastal area management programs. States electing to do so are provided with funding support. The Act places specific requirements on federal agencies to ensure that their activities (and the activities they permit) are consistent with approved state programs (15 CFR 930).

Alabama developed a coastal area management program in 1979 and maintains a federally approved program (see program description under State Regulations). The federal consistency provisions most relevant to the Watershed Management Plan include the requirement that CWA §404 and §402 permits comply with Alabama's Coastal Area Management Program. ADEM has also developed a non-regulatory Coastal Nonpoint Pollution Control Program (CNPCP), according to Section 6217 of the Act.

9.2.2 State Authorities

Several of the State statutes that affect activities in the Eastern Shore Watershed have been mentioned in the discussion of the federal statute. ADEM is the primary state environmental regulatory agency in Alabama. In addition, the ADCNR may also have jurisdiction over certain activities that affect state waters, state natural resources (such as fish and wildlife), and state lands.

Alabama Water Pollution Control Act. The Alabama Water Pollution Control Act (AWPCA), Alabama Code Section 22-22-1, is the State's version of the CWA. The AWPCA prohibits the discharge of pollutants to waters of the State without a permit. It provides the foundation for the State's delegated authority to implement various federal water quality programs, including the CWA Section 402 NPDES permitting program, Section 303 water quality standards and TMDL, and Section 319 Non-Point Source programs. Water quality programs are generally implemented through ADEM Administrative Code R. 335-6. The AWPCA provides the framework for adopting rules that establish water quality standards, effluent limitation guidelines, and other rules as needed to enforce water quality standards adopted by ADEM.

Clean Water Act Section 401(a) Water Quality Certification. As outlined in CWA Section 401(a), ADEM must review CWA Section 404 permit applications to ensure that the proposed permitted action is consistent with the State's water quality program. This review is to ensure that any discharge of dredged or fill material will not cause or contribute to a violation of the State's water quality standards. State water quality standards are outlined in ADEM Admin. Code Reg. 335-6-10.

Construction Site Stormwater. The CWA and federal regulations require construction site operators to obtain NPDES permit coverage for regulated land disturbances and associated discharges of stormwater runoff to State waters. Effective April 1, 2021, ADEM established the new General NPDES Permit No. ALR100000 for discharges associated with regulated construction activity that will result in land disturbance equal to or greater than one acre, or from construction activities involving less than one acre, and which are part of a common plan of development or sale equal to or greater than one acre. This permit replaced the previous General NPDES Permit No. ALR100000, which expired on March 31, 2021. The General Permit falls under the authority of ADEM Admin. Code Reg. 335-6-6, along with the other actions regulated by the NPDES program.

Construction site operators and/or owners seeking coverage under this general permit must submit a Notice of Intent (NOI) following the permit requirements. Operators and/or owners of all regulated construction sites must implement and maintain effective erosion and sediment controls following a Construction Best Management Practices Plan prepared and certified by a qualified credentialed professional (QCP). For priority construction sites, the Construction Best Management Practices Plan must be submitted to ADEM for review along with the NOI. Priority construction sites include any sites that discharge to (1) a waterbody listed on the most recent 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 following ADEM Admin. Code Reg. 335-6-10-.09; and (4) any waterbody assigned a special designation per ADEM Admin. Code Reg. 335-6-10-.10. A qualified credentialed inspector (QCI) or QCP must regularly inspect regulated construction activities to ensure effective erosion and sediment controls are being maintained.

Municipal Separate Storm Sewer System General NPDES Permit. In general, municipalities within "urbanized areas" are subject to MS4 permits (either Phase I or Phase II). Portions of Baldwin County, Daphne, Fairhope, Point Clear and Barnwell, including almost all of the entire Eastern Shore watershed, are within a Phase I MS4 permitted area. In December 2011, the County was redesignated from a Phase I MS4 to a Phase II MS4. The permit was issued in October 2016 expired in September 2021. ADEM reissued the Phase II MS4 permit effective October 2021 which will expire in September 2026. Upon renewals of the MS4 permits, in addition to traditional provisions, significantly increased requirements are expected for both construction site stormwater control and postconstruction stormwater management. Notably, it is anticipated that Stormwater Management Plans (SWMPs) developed by municipalities according to their MS4 permit must implement Low Impact Development / Green Infrastructure (LID/GI) practices, "where feasible." Also, increased requirements for monitoring and evaluation/assessment of impaired/TMDL waters are anticipated.

CWA Section 303(d). The EPA requires that ADEM designate waters for which technology-based limits alone do not ensure the attainment of applicable water quality standards. States are required to submit their list of impaired waters to the EPA on April 1 of each even-numbered year. For each water submitted on the list, the pollutant causing the impairment is included, when known. Impairments include things such as nutrients, pesticides, pathogens, metals, organic enrichment, and siltation and can be caused by point sources or nonpoint sources. Additionally, ADEM assigns a priority for development of TMDLs based on the severity of the pollution and the sensitivity of the uses to be made of the waters. In the Eastern Shore Watershed, Fly Creek, has been determined to be impaired by sediment and pathogens. Although no streams are listed for siltation, many of the tributaries within the urbanized portions of the Watershed have been significantly impacted by sedimentation and the streams exhibit many of the same issues found in the D'Olive Watershed. Development has altered the habitats and increased volume and velocities of stormwater runoff have impacted the local waterways. No total maximum daily load (TMDL) has been calculated for these Eastern Shore Watershed streams at this time. Any development or redevelopment activity affecting these streams should take the listing and impairment into consideration and increased regulatory agency scrutiny of proposed activities is expected.

Alabama Coastal Area Management Program. The Alabama Coastal Area Management Program (ACAMP) was approved by National Oceanic and Atmospheric Administration in 1979 as part of the National Coastal Zone Management Program. As such, the ADCNR is responsible for the overall management of the ACAMP program. Its ultimate purpose is to balance economic growth with preservation of Alabama's coastal resources by promotion of wise management of the cultural and natural resources of the State's coastal areas, which include the Dauphin Island Watershed. ACAMP is implemented in the area defined as the "Alabama Coastal Area," which extends from the continuous 10-foot contour seaward to the 3-mile limit in Mobile and Baldwin Counties.

ADCNR, in conjunction with ADEM, is the lead agency responsible for overall management of the program including planning, fiscal management, and education through dissemination of public information. Likewise, ADEM oversees regulatory, permitting, monitoring and enforcement responsibilities of the program. Based upon current Federal legislation, the State of Alabama continues to administer the ACAMP as its Coastal Zone Management Program under the Coastal Zone Management Act of 1972. The Coastal Zone Management Act also requires the State to develop and implement its Alabama Coastal Nonpoint Pollution Control Program, in order to deter potential impacts and enhance coastal waters, under Section 6217 of the Coastal Zone Act Reauthorization Amendment of 1990.

Coastal Zone Management. The Alabama Coastal Area Management Act, Alabama Code Section 9-7-1 et seq., provides the state's statutory authority to develop and implement a coastal area management program. ADEM, through Admin. Code Reg. 335-8-1, et seq., regulates the filling and excavation of wetlands and certain types of development within the coastal area, requiring a determination of consistency by the applicant proposing the activity. This is usually part of the CWA Section 404 joint application process initially filed with the Corps of Engineers. The ADEM coastal area management plan (now administered by ADCNR) and the ADEM Coastal Regulations (administered by ADEM) are limited to the coastal area. Here "coastal area" is defined as an area with outside or upland boundary determined by the continuous 10- foot contour in Mobile and Baldwin Counties. The last time any significant changes, updates, or amendments were made to the Coastal Regulations was 1995. There are general and nationwide permits issued by the Corps of Engineers that presently have been given coastal program and regulation consistency for discharging fill to wetlands in the coastal area, such as NWP18. The present consistency determination was made by ADEM in January 2017, for five years. The Corps of Engineers on December 27, 2021 issued a Rule published in the Federal Register to reissue and modify Nationwide Permits. In this rule, the 2017 version of the existing NWP18 will expire on the day before February 25, 2022. In the Final Rule, NWP18 was reissued on February 25, 2022, and expires March 14, 2026.

ADEM and ADCNR have also developed a CNPCP according to Section 6217 of the Coastal Zone Management Act. This program is non-regulatory, relying heavily on existing state, county, and local programs to address various non-point sources of pollution impacting coastal waters. The necessary management measures that comprise the state's program include Coastal 6217 Management Boundary; Agriculture; Forestry; Urban Development; Marinas; Hydromodification; and Wetland and Riparian Areas. To date, the program has undertaken or funded several projects designed to gather data on existing or potential pollutant sources, test new technology through pilot projects, assist property owners and regulators in developing and implementing pollution controls in the coastal counties. The state program is currently considered "conditionally approved" by NOAA.

