

PRESERVATION IN HOT WATER: SEA LEVEL RISE AND THIRD SYSTEM
FORTS OF LOUISIANA AND THE GULF COAST

by

LINDSEY ELAINE WALSWORTH

(Under the Direction of Wayde Brown)

ABSTRACT

The Third System of American fortification was the first cohesive network of military protection for the United States. From 1816 to 1867 forts were built to protect New Orleans, Mobile Bay and Pensacola Bay. Since their construction, land subsidence and relative sea level rise have threatened to destroy many of the forts and their subsidiary structures. This thesis examines the threat of sea level rise and land subsidence to the preservation of Third System forts in Louisiana and the Gulf Coast. The analysis of this paper discusses damage already done to forts and subsidiary structures, natural and anthropogenic causes of relative sea level rise, current methods of climate change mitigation, and how environmental conservation is the best path to the structures' long-term preservation.

INDEX WORDS: Historic Preservation, Climate Change, Fortifications, Louisiana, Gulf Coast, Sea Level Rise, Land Subsidence, Natural Disaster Mitigation, Landscape Restoration

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DEDICATION

This thesis is dedicated to my parents, whose unwavering confidence in me inspired unwavering confidence in myself. I am forever indebted to them for their kindness, support, patience and willingness to hear about forts.

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I would like to thank my committee, especially my advisor, Wayde Brown, who never sugar coated anything. I could not have completed this thesis without the tireless work of Donna Gabriel, who kept me on track and got me enrolled when I had definitely missed official deadlines.

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In the course of my research, I have fallen in love with the beauty of the Gulf Coast's Third System forts. It is important that I acknowledge the uncomfortable, often insufferable and occasionally deadly work that went into constructing them. This work was completed by free men as well as enslaved ones. My paper is an attempt to honor their tremendous contribution to American history and to ensure that their sacrifices are not forgotten.

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS.....	v
LIST OF TABLES.....	ix
LIST OF FIGURES.....	x
LIST OF MAPS.....	xiv
CHAPTER	
1 INTRODUCTION.....	1
2 EARLY U.S. MILITARY AND FORTIFICATION HISTORY.....	8
3 FORT HISTORIES.....	24
Forts in the State of Louisiana.....	25
Fort Pike.....	27
Fort Macomb.....	37
Fort Jackson.....	41
Fort St. Philip.....	44
Fort Livingston.....	48
Battery Bienvenue.....	48
Tower Dupré.....	46
Fort Proctor.....	49
Forts in the State of Alabama.....	52
Fort Morgan.....	53
Fort Gaines.....	54
Forts on the Gulf Side of Florida.....	57

	Fort Pickens.....	58
	Fort McRee.....	61
	Fort Barrancas.....	61
	Advanced Redoubt.....	63
	Fort Massachusetts, Ship Island, Mississippi.....	64
4	SEA LEVEL RISE AND COASTAL WETLANDS LOSS.....	68
5	CURRENT METHODS OF ENVIRONMENTAL CONSERVATION, RESTORATION AND PROTECTION OF THE GULF COAST.....	91
	Louisiana.....	92
	Alabama.....	104
	Florida and Mississippi.....	108
6	MANAGEMENT, PROTECTION AND CURRENT STATUS OF THIRD SYSTEM FORTS OF THE GULF COAST.....	115
	Fort Pike.....	115
	Fort Macomb.....	121
	Fort Jackson.....	125
	Fort Livingston.....	129
	Fort St. Philip.....	130
	Battery Bienvenue.....	131
	Tower Dupré.....	131
	Fort Proctor.....	133
	Fort Massachusetts.....	134
	Fort Gaines.....	135
	Fort Morgan.....	138
	Fort Pickens.....	142

	Fort Barrancas and Spanish Water Battery.....	145
7	SURVEY OF SIMILAR SITES.....	148
8	CONCLUSION AND RECOMMENDATIONS.....	166
	Recommendations for Third System forts of Louisiana and the Gulf Coast.....	171
	Recommendations for Forts in the State of Louisiana.....	175
	Fort Pike.....	176
	Fort Macomb.....	178
	Fort Jackson.....	179
	REFERENCES.....	182
	APPENDICES.....	189
	A. Elements of Bastioned Fortification, Plan.....	190
	B. Fortification elements often found in Third System forts, Section View.....	191
	C. GLOSSARY.....	192

LIST OF TABLES

	Page
Table 1: Ranking of Cultural and Architectural Significance of Third System Forts in Louisiana and the Gulf Coast.....	67
Table 2: Ranking of Risk of Third System Fort Loss Due to Sea Level Rise and Land Subsidence.....	147
Table 3: Comparative Chart Ranking Risk of Loss from Multiple Factors.....	167

LIST OF FIGURES

	Page
Figure 1: Louisiana Tabby Fill.....	29
Figure 2: Fort Pike Citadel, Parade and Casemates.....	30
Figure 3: Fort Pike Plan.....	32
Figure 4: Aerial Photo of Fort Pike.....	33
Figure 5: Schematic Drawing of Fort Pike Area 1980 with dotted lines representing the 1840 shoreline.....	33
Figure 6: Fort Pike Area Today.....	34
Figure 7: Plan of Fort Wood (Fort Macomb).....	40
Figure 8: Plan of Fort Jackson.....	43
Figure 9: Plan of Fort Livingston.....	47
Figure 10: Plan for Tower Dupré.....	49
Figure 11: First Floor Plan of Fort Proctor, Lake Borgne, Shell Beach, St. Bernard Parish, LA.....	51
Figure 12: Plan of Fort Morgan.....	53
Figure 13: Fort Gaines, Elements of Fortification in Profile.....	55
Figure 14: Plan of Fort Gaines.....	56
Figure 15: Sketch of Fort Pickens, Florida.....	59
Figure 16: Fort Barrancas as Completed in 1844.....	62
Figure 17: Plan of Fort Massachusetts.....	66
Figure 18: Sea Level Rise in Millimeters over Time.....	69
Figure 19: Gulf Loop Current.....	73

Figure 20: Vertical Section Through a Hypothetical Fault.....	75
Figure 21: Lake Pontchartrain Basin Map.....	78
Figure 22: Sequence of Production-Related Subsurface Events That May Induce Land Subsidence and Reactivate Faults.....	83
Figure 23: Canals Dredged by the Energy Industry South of Lafitte.....	84
Figure 24: Map of Oil and Gas Well, Pipelines and Platforms Found in the Gulf of Mexico.....	87
Figure 25: The Wall.....	95
Figure 26: IHNC Seabrook Floodgate Structure on the Industrial Canal.....	96
Figure 27: New Orleans Metro Area Hurricane Protection System.....	96
Figure 28: Restoration Projects of Louisiana’s 2017 Coastal Master Plan.....	99
Figure 29: Aerial Photo of Fort Proctor and Shoreline Protections.....	100
Figure 30: Aerial Photo of Fort Livingston.....	103
Figure 31: Aerial Photo of Fort Gaines.....	106
Figure 32: Dune Protection and Warning Signs.....	108
Figure 33: Fort Pike Casemate with Marsh Grass Debris.....	118
Figure 34: Storm Debris in Moat at Fort Pike.....	119
Figure 35: Hurricane Katrina Damage to Northern Bastion of Fort Pike.....	119
Figure 36: Current Riprap Barrier on Seaward Arc of Fort Pike.....	120
Figure 37: Destroyed Outworks and Storm Debris at Fort Pike.....	120
Figure 38: Parade and Citadel of Fort Macomb.....	122
Figure 39: Vegetation Destroying Masonry Walls at Fort Macomb.....	123
Figure 40: Masonry Damage from Roots and Vines at Fort Macomb.....	124
Figure 41: View of Fort Jackson from Battery Millar Showing Tree Growth on Terreplein.....	126
Figure 42: Fallen Trees at Fort Jackson.....	127