9.2.3 Local Government Regulations

In addition to the overarching federal and state regulations, two municipalities and Baldwin County also have various regulations, ordinances, and permitting requirements that cover activities within the Watershed. In place of a detailed discussion of each local ordinance, to determine who regulates what and how they implement and enforce the local requirements, a matrix listing various topics related to water quality and resource protection was completed for each entity (Table 9.8).

Information originally gathered and provided by the Mississippi-Alabama Sea Grant Legal Program (MASGLP) indicates that Alabama is a "Dillon's Rule" state. 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, and municipal corporations under Alabama law, have the authority to implement zoning, regulate new development, and manage stormwater. For a more detailed description of the legal basis for Dillon's Rule as it applies to the Eastern Shore refer to the South Alabama Stormwater Regulatory Review (Carlton, 2018). Baldwin County government statutory authority is somewhat more limited. Baldwin County requirements apply county-wide in areas not subject to a municipalities' planning jurisdiction. Code of Alabama 1975 §11-19-1 through 24 provides general authority for the counties of Alabama to adopt zoning ordinances in flood-prone areas. Baldwin County cites Code of Alabama 1975 Sections 45-5-261, 11-19-1, 11-24-1, and 11-52-30 as the authority for developing its planning and zoning program and subdivision regulations (Carlton, 2018).

In addition to the regulatory drivers noted above, restrictive subdivision covenants can also play an important role in stormwater management. Usually, within a residential subdivision, property owners' associations are incorporated. Various subdivision restrictions 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.

The areas covered in the regulatory matrix (Table 9.8) include the following:

- Construction phase BMP requirements
- Post-construction stormwater management requirements
- Coastal area resource protection requirements
- LID
- Shoreline stabilization
- MS4 permit coverage

Table 9.8 Eastern Shore WMP Regulatory Matrix

		ADEM	Baldwin County	Daphne	Fairhope
Construction Phase BMPs Requirements		Yes	Yes	Yes	Yes
	Design Standards	AL Handbook*[1]	AL Handbook	AL Handbook	AL Handbook
	Design Storm	2yr-24hr[2]	Not specified	25yr-24hr	25yr-24hr
	Site Size	>1 ac[1]	Any	>1,000 ft^2	Any
	Stabilization Time	13 days[1]	10 or 13 days	13 days	10 days
	Inspections	Self Inspection I/month + 3/4" rain[1]	Yes	Yes	City-Random; Contractor-Daily
	BMP Repair/Maint. Time	5 days[1]	Not Specified	2 Days	2 Days
	Non-compliance Reporting	Yes[1]	No	No	No
	Buffer Requirement	25'	30' wetland, 50' waterway	No	20' / 30'
	Litter/Trash/Recycling	Yes	Yes	Yes	Yes
Post Construction SW Mngt Requirements		No	Yes	Yes	Yes

		ADEM	Baldwin County	Daphne	Fairhope
	Stormwater Quality	No	No	Yes	Treat 1.8", 85% Capture, 80% TSS Removal
	Stormwater Quantity	No	Yes	Yes	Yes
	Design Storm	N/A	2 - 100 yr	2 - 100 yr	2 - 100 yr
	Site Size	N/A	Any	Any	All Subdivisions
	Inspection	N/A	Yes	1 / 5 yr	1/ 3 yr
	Maintenance	N/A	Developer/Owner	Developer Trustee	Developer/Landowner
	Reporting	N/A	No	Yes	Yes
	Calculation Method	N/A	SCS	Rational or Modified Rational Method	Rational <100 ac, SCS >100 ac
Coastal Area Resource Protection		Yes[3]	Yes	Yes	Yes
	Wetland/Stream Buffer	Yes[3] 25 ft.[1]	5 feet[4]	Stream-50'/Wetland-30'	Wetland-20'-30' Streams 50'-100' (by watershed)
	Permit Requirement	Yes[3, only in coastal area]	ADEM/COE only	USACOE	Yes
Low Impact Development (LID)		No	No	Yes	Yes
	Development Size	N/A	N/A	No	Not Specified
	Impervious Cover	No	No	No	Optional
	On-site Retention	No	No	No	Optional
	LID Standards	No	No	Yes	Not Specified
	Impediments to LID	N/A	N/A	No	No
Shoreline Stabilization		Yes[3, only in coastal area]	No	No	No
	Piers and Bulkheads	Yes[3, only in coastal area]	No	USACE, ADCNR ADEM Verification	N/A
	Living Shorelines	No	No	USACE, ADCNR ADEM Verification	N/A
MS4 Permit Coverage		N/A	Yes	Yes	Yes

Footnotes:
1 ADEM NPDES General Permit ALR100000, Part III
2 ADEM NPDES General Permit ALR100000, Part I
3 ADEM Admin. Code Reg. 335-8 (Coastal Area Management Program)
4 Baldwin County Subdivision Regulations, January 1, 2008 (Applicable County wide)
Source: Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas, September 2014

9.2.3.1 Baldwin County

Baldwin County became an organized governing authority in 1809 and remains one of the largest and fastest growing counties in the state. The Baldwin County Commission is tasked with assisting the "State in carrying out the authorized functions necessary to protect the health and welfare of the citizenry" (Baldwin County Commission 2016). Essential to this function is protecting the water quality to safeguard the health and welfare of the community. The Baldwin County Commission protects water quality using the following ordinances and regulations:

Baldwin County Zoning Ordinance (July 2022). The Baldwin County Zoning Ordinance is administered County-wide in unincorporated areas that have voted for zoning by the Baldwin County Commission and the Planning and Zoning Department. The ordinance establishes planning districts (Figure 9.2) and sets forth zoning requirements within the county related to various land uses. The development standards outlined in Section 9.6.4 require that a 50-ft-wide buffer be maintained whenever the perimeter of a planned industrial development abuts a wetland area. Where the distance between property lines is greater than 1,000 ft, the buffer requirement increases to 100 ft. Section 10.4 establishes a Wetland Protection Overlay District that applies to all zoned areas and requires that a Corps of Engineers permit be obtained prior to county approval of projects involving the filling of jurisdictional wetlands. It also establishes a 30-foot development setback/easement for jurisdictional wetlands. These requirements are in addition to those required by federal and state agencies.

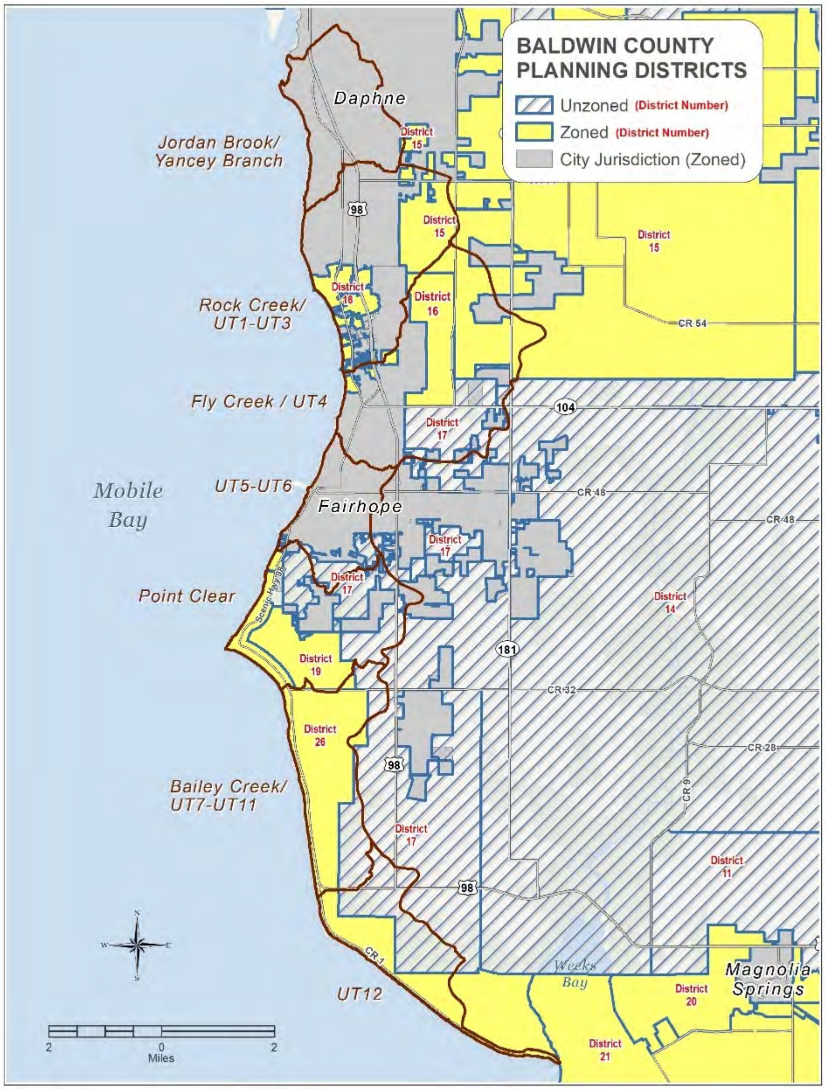

Figure 9.2 Planning Districts in the Eastern Shore WMP.
Source: Baldwin County, 2022

Article 13, Section 13.11 of the Ordinance mentions stormwater management only to the degree that a stormwater management plan is required for all major projects (defined by the type of use, not acreage) and that "reasonable provisions for handling surface drainage have been made."

Section 13.12 (amended December 2020) deals specifically with erosion control practices required during land disturbing construction activities. It sets forth various design principles and design criteria, standards, and specifications to reduce erosion and sedimentation during construction. Section 13.13 requires activities to be covered under a county permit; an erosion control plan to be prepared and implemented; BMPs to be implemented and maintained; and final site stabilization to be completed once construction is done. The Baldwin County Planning and Zoning Department has produced two informative pamphlets: 1) Baldwin County Planning and Zoning: Steps to Coming Under the Planning and Zoning Jurisdiction of Baldwin County, and 2) Zoning FAQ's (copies included in Appendix C).

9.3 Regulatory Overlap

Federal, State, and local requirements overlap within the Watershed. The over-arching federal and state water quality regulations apply to all areas of the county and within the Cities of Daphne and Fairhope. Any proposal to fill jurisdictional wetlands located within the Eastern Shore Watershed, must have:

- A proper permit application for a CWA Section 404 permit with review by all agencies and the public (unless authorized by an NWP);
- Appropriate ADEM Section 401 water quality certification;
- Consideration of CWA Section 303(d) impacts (for listed stream segments);
- ADEM coastal program consistency determination if in the coastal area;
- A CWA Section 402 NPDES – ADEM Admin. Code Reg. 335-6-12 construction stormwater permit (if greater than 1 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.

The overlap between federal, state, and local requirements is unavoidable; nevertheless, the degree of overlap has been lessened by EPA delegating certain programmatic or regulatory authority to ADEM, and ADEM delegating certain coastal program requirements to the local authorities. The cities of Daphne and Fairhope exert their jurisdiction and permitting requirements within their respective geographical boundaries. In addition to the federal and state permit requirements, each local entity requires permits for development, land disturbance, and building construction, depending on the jurisdiction. Often the federal or state permit is a prerequisite to the issuance of the local permit. Where City and County jurisdictions overlap, it is customary for the more stringent requirements to apply. In general, the current level of regulatory overlap is not considered a significant issue relative to stormwater management within the Watershed.

A regulatory "matrix" based on several elements deemed critical to effective stormwater management programs was created to assist in the review process. The matrix is contained in Table 9.8. The rows in the table list the four review elements considered:

(1) construction phase BMPs;
(2) post-construction stormwater management;
(3) coastal area resource protection
(4) low impact development (LID)
(5) shoreline stabilization; and
(6) MS4 permits

The columns in Table 9.8 summarize the results of the review of the regulations or ordinances for each of the four regulatory entities having jurisdiction within the Eastern Shore Watershed. There is some degree of consistency among the various programs concerning the elements that are addressed (e.g., all programs require some type of construction phase BMPs, address stabilization time). However, there are significant differences between each regulatory entity's specific requirements, as stated in the regulations or ordinances (e.g., design storm). These differences and any perceived deficiencies are addressed in the following sections.

The cities' extra-territorial jurisdictions extend beyond their boundaries for up to three miles for planning purposes and overlap into the County, but not an adjacent municipality. Each City exerts its jurisdiction and permitting requirements within their respective geographical boundaries. Each local entity requires permits for development, land disturbance and building construction, depending on jurisdiction, that are in addition to the federal and state permit requirements. Often the federal or state permit is a prerequisite to issuance of the local permit. Where City and County jurisdictions overlap, it is customary for the "more stringent" requirements to apply. With the passage of Act 2021-297 and with the subsequent County's notice to municipalities, this city-county permitting overlap will cease within Baldwin County beginning July 26, 2023 as discussed in Appendix C.

9.4 Enforcement

Enforcement, as used herein, is considered in a broader sense to include not only instigating a formal administrative or legal action to compel compliance; but the regulatory requirements to comply with the terms of a permit and conducting routine monitoring and maintenance to ensure stormwater management controls function properly. Rules, regulations, ordinances, and restrictions usually require some degree of enforcement to ensure compliance. To achieve the ultimate objective of the rule, enforcement must be timely and meaningful. Further, to maintain the integrity of the implementing agency, enforcement must be consistent and impartial. Each program reviewed contained enforcement provisions ranging from warnings to "stop work orders" to civil or criminal penalties.

Although a detailed review of each agency's enforcement history was not performed, most local agencies indicated that formal enforcement was "rare". In several cases identified during the review process, local governments were relying on enforcement by the state for construction phase BMP compliance, routinely referring non-compliant sites to ADEM for action.

Routine inspection, monitoring, and maintenance is a critical component of maintaining construction phase BMPs and insuring that post construction stormwater management facilities function properly. Agency resources are, in many cases, scarce and routine regulatory oversight of permitted activities can be all but non-existent, particularly at the federal and state level. ADEM, under the provisions of the construction stormwater permit, is currently the only agency that requires "self-monitoring" and reporting be performed during construction, but generally only perform their own inspection when a citizen complaint is lodged or a referral is made by local government. Many of the local entities reported that their staff were routinely monitoring projects during the construction phase to ensure compliance with state or local requirements. However, most entities were not routinely performing post construction inspections (other than a final "as built" inspection), or requiring that the responsible entity perform regular inspections of stormwater management facilities. Inspections and any resulting repair or maintenance cost money and will rarely be performed unless mandated.

9.5 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. Consistency among the local government ordinances will be a key factor in effectively implementing the management measures necessary to protect the Watershed's natural resources. Development entities often gravitate to or seek incorporation into jurisdictions with less regulation. The long-term costs of this approach to the broader community and its citizens will be realized as flooding increases and water quality decreases. Additional costs due to poor flood zone management include the following: (1) flood zones expand, which increases insurance rates; (2) waterbodies become polluted, which prompts additional regulatory oversight, expensive restoration projects, decreased land value with decreased tax income, and increased stormwater treatment costs; and (3) stormwater conveyance, maintenance, and dredging costs manifest and increase. Examples of regulatory inconsistencies are discussed in detail in the *South Alabama Stormwater Regulatory Review* (Carlton, 2018).

9.6 Regulatory Gaps

Often the federal or state regulatory requirements serve to provide a measure of consistency or provide some minimum baseline for local regulation, and often local units of government rely on or defer to the state or federal requirements. Without this foundation, it is difficult to achieve regulatory consistency among local units of government. Even when state and federal regulations are in place, they usually have such a broad nature and scope (national or statewide) that they may not be meaningful at a watershed specific level. In such cases, it falls to the local units of government to adopt and implement regulations that are effective in achieving specific watershed management goals. Currently, except for compliance with FEMA, there are no overarching federal or state regulatory requirements for post-construction stormwater quantity or quality. Regulatory gaps can also be due to antiquated regulations. At the state level, the coastal area management program regulations relating to resource impacts (ADEM Administrative Code R. 335-8-2) have not been revised in over 20 years. ADEM and ADCNR struggle to maintain a federally approved coastal management program, due in part to the lack of a regulatory framework that would allow the state to ensure the federal goals can be met. Significant advancements in resource protection alternatives have been realized during the intervening years, some of which may be precluded by outdated regulations. Because federal and state regulatory requirements are so broad in nature and scope, developing and implementing local stormwater management regulations and ordinances are often the best or only way to achieve watershed resource protection goals and/or address local stormwater-related impacts.

9.7 Recent Local Regulatory Changes

The purpose of post-construction stormwater management is to ensure that the original design, placement and implementation of the original stormwater retention and treatment safeguards maintain their purpose to effectively prevent non-stormwater discharges from entering environmentally sensitive areas after construction has been completed. There is a lack of post construction stormwater management in the State of Alabama, as such, numerous projects that have had to utilize proper BMPs to maintain compliance fail to do so after construction. Failure of poorly designed detention ponds, riparian buffers, and Low Impact Developments can cause more sedimentation and flooding issues in environmentally sensitive areas if not inspected and maintained after construction activities have ceased. This, in essence, can cause long-term issues. Therefore, it is suggested that the municipalities across the Eastern Shore implement some way to create and enforce a post-construction stormwater management plan to reduce or even eliminate some of these residual issues that arise from poorly designed BMPs. Additionally, steps can be taken to modify regulations so that quality construction phase BMPs put in place also extend beyond construction and meet post-construction goals.