Figure 43: View of Moat and Sallyport of Fort Jackson Showing Katrina Flood Waterlines on Masonry.....	127
Figure 44: Tree Growth and Collapsed Outwork at Fort Jackson.....	128
Figure 45: Crack in Northwest Bastion of Fort Jackson.....	128
Figure 46: Aerial Photo of Fort Livingston.....	129
Figure 47: Aerial Photo of Fort St. Philip.....	130
Figure 48: Aerial Photo of Battery Bienvenue.....	131
Figure 49: Tower Dupré in 2004.....	132
Figure 50: Tower Dupré after Hurricane Katrina.....	132
Figure 51: Fort Proctor.....	133
Figure 52: Aerial Photo of Fort Massachusetts Before Beach Nourishment.....	135
Figure 53: Aerial Photo of Fort Massachusetts After Beach Nourishment.....	135
Figure 54: Fort Gaines Eastern Wall.....	136
Figure 55: Crack in Fort Gaines' Covert Way Masonry.....	137
Figure 56: Fort Gaines Southeast Bastion with seawater in moat.....	137
Figure 57: Seaward Side of Fort Gaines.....	138
Figure 58: Sand Accumulation at Intersection of Groine and Riprap Shore Protection in Front of Front Gaines.....	138
Figure 59: Fort Morgan Northeast Bastion.....	140
Figure 60: Fort Morgan Sallyport.....	140
Figure 61: Signs of Inconsistent Masonry Repair at Fort Morgan.....	141
Figure 62: Evidence of Rising Damp and Salt Accumulation in Masonry Walls of Fort Morgan.....	141
Figure 63: Destroyed Bastion and Interpretive Center at Fort Pickens.....	143
Figure 64: Landward Side of Fort Pickens.....	144
Figure 65: Calcium Leached from Masonry Walls at Fort Pickens.....	144

Figure 66: Scale Model of Fort Barrancas and the Spanish Water Battery.....	145
Figure 67: Evidence of Preservation Monitoring at Fort Barrancas.....	146
Figure 68: Bastion Damage and Repair at Fort Barrancas.....	146
Figure 69: Maeslantkering at Port of Rotterdam.....	151
Figure 70: Hurst Castle, Hurst Spit and Keyhaven River.....	157
Figure 71: Aerial Photo of Hurst Castle Shoreline Protection.....	159
Figure 72: Map of Atchafalaya National Heritage Area.....	162
Figure 73: Atchafalaya National Heritage Area Organizational Framework.....	164
Figure 74: NPS Map of Gulf Islands National Seashore.....	173
Figure 75: Aerial Photo of Fort Macomb Showing Water Access.....	178
Figure 76: Aerial Photo of Fort Jackson Showing Tree Cover.....	179

LIST OF MAPS

	Page
Map 1: Four Approaches to New Orleans by Water.....	26
Map 2: Third System Forts and Subsidiary Structures in Louisiana.....	38
Map 2: Third System Forts and Subsidiary Structures in Louisiana.....	42
Map 2: Third System Forts and Subsidiary Structures in Louisiana.....	46
Map 2: Third System Forts and Subsidiary Structures in Louisiana.....	50
Map 3: Forts of Mobile Bay, Alabama.....	52
Map 4: Forts of Pensacola Bay, Florida.....	58
Map 5: Fort Massachusetts, Ship Island, Mississippi.....	65
Map 6: Third System Forts and Subsidiary Structures of the Gulf Coast.....	174

CHAPTER 1

INTRODUCTION

Historic masonry forts dot the landscape of South Louisiana and the Gulf Coast. The forts have long been decommissioned, but remain as relics of early America's domestic defense policy. Each of the forts included in this paper is what is known as a Third System fort. Early America's primary military defense system was its navy, and coastal forts were built to aid sailing war ships in the protection of vital harbors and shipping channels. First and Second System forts were made of wood, earth, and sometimes brick, but most went unfinished and were left to deteriorate. The Third System was the first permanent system of defensive fortification in the United States.

From 1816-1867, 42 Third System forts were constructed along America's coasts. Third System forts are distinguished from earlier systems by their exclusive use of brick and/or stone and a unifying architectural style rooted in classical and contemporary military theory of the day. Four main forts and three subsidiary structures were built in Louisiana. One fort was constructed on a Mississippi barrier island, and two were built in Alabama. Three forts and one subsidiary redoubt were built on the gulf side of Florida. Of the 10 Gulf Coast forts completed in the Third System, all but two remain in relatively functional condition. Fort McRee in Pensacola Bay, Florida was burned and left in ruins during the Civil War, and now exists as just a few scattered and sand covered foundation fragments. It is the only Third System fort in the country to be entirely lost. Fort Livingston on Isle Grand Terre, Louisiana is the state's only truly coastal fort, and it

currently lies in flooded ruins after years of hurricanes and coastal erosion. Unlike Fort McRee, Fort Livingston is still identifiable as a masonry fort and can be visited by those with access to a boat and knowledge of low tide.

Third System forts, particularly those in the Gulf South, have complex and interesting histories. Half were designed by famed French military engineer Simon Bernard and built by enslaved African labor. The forts were built to protect America from a foreign, invading force, but only ever saw combat during the Civil War. Forts Pike and Pickens were both used as prisons for Native Americans during the Seminole and Apache Wars, respectively. As recently as the 1940s, several of the forts were recommissioned to watch for German planes and U-boats in the Gulf of Mexico. Third System forts are an invaluable link to America's military and political history, but the risk of climate change and sea level rise could mean the loss of some, if not all, of them.

Third System forts were strategically placed in one of three general locations on the gulf: islands, shoals and riverbanks/shorelines. The low and water bound locations were due to the then common practice of skipping cannonballs along the surface of a body of water en route to a target.¹ These sites were successful militarily, but present myriad preservation problems today. The entire Gulf Coast is endangered by sea level rise, and each of the eight currently accessible forts will be negatively impacted by even a small increase in sea levels. The four Louisiana forts, though, are in particular peril

¹ John R. Weaver II, *A Legacy in Brick and Stone: American Coastal Defense Forts of the Third System, 1816-1867* (McLean, VA: Redoubt Press, 2001), 33.

because coastal wetlands there are lost at a rate of a football field every 48 minutes, far greater than elsewhere on the Gulf Coast.²

Third System forts of Louisiana and the Gulf Coast face preservation problems common to most masonry buildings of their age. They suffer from rising damp, salt accumulation and mortar loss. They are settling and cracking and always in need of some sort of repair, but hands-on preservation alone will not save these structures. This thesis shows that land loss and sea level rise are the most significant dangers facing Louisiana's Third System forts and that environmental protection and restoration of the forts' surrounding areas is the most effective way to preserve them. The thesis statement applies to all ten of the Gulf Coast forts and their subsidiary structures, but the paper focuses on the four forts and three subsidiary structures found in Louisiana.

The forts of Louisiana and the Gulf Coast are historically and architecturally interesting, but they are also on the frontlines of climate change and act as prime examples of how protecting the environment helps preserve historic structures. The historic forts of the Gulf Coast are indicative of their respective areas' environmental stability with forts in Florida, Alabama and Mississippi faring far better than those found in Louisiana.

A nearly three hundred year history of exhaustive plantation farming, native forest logging, and oil and natural gas extraction has robbed South Louisiana of its protective old growth cypress forests, mangroves and marshes and instead left a lacework of canals and pipelines that funnel storms and ocean water farther inland than they could ever reach

² Bob Marshall, Brian Jacobs and Al Shaw, "Losing Ground," *ProPublica* and *The Lens*, last modified August 28, 2014, <http://projects.propublica.org/louisiana/#>

naturally. Warmer global sea temperatures lead to significantly stronger storms like Hurricanes Katrina, Rita and Isaac, all of which struck South Louisiana in the past twelve years leaving unprecedented structural and environmental damage in their wakes. Every one of the Louisiana forts was damaged by Katrina, Rita or Isaac, including the complete loss of a rare American Martello tower that acted as a support structure to the main forts.

The four Louisiana forts are Forts Pike and Macomb at the Pass Rigolets to the northeast of New Orleans at the entrance of Lake Pontchartrain, Fort Jackson at the southernmost turn in the Mississippi River, and Fort Livingston on Grand Terre Island in the Gulf of Mexico to the west of the Mississippi River. The three supporting structures, all east of New Orleans, are Battery Bienvenue, nearest Fort Macomb at the intersection of Bayous Bienvenue and Villeré; the now-ruined Martello tower, Tower Dupré, in Lake Borgne; and the unfinished Fort Proctor at Shell Beach on Lake Borgne. The forts and subsidiary structures are located in parts of Louisiana most affected by wetlands loss, storm impact, and human landscape alterations such as channel dredging and cypress logging. To complicate matters, none of the forts are open to the public due to funding and management problems. The coastal forts of Mississippi, Alabama and Florida offer valuable comparisons as examples of buildings of similar age, materials and architectural style in areas with fewer historic environmental abuses and more effective ownership and management structures.

This thesis has two research limitations to ensure a clear and focused area of study. First, research was limited to Third System forts of the Gulf Coast in order to analyze the effects of geologic and climatic changes on a specific cultural resource in a relatively small (~150 linear miles) area. Second, this thesis focuses on direct impacts to

the landscape of coastal Louisiana from natural and anthropogenic activities. The results of climate change in the form of sea level rise and land subsidence are researched and analyzed, but the causes of global climate change are not. The processes that contribute to warmer oceans and global sea level rise are beyond the scope of this thesis and would detract from the central area of study.