Setbacks and riparian buffers are areas of vegetation that border a body of water or other environmentally sensitive areas and help prevent sedimentation from entering these aeras thus improving water quality. By trapping and removing sediment and contaminants from stormwater, these buffers can improve water quality, wildlife, and property values. In order for these buffers to become effective, it is best to pair them with other BMP methods such as grassed filter strips. Buffers are only required by ADEM during construction activities whereas the municipalities on the Eastern Shore all require some type of buffer to protect State waterbodies. Since vegetative buffers play an integral part in protecting wetlands and other environmentally sensitive areas, it is suggested that the Fairhope, Daphne and Baldwin County utilize permanent riparian buffers, whenever possible. These buffers would provide a way to protect the environmentally sensitive areas from sedimentation and pollutants carried in stormwater on the island as well providing more greenspace, which will help with flooding and erosion.

Flood control ordinances were not explicitly reviewed. However, flood control goals and stormwater treatment goals are often in opposition. One is trying to remove water as quickly as possible and the other is trying to slow-release rates and/or volumes. A detailed review of flood control requirements and comparison to stormwater management requirements could help identify potential conflicts. Further, all aspects of local development requirements that could potentially conflict with stormwater management goals were not studied.

There is quite a bit of complexity around the “extra-territorial jurisdictions” (ETJ) or “planning jurisdictions” that can create confusion with the regulatory requirements in the Watershed. The local cities and towns, as municipal corporations under Alabama law, have the authority to implement zoning, regulate new development, and manage stormwater. Some municipalities have exercised their authority to issue permits outside of their corporate limits and within their ETJ while others confine permitting to the city limits. Passage of Act 2021-297 in 2021 clarified and restricted municipality planning jurisdictions as discussed in Appendix C. While the extension of municipality authority beyond their corporate limits and into the planning jurisdiction served to regulate development where in the past the County lacked organization for the same, this is no longer the case. Thus after passage of the Act, the Baldwin County Planning Commission formally gave municipalities a 24-month notice of the County’s intent to regulate the construction of buildings in all unincorporated lands of the County (Act 2021-297 §2(b)(2)a). This takes effect July of 2023 thus ending city-county overlap that will provide clarity in development regulations throughout the Watershed.

With respect to zoning, the Baldwin County Commission has additional regulating oversight and regulations in zoned Planning Districts within the County (unincorporated lands) depending on the type of development or construction. Zoned District review process includes approval of an Administrative Site Plan Approval for most residential projects, a Commission Site Plan Approval for larger commercial projects, and a Land Disturbance Permit, if applicable. These are administered by the planning and zoning department to ensure development is in accordance to the zoning ordinance of each District. Each Planning District can vary in terms of their local provisions. Overall zoning ensures that proposed development (or use) is compatible with the surrounding land uses and provides members of the community an opportunity to comment on those proposed uses. (Baldwin County Zoning Facts Worksheet, January 2022). As of the time of writing (per update in Appendix C, Baldwin County is divided into 37 Planning Districts, of which 23 have voted to adopt zoning ordinances for their district.

As shown in Figure C-1 of Appendix C, the most zoned districts are located along the most populated areas of the county subject to development pressures from adjacent cities, transportation corridors, and beaches. As development and growth continue in the County, it is imperative that citizens understand that zoning can be an extremely effective way to manage that growth. While some feel that zoning may restrict their property rights, there is an outweighing benefit to zoning ordinances that ensure compatible land uses and guide development in a manner desirable by communities at large. The Baldwin County Planning and Zoning Department has zoning information available for citizens to review and learn about, including; an informational webpage (https://baldwincountyal.gov/departments/planning-zoning/zoning-in-baldwin) which includes some informational FAQs and printed materials (copies included in Appendix C).

9.8 Potential Regulatory Tracking/Engagement

While the existing environmental and water quality protections and enforcement mechanisms related to watershed management for the cities of Daphne and Fairhope and for Baldwin County are progressive when considered across the southern portion of Alabama, there should be considerations given to development of a "watershed task force" type group to "be at the table" as regulations are promulgated by municipalities and the county. Such an intergovernmental/stakeholder-based group would be especially helpful as the previously discussed local regulatory ETJ changes related to Alabama's Act 2021-297, as well as the rapid population/development activities within the Eastern Shore Watershed area of Baldwin County. The group should consist of a good mix of governmental representatives and other key stakeholders that participated in the development of this Eastern Shore WMP.

10.0 Financing Alternatives

10.1 Introduction

Significant and reliable funding will be necessary to execute the management measures proposed within this Watershed Management Plan. Implementing this Plan will require stakeholder and community support through coordination and a variety of financial resources. We encourage a combination of securing federal, state, and local funding, and creating public-private partnerships. Such partnerships are recommended because government jurisdiction will not necessarily be confined to the Watershed boundary, and partnerships can better facilitate the available resources. Examples of partnerships include arrangements between landowners and governments or collaboration between civic groups and government. Together, public and private entities can explore financial assistance opportunities such as grants and cooperative agreements. Funding across an entire watershed is a challenging endeavor, and some financing alternatives are better suited for targeted areas. By leveraging multiple funding opportunities amid organized partnerships, the success of ESWMP implementation can be maximized. Potential teaming partners are listed below (Table 10.1):

Table 10.1 Potential Financial Teaming Partners

Alabama Coastal Foundation	Dauphin Island Sea Lab
Alabama Department of Conservation and Natural Resources	Geological Survey of Alabama
Alabama Department of Economic and Community Affairs	Mississippi-Alabama SeaGrant Consortium
Alabama Department of Environmental Management	Mobile Bay National Estuary Program
Alabama Department of Public Health	Mobile Baykeeper
Alabama Department of Transportation	National Fish and Wildlife Foundation
Alabama Forest Resources Center	Pelican Coast Conservancy
Alabama Forestry Commission	Daphne Utilities
Alabama Power Company	Southeast Aquatic Resources Partnership
Alabama Water Watch	South Alabama Land Trust
Alabama Wildlife Federation	South Alabama Regional Planning Council
Auburn University Marine Extension and Research Center	The Nature Conservancy
Baldwin County-Alabama Cooperative Extension	University of South Alabama
Baldwin County Commission	US Army Corps of Engineers
Baldwin County Health Department	US Environmental Protection Agency
Baldwin County Public Schools	US Fish and Wildlife Service
Baldwin County Sewer Service	US Geological Survey
Baldwin County Soil and Water Conservation District	USDA, Forest Service
City of Daphne	USDA, Natural Resource Conservation Service
City of Fairhope	Weeks Bay National Estuarine Research Reserve

Financial structures and sources that could provide funding for the management issues and projects identified in this WMP are discussed below. Some financial structures could be helpful across the entire Watershed and some within limited areas. Many would require public-private partnerships and cooperation among landowners, organizations, and governments, rather than imposition by governmental entities.

10.2 Financial Strategies

Multiple funding sources are available to execute this WMP. The following sections detail these sources and the opportunities available for each source.

10.2.1 Federal Funding Programs

Federal funding opportunities, such as grants, revenue sharing, and loans, can be pursued through USEPA, NOAA, USFWS, USGS, USACE, and the USDA. These funding opportunities can be used by public and private entities to execute the measures proposed in the Watershed Management Plan. Funding opportunities can be located and applied for through the federal portal at Grants.gov.

Some of the most viable funding sources for the Watershed include the Resources and Ecosystems Sustainability, Tourist Opportunities and Revived Economies (RESTORE) Act, National Fish and Wildlife Foundation's (NFWF) Gulf Environmental Benefit Fund, and the Gulf of Mexico Energy Security Act (GOMESA).

The RESTORE Act was signed into law in 2012 in direct response to the Deepwater Horizon oil spill of 2010. The RESTORE Act established the Gulf Coast Restoration Trust Fund in the U.S. Treasury Department and designated that 80% of all administrative and civil penalties in connection with the oil spill be deposited in the Trust Fund and invested. The Gulf Coast Ecosystem Restoration Council has oversight of 60% of the Trust Fund, with 30% designated for developing a comprehensive recovery plan and the other 30% allocated to the states under the Spill Impact Component and spent according to the state's individual State Expenditure Plan. A total of 35% of the Trust Fund was evenly split among the five Gulf states for economic and ecological recovery. The NOAA Science Component was awarded 2.5% of the Trust Fund, which they dedicated to the Gulf Coast Ecosystem Restoration Science, Observation, Monitoring, and Technology Program, and the Center of Excellence for use in the Research Grants Program was awarded the remaining 2.5% of the funds. The Alabama Gulf Coast Recovery Council governs direct funding to Alabama. Projects and programs which propose restoration and protection of Gulf Coast natural resources, ecosystems, and habitats may be eligible for funding (https://home.treasury.gov/policy-issues/financial-markets-financial-institutions-and-fiscal-service/restore-act).

NFWF was created by Congress in 1984 and is the nation's largest private conservation grant-maker (https://www.nfwf.org/). They work to coordinate individuals, government agencies, nonprofit organizations, and corporations with the intent of sustaining and enhancing the nation's natural resources. Specifically, the NFWF prioritizes protecting and restoring imperiled species, promoting healthy oceans and estuaries, improving working landscapes for wildlife, advancing sustainable fisheries, and conserving water for wildlife and people. NFWF provides competitive funding to projects that support their initiatives. Each initiative has a business plan that projects should align with, and many actions proposed within the ESWMP are well suited for a NFWF grant. The NFWF Gulf Environmental Benefit Fund (GEBF) was established as a result of the Deepwater Horizon Oil Spill and supports state and local organizations that are committed to conserving, restoring, and enhancing coastal habitats. Similar to the Natural Resource Damage Assessment process, the Gulf Environmental Benefit Fund was established under a different legal framework and supports projects that complement ongoing Natural Resource Damage Assessment work. The NFWF Five Star Urban Waters Restoration Grant Program is well suited for the Eastern Shore because it focuses on water quality issues in priority watersheds, including pollution from stormwater runoff and degraded streams caused by development. Additional grant opportunities include the Conservation Partners Program and the National Wildlife Refuge Friends Program.

GOMESA was signed into law in 2006 to enhance outer continental shelf oil and gas leasing activities and revenue sharing in the Gulf of Mexico. GOMESA 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 for existing leases to be exchanged for bonuses and credits to be used on other leases in the Gulf. Funding for projects is generated through revenue sharing with Gulf states and the Land and Water Conservation Fund. Revenue sharing provisions were extended to Alabama, Louisiana, Mississippi, and Texas. Funds are specified for use in coastal conservation, coastal restoration, and hurricane protection. For Alabama, money is dispersed to the State, Baldwin County, and Mobile County. The pursuit of such funds is recommended for ESWMP project implementation.

The U.S. EPA announced a $3.75 million grant to support local projects to protect and sustain healthy watersheds (https://www.epa.gov/hwp/healthy-watersheds-consortium-grants-hwcg). EPA has made an official award to the U.S. Endowment for Forestry and Communities, Inc. (Endowment) to support the coordinated efforts of the Endowment and its partner organizations. The Healthy Watersheds Consortium Grant Program goal is to accelerate strategic protection of healthy, freshwater ecosystems and their watersheds (http://www.usendowment.org/partnerships/healthywatershedsconsor.html). The EPA also supports the Five-Star Restoration Program by providing funds to NFWF, the National Association of Counties, NOAA's Community-based Restoration Program, and the Wildlife Habitat Council. These groups are then able to make subgrants to support community-based wetland and riparian restoration projects. Competitive projects must have a strong on-the-ground habitat restoration component with long-term ecological, educational, and/or socioeconomic benefits to the people and their community. Preference is given to projects that are part of a larger watershed or community stewardship effort and include a description of long-term management activities. "Projects must involve contributions from multiple and diverse partners, including citizen volunteer organizations, corporations, private landowners, local conservation organizations, youth groups, charitable foundations, and other federal, state, and tribal agencies and local governments" (https://privatelandownernetwork.org/). It is desirable that each project involve at least five partners who are expected to contribute funding, land, technical assistance, workforce support, or other in-kind services that are equivalent to the federal contribution.

10.2.2 Stormwater Programs

The U.S. EPA provides numerous resources to support funding procurement for stormwater projects. Their Water Finance Clearing House and Water Infrastructure and Resilience Finance Center serve as a database and assistance center, respectively, to locate funding opportunities and support local decision-makers regarding stormwater infrastructure. Additionally, the Clean Water State Revolving Fund provides low-cost financing for a variety of water quality infrastructure projects. Beyond the traditional acquisition of funding, the U.S. EPA also recommends that communities explore establishing a stormwater utility. A stormwater utility operates similarly to a water or electric utility and collects fees associated with the controlling and treating stormwater (https://www3.epa.gov/region1/npdes/stormwater/assets/pdfs/FundingStormwater.pdf). A stormwater utility within the watershed would provide stable, long-term support of stormwater management through equitable and transparent funding. Fees may be based on the parcel size, property type, and/or the degree of impervious area, or fees may be fixed in a specific geographic area. For example, lots within a residential development may be subject to predetermined stormwater user fees, which are not a function of the lot characteristics. Property owners could also earn credits or be subject to surcharges as a function of stewardship. Individuals who implement on-site attenuation or related LID measures could experience reduced fees. In contrast, those that increase industrial activity or modify the land use in a way that negatively impacts stormwater management could see an increase in fees. Additionally, certain roadways, rights-of-way, or undeveloped areas may be exempt from fees. The utility fee generally appears as an individual bill, as a line item on a water and/or sewer bill, or as a component of property tax bills. This revenue source would support the stormwater utility with planning and executing programs that address stormwater issues identified within the Eastern Shore Watershed. Citizens might not be educated or knowledgeable regarding issues related to local water quality and stormwater management. As such, it can be expected that they would likely approach the development of a stormwater utility with skepticism or distrust. Extensive education and outreach would be needed to support the successful implementation of a stormwater utility. Local programs such as "Create a Clean Water Future" (https://www.cleanwaterfuture.com/) can help provide educational resources.

10.2.3 State Funding Programs

The Alabama Coastal Area Management Program (ACAMP) was approved by NOAA in 1979 as part of the National Coastal Zone Management Program. Its purpose is to balance economic growth with the need for preservation of Alabama's coastal resources for future generations. Annual program activities include coastal cleanup, implementation of public access construction projects, planning support for local governments, and providing funds to Alabama's coastal communities and partners. ACAMP's annual grant program supports projects that protect, enhance, and improve the management of natural, cultural, and historical coastal resources and that increase the sustainability, resiliency and preparedness of coastal communities and economies. Therefore, ACAMP should be considered as a top financial resource on the state level.

10.2.3.1 State Revolving Funds

The EPA State Revolving Fund (SRF) loan program offers a reliable source of funding (Berahzer, 2010b). There are separate SRF programs for "Clean Water" and "Drinking Water". Funds are provided annually to each state by the federal government with the states providing a 20% matching amount. To receive funding, a project must be on the state's annual "Intended Use Plan" (IUP) list. The IUP contains a "comprehensive" list and a shorter "fundable" or "priority" list. A public comment process is required for the IUP. Since 2007, the SRF has moved beyond the traditional "water treatment works" projects and has begun to emphasize nonpoint sources and estuary protection as funding priorities. Projects that strengthen compliance with federal and state regulations and enhance protection of public health are eligible for consideration to receive SRF loans. There are also benefits to obtaining such funding. The engineering, inspection, and construction costs are eligible for reimbursement if a project qualifies.

10.2.4 Local Government

The Cities of Daphne and Fairhope and Baldwin County are the coordinating municipalities within the Eastern Shore Watershed and have an established relationship that will only help to further the goals of this Plan and funding strategies.

10.2.4.1 Property, Sales, or Other Taxes (General Fund)

The use of public "general funds" to finance projects is considered undesirable because no dedicated source of continuing and consistent funding would be created. This limits the success of funding WMPs as these programs would have to compete with maintenance and construction projects for funding.

Environmental projects are often considered less essential than priorities such as police, fire, and emergency medical personnel. Environmental projects are also vulnerable to budget cuts (Spitzer, 2010). It is important for the Cities of Fairhope and Daphne as well as Baldwin County to set aside funds specifically for environmental projects identified in Chapters 7.0 and 8.0.

10.2.4.2 Impact Fees

Impact fees are paid by developers (usually at the time of development) to obtain a building permit. The fee is designed to reimburse the government for the additional impact a development may have on the community. They may be for transportation (i.e., increased impact on roads and bridges as a result of constructing a development), water and sewer (i.e., the impact on the system capacity as a result of increased volume and demand), as well as other public infrastructure impacts. Typically, a direct relationship between the development and the impact fee must exist. These fees must often be authorized by statute and are used for capital improvements, not for maintenance. They are a one-time, up-front charge for new construction (Mustian, 2010). As stated previously, Baldwin County is one of the fastest growing counties in Alabama. New sub-developments are continuously being built on the Eastern Shore and utilizing impact fees could provide substantial revenue to update and increase infrastructure to support water quality enhancements.

10.3 Business and Industry

The business and industry community on the Eastern Shore is active and thriving. There are many retail businesses, wholesale operations, industrial operations, technology industries, utilities, maritime industries, and residential and commercial development with enormous opportunity for expansion. Every one of these commercial interests has an economic stake in the health of Mobile Bay and will directly benefit from its recovery or suffer from its decline. Healthy, productive watersheds can reduce water treatment and mitigation costs, support recreation and tourism, increase property values and job opportunities, and generate revenue, which is to the direct benefit of commercial development and production. The Eastern Shore Chamber of Commerce has an established record of facilitating business partnerships that support sustainable growth and development throughout the Eastern Shore. As such, it is recommended that coordination continue to take place with the Chamber to leverage the organization's leadership capacity and existing partnerships to execute the goals of the WMP.