Research began with a review of literature available on Third System forts and was followed by site visits to each accessible fort and subsidiary structure. Visits were made to Forts Pike, Macomb and Jackson in Louisiana and to all of the forts and subsidiary structures in Mississippi, Alabama and the gulf side of Florida. Unable to boat to Fort Livingston, Battery Bienvenue, Fort Proctor or the remains of Tower Dupré, analysis relied on other researchers' publicly available photographs and satellite images to assess current physical states and landscape changes over time.

Following site visits to the forts, research turned to the geographic and land use history of the Gulf South with particular attention paid to South Louisiana. This was accomplished through research conducted at the UGA library's main and science branches, the Louisiana State Archives in Baton Rouge and the Louisiana Research Collection at Tulane University's Howard-Tilton Memorial Library. Historical research of the landscapes led to a review of scientific and preservation literature concerning climate change, sea level rise and coastal wetlands loss.

Literary and archival research was then followed by additional site visits to Gulf Coast barrier islands and to South Louisiana's most endangered landscapes for a better understanding of wetlands loss patterns and rates of landscape change relative to the forts. Finally, examples from Rotterdam, Netherlands; Hampshire, England; and the

Atchafalaya National Heritage Area in Louisiana were studied for best practices in coastal landscape preservation and cooperative management structures for historic sites and landscapes.

This thesis is organized into eight chapters. Following an introduction to the background and problems facing Third System forts of Louisiana and the Gulf Coast, chapter two offers a synopsis of early United States political history for context on the construction of the Third System forts as well as a summary of unifying fortification design characteristics. Chapter three presents individual histories of the forts including site selection, construction, architecture, materials, historic events and current ownership. Maps, plans and contemporary photographs are included for context.

The next chapter introduces global and regional data on sea level rise and land subsidence with distinctions between what is caused by nature and what is due to human activity. Research focuses on the problems unique to Louisiana and compares its rates of land subsidence and sea level rise to those in Mississippi, Alabama and Florida. Chapter five explores the federal, state and local projects designed to mitigate the negative effects of climate change in Louisiana and the Gulf Coast. Chapter six presents the current status of each fort and subsidiary structure with contemporary pictures from site visits and aerial photographs for those sites not visited.

Chapter seven surveys examples of innovative flood control and storm impact mitigation, historic site management, and landscape preservation from international sites as well as from a natural heritage area within the state of Louisiana. The thesis concludes with analysis of best practices from the example sites and offers suggestions for preservation planning for Third System forts in Louisiana and across the Gulf Coast.

When I was a child, these forts were a constant in my life. There was always an old brick fort at the far end of the beach, the curve of the river or as a stop between family members' homes. They were so commonplace that I assumed everywhere had a fort and that every fort was there for vacationers' amusement. I climbed the odd sized stairs, sat on broken mortars and fired imaginary rifles from the bastions.

When the time came to select a thesis topic for the Master of Historic Preservation program at The University of Georgia, those old forts again captured my imagination. I began the MHP program with a lifelong love of architecture and desire to save old buildings, but as I learned more about historic preservation, I became far more fascinated by its intrinsic relationship to environmentalism. The forts of Louisiana and the Gulf Coast are historically and architecturally interesting, but they are also on the frontlines of climate change and act as prime examples of how protecting the environment helps preserve historic structures.

CHAPTER 2

EARLY U.S. MILITARY AND FORTIFICATION HISTORY

This chapter presents an overview of the political and military history of the United States from the first shots of the Revolutionary War to the construction of the nation's Third System forts. Following a short assessment of the First and Second Systems of fortification, the Third System is analyzed for its technological advances in military theory and architecture, and as the point of transition in America's acceptance of military professionalism and permanence. The chapter concludes with the history of the Board of Engineers and an explanation of Third System fort design and siting.

The American Revolutionary War was an eight year conflict that began in 1775 with a skirmish between the well-funded and well organized British army and the local, American colonial militia. As troops from both sides moved from Lexington to Concord, Massachusetts, and eventually to Boston, militia from other areas joined the resistance to lay siege to the city. Until this point, American militias were extremely local in their activities and were under the exclusive purview of local and state governments. The unification of diverse militias in a single location signified a new chapter in American defense and prompted the Second Continental Congress to "create a military force answerable to them rather than to state governments."³

³ Edward M. Coffman, "The Duality of American Military Tradition: A Commentary," *The Journal of American Military History*, Vol. 64, no. 4 (October 2000): 967-980., p. 970

Though America was engaged in a war for its independence from the strongest military in the world, there was still much trepidation at the prospect of a standing army. Militias and Minutemen were considered the backbone of American defense, while a standing army was viewed by many as government overreach and a threat to individual civil liberties. Founding Father Samuel Adams wrote in 1776, “A Standing Army, however necessary it may be at some times, is always dangerous to the Liberties of the People.”⁴ Against the wishes of many early American politicians and philosophers, the Continental Army was formed, funded by and answerable only to the nascent American federal government. The creation of a standing army did not eliminate the use of local militias, which continued to patrol the countryside looking for British sympathizers and using guerilla tactics to slow the movement of British troops by land.

Land battles, though, were not the only concern of early American military strategists. The thirteen original colonies stretched from Georgia to present-day Maine in a long, somewhat narrow band creating a much higher ratio of coastline to interior land than we have today. America was extremely vulnerable along the Atlantic coast, and this prompted George Washington to campaign for a Continental Navy in addition to the Continental Army. He argued, “Whatever efforts are made by the land armies, the navy must have the casting vote in the present contest.”⁵ Washington was proven correct in his assertion. The Continental Navy was quickly funded and blocked British access to significant ports, halted the passage of British supply ships and, when possible, commandeered their cargo.

⁴ Ibid, 970.

⁵ Nathan Miller, *Broadsides: The Age of Fighting Sail 1775-1815*, (New York: John Wiley & sons, Inc. 2000), p. 13.

As the war progressed, the American navy provided protection to ships from France, Spain and Holland carrying necessary arms to supply the revolutionary forces at sea and on land. The American Revolution would not have been successful without the work of the navy. “Ninety percent of the gunpowder available to colonists before the end of 1777—about 1.5 million pounds—was brought in by sea.”⁶ Had the British Navy used their forces effectively, they would have put down the rebellion with little trouble. Bad planning and partisanship on the side of the British allowed America’s ad hoc military to succeed against all odds, bolstering the belief that a militia-based defense system was viable against a massive international power.

The Revolutionary War ended with the signing of the Treaty of Paris (1783), and though President George Washington wanted to keep a peacetime force of both the Continental Army and Navy, Congress did not approve funding. A full standing military in a time of peace was seen as an attack on American freedom, and once again the local militia was America’s primary defensive force. The Militia Acts of 1792 put the onus of civil protection on the individual. All able-bodied, white men between 18 and 45 were conscripted to militia service in their local communities, and each citizen soldier was expected to provide his own musket, bayonet or rifle, flints, shot and gunpowder. The federal government made strict rules for the militias, but provided nothing in terms of funding or supervision.⁷

These militiamen could be called upon by the President to form a central army in times of foreign invasion, Indian attack or state uprising and only then were they

⁶ Ibid, 13-14.

⁷ Coffman, 971.

guaranteed to be paid for their services or to collect a soldier's pension.⁸ The militias were arranged into "divisions, brigades, regiments, battalions, and companies" just as the Continental Army had been. Though the model of military service dictated by the Militia Acts of 1792 was predominantly local in nature, the framework for a regular, standing American military was forged in the document. It was the assurance of soldiers at-the-ready that paved the way for the next steps in American defense policy: a federally funded standing navy and organized seacoast fortification systems.

In the years following the ratification of the Federal Constitution in 1788, it was generally accepted that America needed to protect vital harbor cities from potential attack by England and other countries that might want "to intimidate or subdue the potentially profitable new nation."⁹ In his second term, President George Washington signed the Naval Act of 1794 creating a permanent standing naval force for the United States. Seacoast fortifications were an obvious complement to the navy, and Congress moved to provide mandates for their construction. Much like local militias, the forts were instigated by the federal government but were funded, maintained and owned by the states. Because America had no school of military fortification design, Congress commissioned European engineers. Most European military engineers were trained at the École Polytechnique in Paris and followed a similar theory of fortification planning, but the forts of the First System vary significantly in style and materials because the individual states held the "right of approval" on design plans.¹⁰

⁸ The Militia Acts of 1792, 2 U.S.C. § 1-5 (1792).