10.4 "Green" Stimulus Funding Under the 2009 American Recovery and Reinvestment Act

The EPA introduced, as a part of its SRF Loan Program, a Green Project Reserve, and maintained this funding mechanism in FY 2010. The Green Project Reserve stipulates that at least 20% of the SRF funds shall be used by the states for projects that address green infrastructure, water or energy improvements, or other environmentally innovative activities (Berahzer, 2010a). In general, the combination of the Green Project Reserve and the additional subsidization could lead to better financing terms for stormwater projects. Many stormwater projects and LID strategies may be considered "green" under this funding category. Examples include porous pavement, bioretention facilities, rain gardens, green roofs/walls/streets, wetlands restoration, constructed wetlands, urban retrofit programs, infiltration basins, landscaped swales, downspout disconnection, and tree planting. Land acquisition services and the actual cost for the purchase of land or easements may also be included in the scope of this definition.

10.5 Non-Governmental Organizations and Other Private Funding

Funding opportunities available from private foundations and corporations are identified as non-governmental organizations (NGOs) and other private entities. These programs are included here because of their inclusion in the U.S. EPA Clearinghouse of funding opportunities for environmental reclamation and are applicable to ongoing efforts on the Eastern Shore.

Table 10.2 lists an overview of financial resources that could support implementing the recommendations included in the Watershed Management Plan. Funding categories are represented as: (1) financial assistance, (2) technical assistance, (3) water quality monitoring, and (4) information and education.

10.6 Regional Collaboration Opportunities

There are regional collaboration opportunities applicable to watershed projects. The EPA Region 4 sponsors four (4): the Green Infrastructure Partnership, Smart Growth Implementation Assistance, and Watershed Protection and Restoration Assistance collaboration opportunities. The fourth collaborative opportunity is through the Gulf of Mexico Alliance (GOMA); a partnership of the states of Alabama, Florida, Louisiana, Mississippi, and Texas. The primary goal of the Green Infrastructure Partnership is to reduce runoff volumes and sewer overflow events through the widespread use of green infrastructure management practices that help maintain natural hydrologic functions by absorbing and infiltrating precipitation where it falls. The EPA lists funding opportunities for this program at: https://www.epa.gov/green-infrastructure/green-infrastructure-funding-opportunities.

The Smart Growth Implementation Assistance program is an annual, competitive solicitation open to state, local, regional, and tribal governments (and non-profit organizations that have partnered with a governmental entity) to incorporate smart growth techniques into their future developments. Program opportunities are listed at: https://www.epa.gov/smartgrowth/epa-smart-growth-grants-and-other-funding.

Through the Watershed Protection and Restoration Assistance Partnership, the staff of EPA Region 4 works with state and local governments and watershed organizations to facilitate protection and restoration efforts in targeted watersheds. Funding opportunities for this program are listed at: https://www.epa.gov/nps/funding-resources-watershed-protection-and-restoration.

The goal of GOMA is to significantly increase regional collaboration to enhance the ecological and economic health of the Gulf of Mexico. Priority issues for this group include water quality, habitat conservation and restoration, ecosystem integration and assessment, nutrients and nutrient impacts, coastal community resilience, and environmental education. GOMA lists funding opportunities at the following website: https://gulfofmexicoalliance.org/announcements/funding/.

10.7 Summary

Table 10.2 provides an overview of potential financial resources that could support the implementation of the measures proposed in the ESWMP. The table addresses the type of funding as well as the form of aid provided. Almost all sources provide financial assistance, and some provide technical assistance as well. Examples of technical assistance include sharing information, sharing data, consulting, training, assisting with management measures, and engaging in project partnerships. These funding opportunities are presented as guidance, and consideration should be given to the reality that the financial section of the economy is continuously evolving. Flexibility will be necessary if existing funds cease or a new funding source becomes available. We recommend establishing an authority in addition to public-private partnerships. Such measures could support the acquisition of additional funding, provide a centralized framework, and ultimately enhance the viability of the ESWMP.

Table 10.2 Funding Available to Support Plan Implementation

Funding Source	Description	Type	Actions Funded
Alabama Coastal Area Management Program (ACAMP)	Annual Grant Program	State	Financial assistance, water, quality monitoring
Alabama Department of Conservation and Natural Resources (ADCNR)	Alabama Coastal Area Management Program	Federal	Technical assistance, financial assistance
Alabama Department of Environmental Management (ADEM)	Section 319 Grant Funds Clean Water SRF	State	Financial assistance, water, quality monitoring
Cornell Douglas Foundation Grants	Cornell Douglas Foundation Grants	Private	Information and education, financial assistance
Department of the Interior (DOI)	Land and Water Conservation Fund (LWCF)	Federal	Financial assistance
Federal Emergency Management Agency (FEMA)	Building Resilience Infrastructure and Communities (BRIC)	Federal	Financial assistance
Gulf Coast Ecosystem Restoration Council	Council-Selected Restoration Component of the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE)	Federal	Financial assistance
Gulf of Mexico Alliance (GOMA)	Gulf Star Grants Program	Private-public partnership	Information and education, financial assistance, water quality monitoring

Funding Source	Description	Type	Actions Funded
Gulf Research Program	Gulf Sea Level Variation and Rise Grants	Private	Financial assistance
	Thriving Communities Grants	Private	Financial assistance
National Education Association Foundation	Captain Planet Foundation Grants	Private	Financial assistance, information and education
National Environmental Education Foundation	Everyday Capacity Building Grants	Private	Financial assistance, information and education
National Endowment for the Humanities	Landmarks of American History and Culture	Federal	Financial assistance, information and education
	Infrastructure and Capacity Building Challenge Grants	Federal	Financial assistance
National Fish and Wildlife Foundation (NFWF)	Conservation Partners Program	Private	Technical assistance, information and education
	Gulf Environmental Benefit Fund (GEBF)	Private	Financial assistance
	National Wildlife Refuge Friends Program	Private	Financial assistance, information and education
	Five Star & Urban Waters Restoration Program	Private	Financial assistance, information and education, water quality monitoring
	Gulf Coast Conservation Grant Program	Private	Financial assistance
National Oceanic and Atmospheric Administration (NOAA)	Marine Debris Removal	Federal	Financial assistance
	Marine Debris Prevention, Education and Outreach Partnership Grant	Federal	Financial assistance, information and education

Funding Source	Description	Type	Actions Funded
	Gulf of Mexico Bay-Watershed Education and Training (B-WET) Program	Federal	Financial assistance, information and education
	Restore Act Science Program	Federal	Financial assistance
	Broad Agency Announcement	Federal	Financial assistance, information and education
	Environmental Literacy Grants	Federal	Financial assistance, information and education
	Community-based Restoration Program	Federal	Financial assistance, technical assistance
National Park Service (NPS)	National Maritime Heritage Grant	Federal	Financial assistance, information and education
National Science Foundation (NSF)	Environmental Engineering R&D Grant	Federal	Technical assistance, water quality monitoring
Southeast Aquatic Resources Partnership (SEARP)	Aquatic Habitat Restoration Program	Federal	Financial assistance
The Home Depot	Community Impact Grants Program	Private	Financial assistance
U.S. Department of Agriculture, Natural Resource Conservation Service (USDA, NRCS)	Environmental Quality Incentives Program	Federal	Financial assistance, technical assistance, water quality monitoring
	Conservation Innovation Grants	Federal	Financial assistance, technical assistance
	Conservation Stewardship Program	Federal	Financial assistance, technical assistance
	Agricultural Conservation Easement Program	Federal	Financial assistance, technical assistance
U.S. Environmental Protection Agency (USEPA)	106 Grant Funds (Water Pollution Control)	Federal	Financial assistance, water quality monitoring

Funding Source	Description	Type	Actions Funded
	National Wetland Program Development Grants	Federal	Financial assistance, technical assistance, water quality monitoring
	Clean Water State Revolving Funds	Federal	Financial assistance, technical assistance
	Urban Waters Small Grants	Federal	Technical assistance, water quality monitoring
	Gulf of Mexico Division	Federal	Financial assistance, technical assistance
	Environmental Education Grants Program	Federal	Financial assistance
U.S. Fish and Wildlife Service (USFWS)	Partners for Fish and Wildlife	Federal	Financial assistance, technical assistance
	Coastal Program	Federal	Financial assistance, technical assistance
	National Coastal Wetlands Conservation Grant	Federal	Financial assistance
	State Wildlife Grants Program	Federal	Financial assistance
	Urban Wildlife Refuge Partnership	Federal	Financial assistance, information and education
	National Fish Habitat Action Plan	Federal	Technical assistance, financial assistance
U.S. Geological Survey (USGS)	State Water Research Act Program	Federal	Financial assistance, technical assistance
	Cooperative Matching Funds Program	Federal	Financial Assistance
United States Endowment for Forestry and Communities, Inc.	Healthy Watersheds Consortium Grant Program	Private-public partnership	Financial assistance, technical assistance, water quality monitoring

11.0 Monitoring

11.1 Introduction

Monitoring can be divided into two basic categories: administrative and environmental. Administrative monitoring consists of tracking program accomplishments, the degree to which management measures are implemented (number of acres where BMPs are applied, etc.) and other programmatic indicators. Environmental monitoring consists of direct measurement or tracking of various environmental indicators (water quality, wetland health, etc.) to detect changes or monitor long term environmental trends. Administrative monitoring is straight forward and easily performed by those responsible for implementing the Watershed Management Plan. Environmental monitoring is more complex.

A monitoring program to track the efforts and success of this Eastern Shore WMP should be developed and pursued in a consistent fashion. The Monitoring Program should clearly define the relevant questions that need to be answered and be focused on assessing the implementation of recommended management measures and the success of those measures in accomplishing the goals and objectives. Development of a Monitoring Program that complies with the specific grant requirements of Section 329i of the Clean Water Act is essential to the documenting the success of Plan implementation. The monitoring program should track the number of management measures that are implemented in the Watershed and the degree to which they are implemented. Potential indicators would be such things as: 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 BMPs implemented, acres enrolled in NRCS conservation programs, number or miles of stream restoration, etc. Since this Plan identifies several areas where additional investigation is needed to identify pollutant sources in order to development appropriate management measures, the number of source identification studies or investigations conducted should also be tracked.

11.2 Monitoring Watershed Conditions

There are a number of different environmental indicators that can be monitored to determine the overall environmental conditions in a watershed and track environmental trends. In order for the indicators to be meaningful, they must be monitored in a consistent manner (protocols) and be in a format that is comparable to some accepted baseline condition. The measures of Watershed conditions can be quantitative and/or qualitative and be made by direct measurement (sampling) or through the use of remote sensing. Measures such as wetland health, riparian buffer health, presence of invasive species, or changes in streambank or shoreline morphology and changes in LULC are examples of environmental conditions that lend themselves to the use of remote sensing with limited ground truthing required and are often only apparent over relatively long time periods (years to decades).

- **Wetland and Riparian Buffer Assessment**: As discussed elsewhere in this Plan the condition of wetlands and riparian corridors within the Eastern Shore Watershed are significantly degraded in portions of the Watershed. Periodic condition surveys should be performed every five to ten years to monitor the condition of these valuable resources. These condition surveys will be based upon aerial photograph comparison with the baseline conditions as documented in this Watershed Management Plan. Due to the large size of the Watershed limited field checks will be included in the periodic monitoring of wetlands and riparian buffers.
- **Invasive Species Assessment**: Invasive species infestations are a common issue throughout the entire Eastern Shore Watershed and compromise the overall health. Visual inspections of invasive

species should be made during each monitoring activity. All sampling teams should be trained in the identification of each invasive species that are known to appear in the Watershed and be able to document in field notes and photographs.

- **Coastal Shoreline Assessment**: All coastal shorelines that are most vulnerable should be analyzed on an annual basis. There should be periodic, time-sequenced, geo-referenced, aerial photographs taken from the same location and orientation for each shoreline. These monitoring techniques will help identify shorelines that are continually eroding and help evaluate the success of current projects for coastal zones.
- **Impervious Cover**: A major indicator of watershed conditions is the percent of impervious cover. Remote sensing imagery and technology has been employed to measure and monitor changes in Impervious Cover (IC) over time. IC measurements should be targeted to occur at 5-year intervals consistent with the USGS National Land Cover Database updates; however, the IC data must be processed and analyzed by GIS staff to determine the rate of change for these 5-year intervals. The resulting data should be reported in electronic map format, with accompanying attribute tables to facilitate future data interpretation and analysis. The electronic map format should be compatible with the Baldwin County GIS so that separate Impervious Cover data layers could be prepared for each period.
- **Stormwater Ponds**: A detailed field assessment of the stormwater ponds within the Watershed should be undertaken to verify the GPS location of the outlet structure and status of maintenance. This monitoring could also identify candidates for retrofitting with measures to improve the water quality of stormwater leaving the facility. Following the field inventory/assessment the stormwater facilities should be monitored every 3-5 years by Daphne, Fairhope, or the County.

Other environmental conditions, such as water quality, are usually monitored through direct sampling and on a more frequent basis. These parameters usually include conductivity, pH, temperature, pathogens, nitrogen, phosphorus, turbidity, and dissolved oxygen. In order to ensure comparability of monitoring data to existing State or Federal water quality standards, specific monitoring protocols and analytical methodologies should conform to current guidance from State (ADEM) and Federal (USEPA) authorities. The following Watershed conditions and analytical parameters should be routinely monitored:

- **Standard Field Parameters**: Standard procedure, when collecting water quality samples, should include a collection of *in situ* measurements necessary to interpret any analytical data. These are known as "field parameters" which are geochemical and physiochemical characteristics (abiotic factors) of water to be measured each time sampling is done. These parameters are well understood, there are existing water quality standards established for most of these parameters, and the underlying question to be answered by monitoring is: "Does the waterway meet the ADEM established water quality standard?" Dissolved oxygen, pH, specific conductivity (salinity), and water temperature are typical field parameters. Baseline data provided by routine monitoring of standard field parameters will aid in detection of future Watershed issues and long-term water quality trends. Future monitoring at the 15 sites established by Cook (2021) is recommended to better characterize water quality in the Eastern Shore Watershed. Additional volunteer AWW monitors should be recruited for the standard field parameters monitoring, particularly in areas of past volunteer monitoring such as in lower Fly Creek and other sites vulnerable to water quality degradation issues.

- **Sediment Transport**: One of the primary areas of investigation and consideration in the Plan is sediment loading to Mobile Bay. The underlying question to be answered by sediment monitoring is: "Are sediment loadings (TSS, turbidity and bedload) increasing, decreasing or remaining constant within the Watershed?" Continued monitoring of TSS and turbidity at the Cook 2021 field sites, are suggested at regular intervals (3-5 year) once management measures start being implemented.

- **Pathogens**: Pathogen concentrations have been a vital issue throughout the Eastern Shore Watershed. Pathogens have caused the Mobile Bay, particularly the northeast portion, to be the subject of ADEM's development of a TMDL in 2015, as a result of the northeast portion of Mobile Bay being listed on Alabama's 303(d) list of impaired waters for pathogen impairment in 2010 (an area 1,000-feet wide along the shoreline of Mobile Bay from Ragged Point to the mouth of Yancey Branch). For more on pathogens and the condition of the Watershed, refer to Chapter 4.0. The underlying question to be answered by pathogen monitoring is: "Are the waters in compliance with the bacteriological standard for recreational use?" Pathogen monitoring to determine a waterbody's status relative to the ADEM water quality standard is complicated by the fact that the majority of the Watershed pollutant inputs is likely localized and occurs during and immediately following rainfall events. Maintaining the existing ADEM/ADPH Coastal Alabama Beach Monitoring Program at the five sampling (BEACH) stations at May Day Park, Volanta Avenue, Fairhope Beach, Orange Street Pier, and Mary Ann Nelson Beach will help with tracking long term trends and periodic "sanitary surveys", with sampling performed consistent with ADEM's protocol for the Swimming classification (minimum of 5 samples within 30 days, with samples at least 24 hours apart), performed during the swimming season. However, to have a more robust and meaningful dataset, additional volunteer Alabama Water Watch monitors should be recruited for bacterial monitoring, particularly in areas of high recreational use along the Eastern Shore.
- **Nutrients**: The limited amount of nutrient data within the Eastern Shore Watershed was discussed in Section 4.3.3.5. Total dissolved nitrogen and total dissolved phosphorus concentrations should be included while monitoring for nutrients loading in the Watershed, additionally the species of nitrogen or phosphorus is also of interest. Monitoring for nutrients is significant when trying to pinpoint sources such as farms (fertilizer and livestock manure), lawns, or septic tank contributions, sewer overflows and point source outfalls. Nutrients have been identified as a water quality concern and limited baseline nutrient data (Cook 2021) are available to facilitate collection of additional nutrient field data. There is a need for long-term nutrient data to provide the basis for the development of nutrient water quality standards and to monitor trends in nutrient loading to both the streams and Eastern Shore. To properly monitor nitrogen and/or phosphorus, water samples need to be collected at known sampling locations and then analyzed using appropriate analytical methodology. Suggested nutrient analytical parameters include: Nitrate-Nitrite, TKN, TON, TP, TOC, CBOD, benthic macroinvertebrates and chlorophyll *a*. Continued monitoring of nutrients at the Cook 2021 field sites, are suggested at regular intervals (quarterly) once management measures start being implemented.