⁹ Weaver, xiv.

¹⁰ Ibid, xiv.

The First System forts, constructed from 1794 to 1801, were predominantly made of wood and earth “and were neither durable nor provided adequate defense.”¹¹ Though a few of the forts were well placed and innovative in design, most were never finished and were left to decay as America found her footing and the threat of international invasion became less pressing. It was during this time of peacetime preparation that the United States government began to focus on the future needs of its military. Whether using a militia, standing army and navy, or a combination of the two, the United States needed combat, strategic planning and fortification training that did not rely entirely on European consultants. To that end, in 1802, President Thomas Jefferson with the backing of Congress established the United States Military Academy and the Corps of Engineers.

It did not take long for the fledgling American military to be put to the test. In 1807, a British Royal Navy ship, HMS Leopard, attacked and boarded the USS Chesapeake to seize four Royal Navy deserters, three of whom were American citizens who had previously been pressed into British service against their will. The unprovoked attack on a U.S. navy ship and the capture of three American citizens by Britain was deemed outrageous by the American people and prompted James Monroe, who was then United States Minister to the United Kingdom, to demand Britain return the four seamen, cease all impressments of American sailors and evacuate all warships from American territorial waters. The Chesapeake Affair, as it came to be known, was not the cause of the War of 1812, but is considered to be a contributing factor.

In late 1807, following the Chesapeake Affair and the resulting outrage voiced by the American public, Congress appropriated “a substantial amount of money to construct

¹¹ Ibid, xiv.

what would be referred to as the Second System of American coastal fortifications.”¹²

The earliest of these forts were similar in style and materials to forts of the First System, but some of the later forts contain many of the defining characteristics of the eventual Third System, including arched casemates and all-masonry construction. Second System forts are classified as forts constructed between 1807 and 1812. There are some so-called “transitional forts” that were built during the War of 1812 that expand upon Second System characteristics, but which do not qualify as Third System forts. None were built in the South.

War broke out in June of 1812, and though American troops outnumbered those of Great Britain, U.S. military leadership was faulty and the use of haphazardly trained militiamen proved them to be inconsistent and rarely up to the task of a long range war on multiple fronts. The United States won the War of 1812, but suffered several large and humiliating losses including the burning of Washington, D.C. in August of 1814. The Battle of New Orleans, the United States’ most significant and celebrated victory, actually took place after the agreement to end the war and the signing of the Treaty of Ghent. The treaty had to cross the Atlantic in order to be ratified by the United States, which did not happen until February 1815, thus making it appear the American victory at New Orleans brought about the end of the War of 1812.

Interestingly, Americans still harbored fears of a large, peacetime standing army and, just as they had after the Revolutionary War, Congress cut funding to the Army forcing a severe decrease in the number of full-time troops. With no option for maintaining a standing army, military officials pointed to several instances in the War of

¹² Ibid, xv.

1812 in which a well-placed, coastal fort had repelled the British navy and lobbied for fort construction in lieu of permanent armed forces. Britain had been able to land on American shores and wreck important sea ports by operating from bases in Canada, Bermuda and Jamaica. They had proved that a naval force could be sustained thousands of miles from her shores, and it was generally understood that Britain would have easily won the war and reclaimed the United States had they not also been fighting the Napoleonic Wars in Europe.¹³

The U.S. Congress did not have a history of using federal funds for peacetime military expenditures, but the War of 1812 was for many an opinion-changing war. When Congress met to discuss fortification funding, they were meeting in a temporary location because the capital had been burned. Many of the Congressmen themselves were in temporary housing having lost their homes to the British attack.¹⁴ President James Madison, Secretary of State James Monroe and the Secretary of War James Barbour had little convincing to do when they presented Congress with a proposal for a nationwide coastal fortification campaign.

In 1816, Congress authorized the creation of the Board of Engineers for Fortifications, also known as the Fortifications Board or the Board of Engineers, to oversee the planning of America's coastal forts. This seemingly obvious solution to the problem of an inadequate national defense system was actually a huge step forward for American military policy making and professionalism. In his 1998 article on American Coastal Defense of the early to mid-19th century, historian Samuel J. Watson writes,

¹³ Ibid, 2.

¹⁴ Ibid, 3.

In a largely uninstitutionalized nation governed by generalists rather than a specialized bureaucracy, the Fortifications Board was an advanced model for the application of specialized expertise to public service, an outstanding, though rather exceptional, example of professionalism in the U.S. army of that era. The first permanent official body in U.S. history specifically dedicated to long-range strategic planning, its existence represented an important step towards the institutionalization of expert military advice for civilian policymakers, a significant advance in the army's capacity for responsible service.¹⁵

In addition to a growing professionalism within the U.S. military, the creation of the Board of Engineers for Fortifications, federal funding for a system of permanent forts and the acceptance of long range planning represent a pivotal turn in American cultural ideals and a slowly growing acceptance of a standing peacetime military.

The Fortifications Board was led by Simon Bernard, a Frenchman who was trained at École Polytechnique and had designed the successful defenses at Antwerp. His expertise was unquestioned, but it was an insult to the young Army Corps of Engineers as well as the educators at West Point that a foreigner should be chosen over Americans who had designed some of the very successful Second System forts. The Fortifications Board was intended to work with the Army Corps of Engineers in an advisory capacity, though Bernard and the Chief Engineer for the Corps actually held the same rank. The confusion and professional jealousy that this parallel structure produced would prove untenable for many involved. Professional discomfort aside, the Board began working immediately after its creation by identifying the most vulnerable locations on the American coasts. One was Hampton, Virginia, the other was New Orleans.¹⁶

¹⁵ Samuel J. Watson, "Knowledge, Interest and the Limits of Military Professionalism: The Discourse on American Coastal Defence, 1815-1860," *War in History* 5, no. 3 (1998): 284-285.

¹⁶ Weaver, 5.

The first report of the Board of Engineers was submitted in 1821 and contained an analysis of defense methods, a coastal defense philosophy that would influence American military policy until 1950, and it “systematically addressed all areas of the coastline, grouping proposed fortifications into three classes, according to priority.”¹⁷ The coastal defense philosophy dictated the location, size and munitions in each fort and is the core of what constitutes a Third System fort. The philosophy embraces a four part system of defense comprised of a strong navy, well placed fortifications, a system of communications by land and water, and a standing army with a reserve militia. Bernard’s philosophy was strategic both militarily and politically and opened the door for future federal funding of a full standing army even in times of peace.

The basic goal of Third System forts was “to secure a... harbor or waterway against a hostile navy force,” and that was accomplished through three defensive missions: guard against attacks by ships, prevent a sudden land attack and provide resistance to siege. Forts were placed at narrows in water channels so that the range of their mounted guns could easily reach enemy ships attempting to invade a harbor or city. Under fire in a narrow passage, invading ships would have little time or room to maneuver, thus increasing the potential number of hits the fort could make on a single ship. This is why so many Third System forts, including Fort Pike in Louisiana, are now “in the shadows of a major bridge.”¹⁸

As coastal fortifications, Bernard preferred four general placements for his forts: islands, shoals, riverbanks and hilltops.¹⁹ Of the ten forts built along the Gulf Coast and

¹⁷ Ibid, 5.

¹⁸ Ibid, 30-31.

¹⁹ Ibid, 32.

in Louisiana, none is on a hilltop, but Fort Barrancas in Pensacola Bay does sit at a significantly higher elevation than the rest, and is the farthest from water. Conventional defensive theory prioritized high ground, but that was not feasible for Gulf Coast forts for two reasons. First, there is very little high ground on the Gulf of Mexico and none in Louisiana. Second, even in narrow passages, cannon shot did not always have the propulsive force necessary to reach its target in a single arc. Instead, artillerymen were trained to skip the cannon balls along the surface of the water like skipping stones, and this could only be accomplished with cannons set relatively close to water level.²⁰

Third System forts are also typically found several miles from the cities they were built to protect. This can be confusing for modern visitors, but before the native forests were cleared and roads were built, coastal cities along the Gulf of Mexico were very much protected by nature. Waterways were the only viable access points to cities like New Orleans and Mobile. Placing the forts a good distance from the cities they guarded allowed for more time to muster militia forces and transport munitions. It also meant that if the fort failed, invading forces still had miles of difficult landscape to navigate before reaching their target. In the time it took a foreign force to make its way through cypress forests and marshy bayous to New Orleans, a local militia could warn city residents and prepare for battle.²¹

Another characteristic of Third System forts that seems counterintuitive to contemporary visitors is that the size of the fort is on no way indicative of the fort's importance or protective capabilities. Fort Pike, which was built to protect New Orleans,

²⁰ Ibid, 33.

²¹ Willard B. Robinson, *American Forts: Architectural Form and Function*, (Chicago: University of Illinois Press, 1977), 86.

was the first fort designed and built in the Third System because New Orleans was given top priority based on its position at the mouth of Mississippi. Not only was New Orleans a massive, international commercial port, it was at the time, the primary access point to the interior of the United States. One might assume that a port city of such significance would get a massive fort for protection. Fort Pike, however, is the smallest of the Third System forts because fort sizes were decided not by the value of the area they protected, but by three strategic criteria: site selection, local militia size and the artillery needed to defend the location.

Siting is an obvious part of what dictates the size of a fort. If the most advantageous spot along the river or harbor is small, the fort will need to be small to accommodate it. The second factor is the area's ability to produce a militia. Each fort was given a small peacetime garrison that would be supplemented by the local militia in times of attack. Engineers did not build large forts in areas with low population densities because entire sections of a fort would run the risk of being unmanned in times of attack. Finally, a very narrow section of river or harbor does not need an excessive amount of oversized artillery to cover it. Money was saved, and therefore approval was more easily given, when forts utilized the smallest amount of artillery necessary to achieve their goal. The fewer cannons, howitzers and mortars a fort needed, the smaller the fort became.

Third system forts do not have a single, unifying shape, but they share many design characteristics. They are all bastioned forts in closed, geometric or truncated geometric forms constructed of brick and stone and have a casemated scarp wall on at least one side. Forty two forts were built as part of the Third System from an astonishing

forty distinct designs. Forts of Louisiana and the Gulf Coast, while subtly different, fall into four basic shapes: pie slice, star, kite and pentagon.

Another typical feature of Third System forts are outworks and subsidiary structures. An outwork is a defensive fortification built outside the closed core of the fort. Outworks can be detached or semi-detached; all of the outworks in Gulf Coast area forts are fully detached. Third System design theory was based on the Vauban style of fortification construction in which a fort is built of concentric rings of defense. As a fort was attacked and enemy forces began to breach the outer defenses, soldiers could retreat to the next inner ring and defend from there. Should that layer fall, there would be another, smaller ring to defend until soldiers were defending the true core of the fort, the citadel.

Outworks of the Third System were a 19th century interpretation of Vauban's 17th century rings. They were highly defensible from the inside facing outward, but were completely uncovered for any attackers who breached the line. Soldiers from within the next ring of defense, be that an additional outwork or the walls of the fort itself were able to fire upon their attackers against a smooth, unbastioned and unforgiving wall of brick. Often the space between the first outwork and the next defensive wall was a ditch or moat filled from the nearby water source. It would be unbelievably dangerous for an attacking force to attempt crossing a moat under fire from muskets and rifles directly above them. Third System forts were designed to be as mentally challenging to take as they were physically difficult to penetrate.

Subsidiary structures come in several forms within the Third System. Some were extant forts that were refitted to comply with Third System standards, such as Fort St.

Philip in Louisiana. Others were brand new structures - defensive towers and batteries, predominantly - and in the case of Fort Barrancas in Florida, a redoubt. Defensive towers are the most architecturally significant of the Third System subsidiary structures. They are often in the style of Martello Towers, which are extremely rare in the United States. Martello Towers were a very common defensive structure built across the British Empire in the early to mid-19th century. They were typically round to deflect cannon fire and no taller than two stories. Hundreds were built in England and elsewhere in the early 19th century, but only seven were ever constructed in the United States. Of those seven, only one remains completely intact - Fort East Martello in Key West, Florida.

Batteries were the most common subsidiary structure of the Third System. A battery, also referred to as a “work,” is a “stand-alone defensive structure, not the external batteries (or outworks) under the protection of the main fort.”²² These works were not part of the Vauban style ring system; rather they were a good distance from the main fort and defended the less advantageous access points to a city or harbor. Such areas did not require a full fort because they were often small and difficult to pass through, but might be used by an attacking force unable to bypass a fully equipped fort. Batteries ran the gamut from very simple, linear, masonry-revetted earthworks to impressive, closed form structures. Closed batteries of the Third System are easily differentiated from forts by their lack of casemates.

The final subsidiary structure is the redoubt, and only one exists along the Gulf Coast. A redoubt is a closed work, not an outwork, that lacks bastions. It is a component of the Vauban system, but is not part of the concentric rings of defense. Rather, redoubts

²² Weaver, 38.

were positioned ahead of the main fort and would act as an early warning system in case of attack. Defenders would hold the redoubt as long as possible before falling back to the main fort for the full attack. Advanced Redoubt, the single redoubt found on the Gulf Coast, is a subsidiary structure of Fort Barrancas on Pensacola Bay. Advanced Redoubt is unusual in that it is behind the fort rather than ahead, and it has two demibastions on the front corners. The reasons for Advanced Redoubt's anomalies will be discussed in the next section.

Third System forts were built between 1816 and 1867, and the many political and technological changes that took place during that time can be seen in the evolution of the forts and their designs with some of the most impressive forts being built in the later years of the System. The Fortifications Board had three Brigadier Generals during the 51 year span of the Third System. Simon Bernard was the board's first Brigadier General and served alongside the Corps of Engineers' Chief of Engineers, J.G. Swift and later Charles Gatriot. Bernard was an impeccable engineer with a knowledge of fortification theory and design that was virtually unparalleled in his time. He was, however, an outsider to American military practice and politics. He did not speak English and traveled with a translator. He was vocal in his disapproval of how Congress allotted funds for fort construction and did not hide his disappointment when his plans for a series of canals connecting fortified regions was denied.²³ In 1830, an opportunity to return to France presented itself, and Bernard took it.

In Bernard's absence, Joseph Totten was appointed the post of Brigadier General. Totten had been an engineer for the Third System from the very beginning and had

²³ Ibid, 11.

worked closely with Bernard and Gatriot on pivotal Gulf Coast projects. He was so esteemed in the military and political communities, that upon Gatriot's retirement in 1838, Totten was named Chief of Engineers in addition to his role as Brigadier General and held the dual posts for nearly 25 years. In fact, the third System is alternatively known as the "Totten System." Totten wrote The 1851 Report, the largest report ever composed on the Third System, and presented it to Congress. By that time, Congress was beginning to feel that the Third System was outdated and expensive, but Totten's masterful report secured funding for the continuation of what he named in his report as the "Permanent System" of coastal fortifications. This represents the first time the forts are officially named to be a permanent system.

Totten was still on active duty with the Corps of Engineers when he died in 1864. Richard Delafield was then appointed Brigadier General and Chief Engineer, but the ongoing Civil War followed by Reconstruction rendered his tenure somewhat unremarkable. Fort construction all but halted, and many forts were left unfinished or entirely unbuilt. Evolutions in military technology, particularly rifled cannon and large smoothbore cannon, proved more powerful than masonry walls. Just as Congress had feared in 1851, the forts were indeed outdated. Civil War battles along the Gulf Coast and Union invasions near New Orleans demonstrated multiple problems with Third System forts. Exposed masonry was not strong enough to withstand multiple shots from large, rifled artillery. Mounted cannons within forts were not strong enough to land a strike on an invading steam ship. The forts were designed in the age of sail, but steam power allowed ships to pass in front of forts at speeds that outstripped a cannon ball skipped

across the water's surface. In their only test, the Civil War, Third System forts failed across the board.

The forts built between 1816 and 1867 were the last enclosed forts ever built in the United States. Most Third System forts were decommissioned without ever seeing battle, and those that did were proven not up to the task. Surprisingly, though, the forts were not entirely cast aside. Many were strengthened with reinforced concrete and heavier artillery as part of the Endicott System in the late 19th Century and the seemingly incongruous concrete works and outworks are still present at many of the Louisiana and Gulf Coast forts. Third System forts were relics of the past even as they were being built, but they were then and are now strategically placed. Several Southern forts were recommissioned during World War II to watch for enemy planes and submarines in the Gulf of Mexico, and many Third System forts, including Fort Jackson in Louisiana and Fort Barrancas in Florida, are now the location of active military bases. It is a testament to Simon Bernard's military knowledge that the site selections of his fortifications have remained relevant for 200 years.

CHAPTER 3

FORT HISTORIES

The previous chapter explored early America's military and political culture and examined how both contributed to the formation of the Board of Engineers and the establishment of the Third System. This chapter focuses on Third System forts located in Louisiana, Mississippi, Alabama and the panhandle of Florida. The history of each fort is presented from the design phase to decommission. Historic plans and renderings, along with contemporary photographs, highlight the diversity of design as well as the unifying characteristics of Third System forts. The chapter concludes with a comparative chart that classifies the forts into varying levels of cultural and architectural significance.