11.3 Recommended Monitoring Locations

There have been a number of various sample collection locations throughout the Eastern Shore Watershed in the past. The five BEACH bacterial pathogen locations at May Day Park, Volanta Avenue, Fairhope Public Beach, Orange Street Pier, and Mary Ann Nelson Beach should be continued as required by the BEACH law. Water quality monitoring at the 15 sites established by Cook (2021) should be continued to compare with the 2019 sampling results, as well as to assess effectiveness of watershed management measures implemented.

Historically several AWW sites have been monitored within the Watershed but, since this program is dependent upon volunteers to collect the monthly field data, all have been discontinued for various reasons. AWW volunteers should be recruited to establish/re-establish local bacterial pathogen and standard water quality parameter sites, particular within Eastern Shore Watershed perennial streams such as Jordan Brook, Yancey Branch, Rock Creek (notably at **Site Code 06009001** on Rock Creek Parkway, chemical and bacterial data collected 2003-2014)), Fly Creek (notably at **Site Code 06004015** in lower Fly Creek upstream from Marina, chemical and bacterial data collected from 2002-2021/ **Site Code**

06009006 in Fly Creek on east side of Scenic 98 bridge, chemical and bacterial data collected 2009-2018)/**Site Code 06009003** in Fly Creek on east side of Hwy 98 culverts, chemical and bacterial data collected 2003-2021/ **Site Code 06009007** in Fly Creek east side of CR13 bridge, chemical and bacterial data collected 2009-2018), Point Clear Creek, and Bailey Creek (notably at **Site Code 06016003**, west side of Scenic 98 bridge, small number of chemical data collected 2018-2019). Another historic AWW site that should be re-established is **Site Code 06004006**, at Mullet Point Park, chemical data collected 1999-2003. Figure 11.1 shows the location of these recommended monitoring sites.

11.4 Monitoring Program Approach and Schedule

The BEACH five bacterial sampling sites should continue their existing sampling frequency. The Cook (2021) 15 sediment, nutrient, and standard field parameter sites should be sampled every 3-5 years. Samples should be collected on a monthly or quarterly basis for the volunteer AWW proposed sites, or consistent enough to accurately monitor trends in Watershed conditions and parameters. The sampling schedule should not be burdensome to the field teams or an excessive drain on budgets. Water quality samples are usually collected more frequently than on a quarterly or annual basis because Watershed conditions and indicators can change rapidly and are affected by many factors. Each sampling data point taken represents a snapshot of Watershed conditions at a certain point in time. The more samples collected the easier it is to put the data into context and analyze the health of the overall Watershed. All monitoring activities should be conducted in accordance with ADEM or Alabama Water Watch (AWW) protocols, as appropriate for the parameter being monitored.

11.5 Citizen Participation and Volunteering

A vital element of the Watershed Monitoring Program will be citizen participation through volunteering as an AWW monitor. With the help of volunteers, the Watershed Monitoring Program will enable successful implementation and establish a sense of community ownership within the watersheds. Community volunteers are able to take part in watershed management by assisting with collecting data as members of field sampling teams and participating in public outreach events. Previous volunteer watershed monitoring networks have proven to be a successful model for long-term monitoring and community engagement in watershed throughout the country. Efforts should be made to recruit as many volunteer monitors as possible, particularly for the historic seven AWW sites that have had a significant number of samples taken over the past 20+ years.

11.6 Adaptive Management

Adaptive management principles will be implemented as the Watershed Management Plan transitions into the implementation phase. Adaptive management will maximize the effectiveness and efficiency of implemented management measures. The adaptive management process will consist of an annual review of progress reports for each of the Eastern Shore Subwatersheds and comparison of watershed conditions against goals and objectives identified in this Eastern Shore WMP. This review and comparison will allow decision makers to evaluate the success of implemented management measures and recommend changes or additional management measures needed to achieve stated goals and objectives. Adaptive management will ensure that implementation strategies are constantly being assessed and updated, based on the best available science, and adjusted according to changing watershed conditions. Adaptive management will also ensure that staff time and funding resources are used in the most efficient way possible to produce positive measurable results.

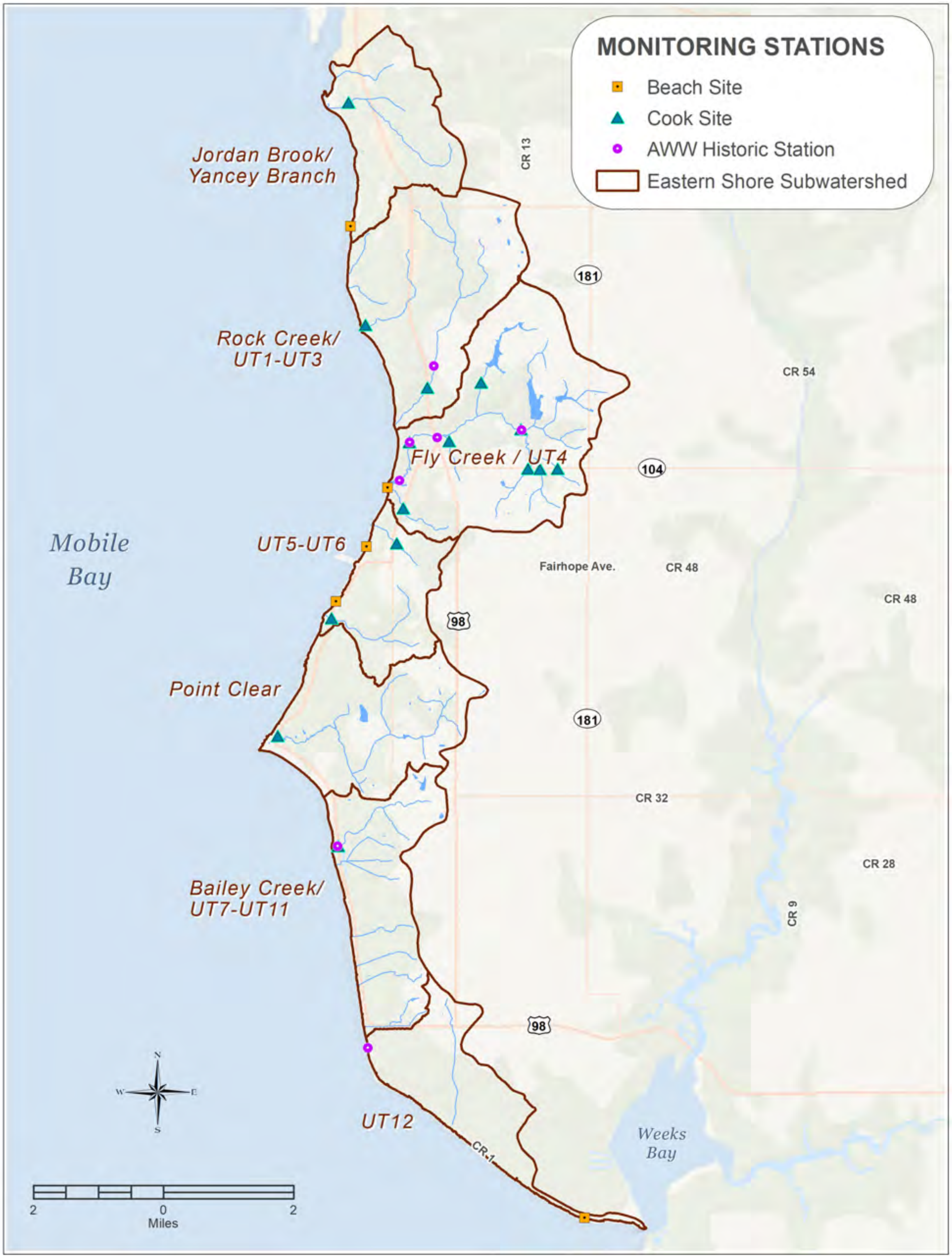

Figure 11.1 Monitoring Station Location Map

11.7 Anticipated Costs

It is believed an adequate Monitoring Program (in addition to ADEM/ADPH monitoring and anticipated AWW volunteer monitors) can be established and pursued at an initial annual cost of approximately $85,000. Additional monitoring sites would be added over time increasing the annual monitoring cost to $125,000. This cost estimate covers the ES Watershed, encompassing approximately 22,400 acres. Ultimately, the overall monitoring costs will be dependent on the exact parameters to be monitored, number of stations, and frequency of sampling.

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