Third System forts were originally ranked according to their importance to the system as a whole, and initially Bernard devised three classes for the fortifications. First Class forts defended significant commercial cities, harbors and naval arsenals. These forts were typically primary in terms of funding and construction priority. Second Class forts defended cities of lesser commercial or political importance or areas that had existing fortifications. Third Class forts were typically subsidiary structures that aided a First Class fort but were not necessary to its defensive function.²⁴ The class system was flexible, and forts did sometimes move from second to first class. This section of the thesis is organized by state and further by fort class.

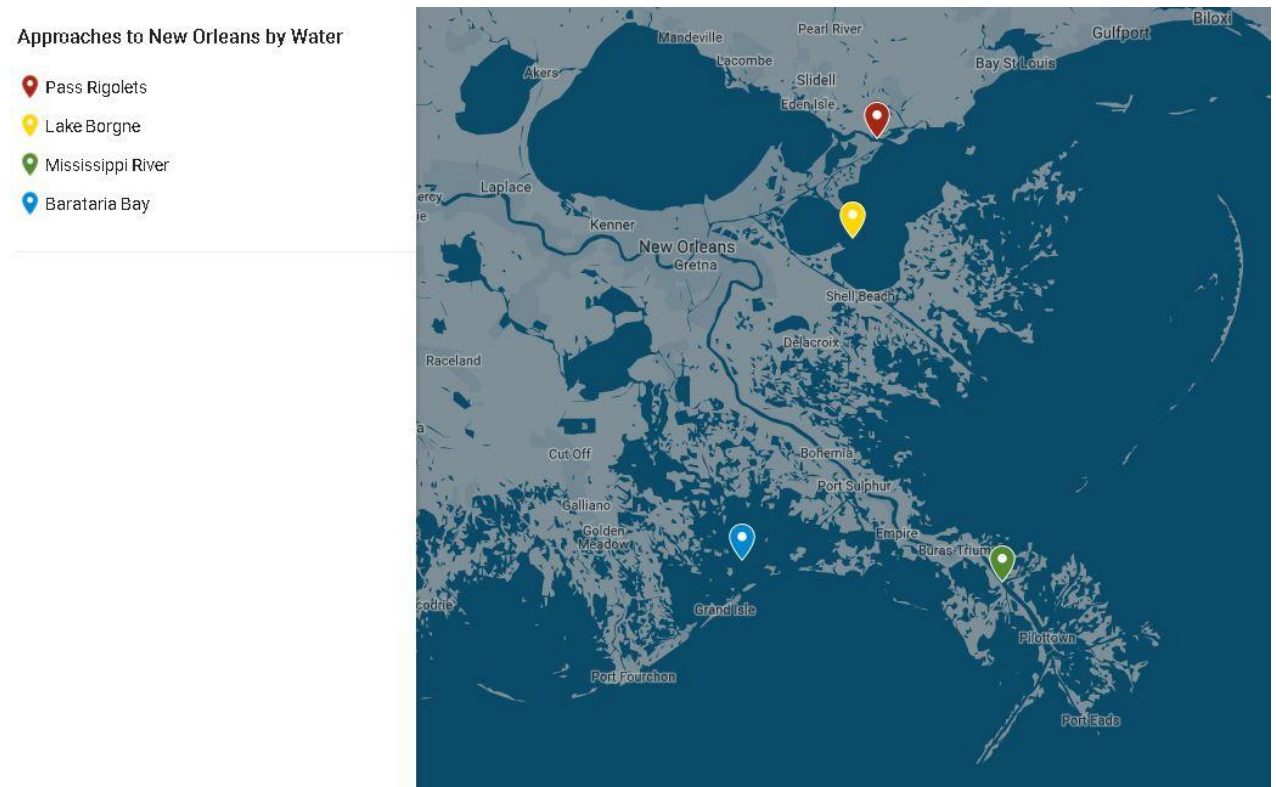
²⁴ Robinson, 88.

Louisiana was the only state on the Gulf Coast with first class forts according to Bernard's initial plan, and is the first state discussed in this section, though second and third class forts are included. The next state is Alabama, followed by Florida and finally, Mississippi. Bernard's ranking system did not last long into Totten's management of the Board of Engineers, but it provides a logical framework for this section based on the construction timeline of the forts discussed. Louisiana had first class forts, and the majority of those forts were constructed before the second class forts of Alabama, which were built before the unclassified forts of Pensacola Bay and Mississippi. This organization also showcases the evolution of the Fortifications Board and Third System design from Bernard to Totten to Delafield.

Forts in the State of Louisiana

The Battle of New Orleans was an important victory for the United States during the War of 1812, but it highlighted a considerable problem in domestic defense strategy. New Orleans was a major commercial city with an international shipping port and access to the American interior. Its need for protection was obvious, but the means of that protection was daunting. New Orleans is vulnerable to attack from multiple sides. Naval strategists of the time, along with the Fortifications Board, identified four main approaches that might be taken by an invading force (Map1).

Map 1: *Four Approaches to New Orleans by Water*. Digital Image courtesy of Google Maps. (Created by author July 30, 2017) <https://www.google.com/maps/@29.7553195,-90.1677688,214517m/data=!3m1!1e3>.



The first was directly up the Mississippi River. The second was through the Mississippi Sound and the Pass Rigolets into Lake Pontchartrain. The third was directly through Lake Borgne. The fourth passage was through Barataria Bay and was the least likely because it would involve traversing miles of swamps and dense marshes that would be difficult to move an army through.²⁵ Unlikely though it was, the approach had to be considered because it would be the obvious choice for an invading force that had been thwarted at the other three passages.

²⁵ Weaver, 179.

According to Bernard's 1821 plan, New Orleans was to receive five first class forts and two third class forts. In the end, three first class forts, three subsidiary structures and one-third class fort were built in Louisiana. Additionally, one French fort ca. 1786 was modified to comply with Third System defense strategy.

Fort Pike

Fort Pike was the first fort designed and constructed in the Third System. It sits on the Pass Rigolets, a body of water that connects the Mississippi Sound to Lake Pontchartrain and would provide the quickest access to New Orleans for an invading force. Many Third System forts are near or on the sites of previous forts, and Fort Pike is no exception. An older, wood and earthen Spanish fort was located about a mile northwest of the site selected for Fort Pike. The original fort, Fort Petites Coquilles, was built in the 1790s and was reinforced and garrisoned by the American military in 1813-14 as part of the War of 1812 defense of New Orleans. Fort Petites Coquilles never saw action, but was believed to be the reason British forces opted to approach New Orleans by way of the Mississippi River rather than through the Pass Rigolets. The exact site of Fort Petites Coquilles was not optimal for cannon fire, so for the protection of the pass, Fort Pike was sited a mile southeast for greater range in cannon shot and to limit the number of places an invading force could retreat and regroup.

Fort Pike, named for Brigadier General Zebulon Pike, was designed by Simon Bernard and drawn by his assistant, Guillaume Tell Poussin in 1817 with the intention of being used in three separate locations within Louisiana: Pass Rigolets, Chef Menteur Pass and Grand Terre Island. On July 20, 1818, the United States entered into a contract with

James Bennett and Peter Morte of Washington D.C. for the construction of Fort Pike at Pass Rigolets and its twin fort, Fort Wood (later Fort Macomb), at Chef Menteur Pass. Construction began in 1819 with a crew of enslaved and contract laborers and an overly optimistic plan for completion by December 1, 1821. The two year goal did not take into account the local climate, storms, floods, seasons of yellow fever, challenges presented by the local geography or difficulty finding and keeping skilled craftsmen.²⁶ Fort Pike was not officially declared complete until February of 1827.

The fort is located in an area with very marshy, alluvial silt-based soil that makes traditional foundation construction difficult. Fort Pike's foundation, like those of Forts Wood and Jackson, is made of layers of local cypress logs laid as grillage below the waterline with a layer of cemented shells, similar to common tabby, on top.²⁷ Timber as a foundation material, particularly cypress, is an exceptional choice for wet landscapes because it "will last indefinitely if continuously kept either wet or dry and not allowed cycles of change."²⁸ The layer of tabby on top of the logs provided a solid, level surface for the fort walls and helped keep the logs below the waterline. The use of "Louisiana tabby" is also found within the masonry walls of the scarp and counterscarp at Fort Pike. Louisiana tabby uses oyster shells as well as the little shells or "petites coquilles" common to coastal areas there.

²⁶ Powell A. Casey, *Encyclopedia of Forts, Posts, Named Camps and Other Military Installations in Louisiana 1700-1981*. (Baton Rouge: Claitor's Publishing Division, 1983), 153.

²⁷ Ibid, 153.

²⁸ Robinson, 95.



Figure 1: *Louisiana Tabby Fill*. (Photo by author, March 8, 2013)

Fort Pike is one of the smallest of the Third System forts and was designed for a full, war-time garrison of 400 men. The fort has a perimeter of 308 yards and is “shaped like a piece of pie with one bastion at the junction of the straight sides and a demibastion at each intersection of the arc with a side.”²⁹ The red bricks used for Fort Pike were fired in kilns on the Tchefuncte River in St. Tammany Parish, Louisiana, while the granite for the gun platforms was shipped in from New England.³⁰ Frequently in the construction of Third System forts, the American engineers overseeing construction altered Bernard’s original plans to make them comply with more traditional forms, rather than utilizing avant garde French designs.

²⁹ Weaver, 182.

³⁰ Codman Parkerson, *New Orleans: America’s Most Fortified City*, (New Orleans: The Quest, 1990), 60.

Fort Pike and Fort Macomb are the only forts in the Third System that maintained Bernard's original plans for tunneled casemates. The walls at both forts are one story with casemates accessed through long tunnels rather than having large openings onto the parade. This design was meant to protect the gunners in the case of simultaneous attack from sea and land, but it made for an inhospitably smoky and loud working environment for the soldiers and was not used in later forts.

At the center of Fort Pike is the slightly curved, one story brick citadel. During the 1850s, the citadel was altered to have a second story, but it burned in 1887, and now the citadel has a contemporary, flat zinc roof on the center section with both side sections entirely open to the elements.



Figure 2: *Fort Pike Citadel, Parade and Casemates.* (Photo by author, March 8, 2013)

The citadel is the dominating feature of Fort Pike's parade, but there are several other important elements: the remains of two furnaces for heating cannon shot and the footprint of the fresh water cistern. Surrounding the grassy parade are the parade walls. The curved, seaward wall has 13 casemates on the ground level and 11 barbettes on the terreplein. The southwest wall has three rooms that directly access the parade: the commissary store, bakery and a magazine. Between the rooms are tunnels that lead to the five ground level casemates. The northwest wall also has three rooms that access the parade: the garrison store, the sutler store and a magazine. Tunnels between these rooms access four casemates with the guard room at the center. The guardroom is home to the fort's only point of entry, the sallyport.

Originally, there was a drawbridge at the sallyport that allowed soldiers to cross the 60 foot inner wet moat. Today that draw bridge is gone and has been replaced by a fixed wooden bridge, but the wet moat still exists. Beyond the moat were extensive outworks that have been lost to the construction of modern-day transportation projects and the encroachment of both residential development and the waters of Lake Pontchartrain. An 1840 diagram of Fort Pike shows a vast place d'armes, parapet and banquette, as well as a sloping glacis that led to a second, larger wet moat that was about 115 feet wide connected to the mainland by a wooden bridge that would have been burned in the event of attack

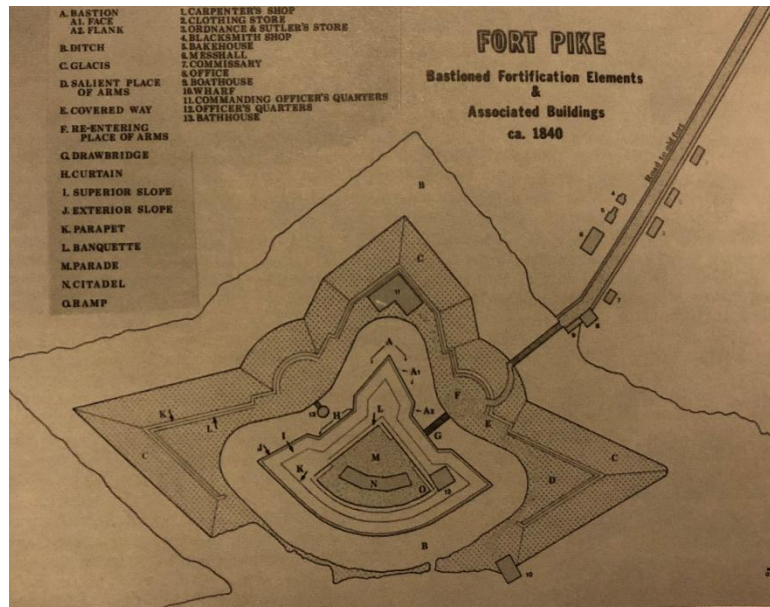


Figure 3: *Fort Pike Plan*, 1840. National Archives. (Reproduced in Groene, 12)

Though only a small portion of the parapet and banquette remains, the outline of the work is easily visible in aerial photographs (Figure 4). The bridge led to what was then called “Shell Road” that ran from Fort Pike to the old Fort Petites Coquilles. Shell Road was lined with businesses and residential buildings that supported the fort. There was a carpenter, blacksmith, bakehouse, mess hall and clothing store along with officers’ quarters and commanding officers’ quarters. At the end of the road was a hospital within the confines of the old Fort Petites Coquilles. Shell Road is long gone, but a present-day road in roughly the same location is named “Hospital Road,” though the nearest modern hospital is 21 miles away (Figures 5 & 6).



Figure 4: *Aerial Photo of Fort Pike*, Digital Image courtesy of Google Maps. Accessed January 4, 2017.

<https://www.google.com/maps/place/Fort+Pike+State+Historic+Site/@30.1662503,89.7393042,995m/data=!3m2!1e3!4b1!4m5!3m4!1s0x889de02cc41c6691:0xa9cf9c0d35376e31!8m2!3d30.1662457!4d-89.7371155>.

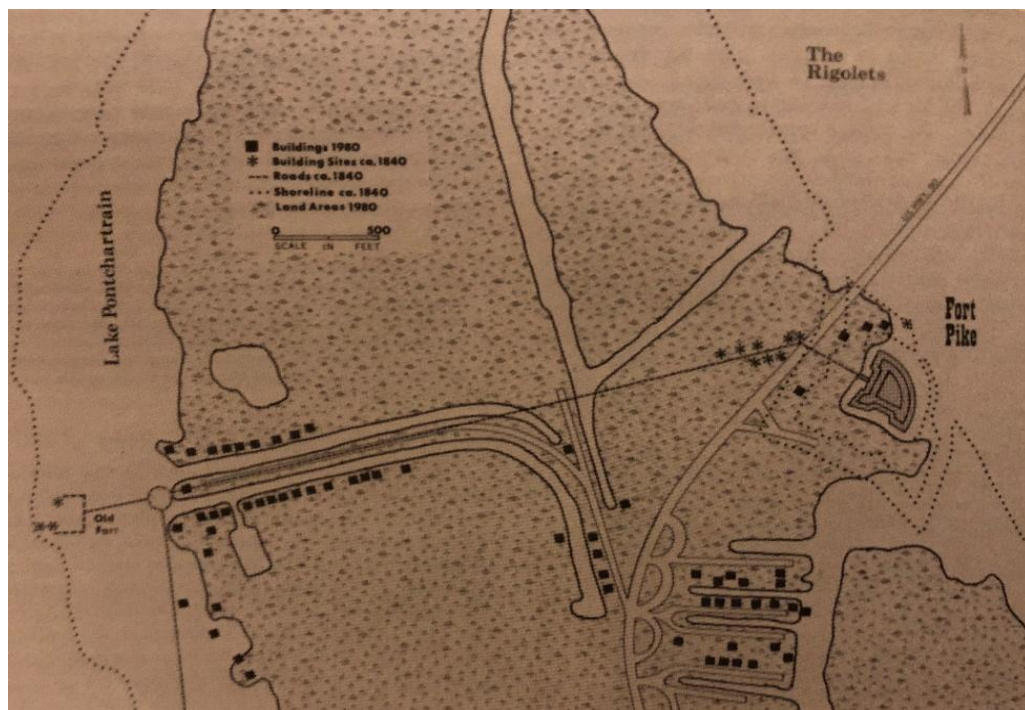


Figure 5: *Schematic drawing of Fort Pike area in 1980 with dotted lines representing the 1840 shoreline*. Ferguson, Barry. (Groene, 50)

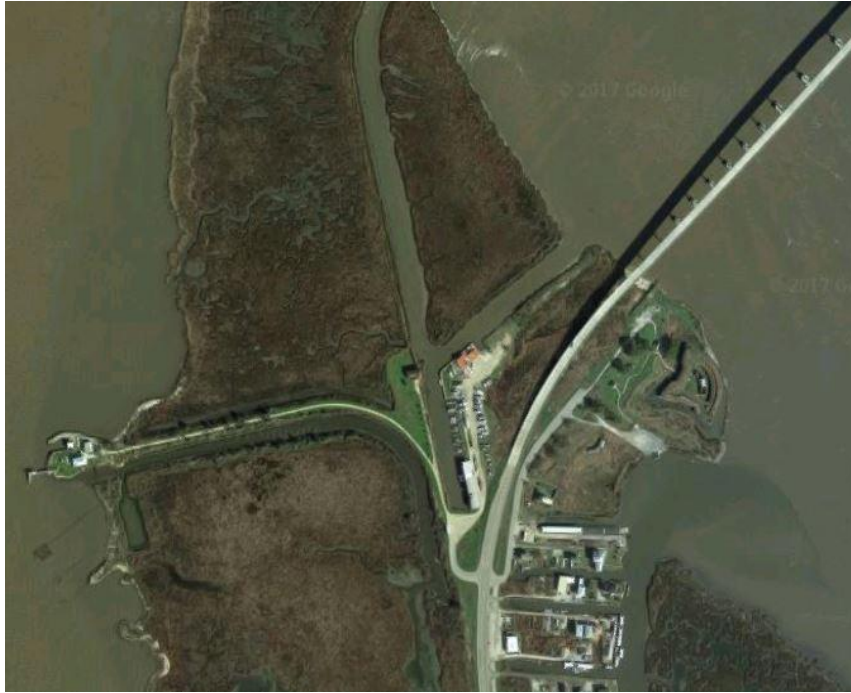


Figure 6: *Fort Pike Area Today*. Digital Image courtesy of Google Maps. Accessed July 30, 2017. <https://www.google.com/maps/@30.166027,-89.7388144,1934m/data=!3m1!1e3>.

Fort Pike was designed and outfitted to function in defense of the United States. Ironically though, it played only a passive role militarily and its significance arises from the fort's unique architecture, the famous men who served there and its temporary use as a prison. Fort Pike was issued weapons and officially considered active in early 1827. Records show that various regiments cycled through the fort with no significant activity until 1837. In October of that year, 87 Seminole Indians and African Americans were brought to Fort Pike as prisoners of war. The men had been captured in the fighting of the Seminole Wars and were kept at Fort Pike until March 1838 when they were moved

elsewhere.³¹ In the two decades that followed, Fort Pike was only sporadically occupied, and in January of 1861 it was taken over by the Louisiana militia as one of the earliest acts of war by the new Confederate States of America.

Confederate soldiers held Fort Pike for a little over a year before Admiral Farragut and Union troops took New Orleans, and the CSA was forced to abandon their stronghold. Fort Pike was completely deserted for about one week when two Union ships approached the fort and noted its damage. Lieutenant King of the steamboat *New London* wrote of the Confederate retreat, “The enemy damaged it as much as possible on leaving, spiking the guns...the walls were charcoaled with bad pictures and vulgar allusions addressed to the ‘invaders.’ ”³² The Union Army refitted Fort Pike with modern guns and used the fort as both a central reconnaissance point and a training facility for troops. Notably, it was used to train the Union Corps d’Afrique, a local New Orleans militia comprised of property owning free men of color as well as recently freed enslaved workers who had little means of providing for their families outside a plantation setting. Upon completing their training, the Corps d’Afrique was replaced by the 7th U.S. Colored Regiment of Infantry and then by the 10th U.S. Colored Heavy Artillery regiment.³³

During its years of active service, Fort Pike was the training ground for hundreds, if not thousands of men both on the Confederate and Union armies. Significant among these many soldiers were Full General P.G.T. Beauregard, New Orleans’ most famous

³¹ Casey, 157.

³² Bertram Hawthorne Groene, *Pike: A Fortress in the Wetlands*. (Hammond, LA: Southern Louisiana University Press, 1988), 32.

³³ Casey, 159.

Civil War general; Brigadier General William Chase, engineer within the Corps of Engineers and builder of many southern Third System forts; and Brigadier General G. J. Raines, chief of the Confederate Torpedo Service.³⁴ General P.G.T. Beauregard is by far the most famous locally and nationally, and his association with Fort Pike and other Louisiana forts was a major factor in the push for their preservation in the mid twentieth century.

After the Civil War, Fort Pike was occupied predominantly by black troops whose role as makeshift policemen in a rough, Reconstruction environment proved extremely complicated as most of the soldiers were former slaves. The three companies of black soldiers active at Fort Pike were eventually consolidated into the famous Twenty-fifth Infantry and were sent to Fort Jackson and then out west where they became known as the “Buffalo Soldiers” and achieved military glory in the Plains Indian Wars of the 1870s.³⁵ Following the exit of the Colored Troops, Fort Pike was only lightly staffed until May 22, 1871 when an order to withdraw all remaining troops was declared and Fort Pike was left with a single caregiver, Ordnance Sergeant Thomas Cooney.

Cooney monitored the fort, noting storm damage and rot until the early 1880s when he was replaced by Ordnance Sergeant David Porter, who witnessed the great marsh fire of 1887 that took the citadel, shops and officers’ quarters. On October 7, 1890, the United States Army officially abandoned Fort Pike, and by 1913, Lake Pontchartrain had risen to overtake the hospital at Petites Coquilles, Shell Road and the officers’ graveyard.³⁶ For a short time, the area was used for a light house, and in 1928 was

³⁴ Groene, 37.

³⁵ Ibid, 39 & 45.

³⁶ Ibid, 49.

purchased by the State of Louisiana. On November 15, 1934, Fort Pike and a few acres of surrounding land were named Fort Pike State Park by Governor O.K. Allen. The fort was officially named to the National Register of Historic Places on August 14, 1972.

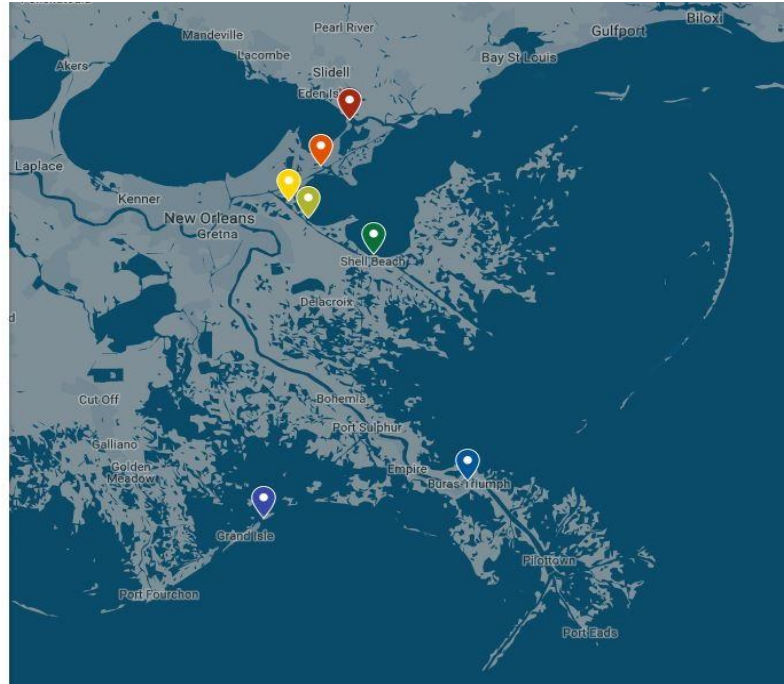
Fort Macomb

Fort Macomb is Fort Pike's twin and is located about seven miles southwest on Chef Menteur Pass, which connects Lake Borgne to Lake Pontchartrain (Map 2). Fort Macomb was originally called Fort Wood, but was renamed in 1851 when a fort in New York was given the same name. To avoid confusion, the fort at Chef Menteur Pass was renamed after Major General Alexander Macomb, who fought in the War of 1812 and was a regular visitor to Louisiana. Fort Macomb was part of the building contract between the United States and James Bennett and Peter Morte of Washington D.C. Construction began in 1822 and was completed in the Fall of 1827.

Map 2: *Third System Forts and Subsidiary Structures in Louisiana*. Digital Image courtesy of Google Maps. (Created by author July 30, 2017)
<https://www.google.com/maps/d/viewer?hl=en&hl=en&mid=18hM33AmjUwwcJo3W4LQ0TKejGmw&ll=29.62200457302471%2C-88.47625851640623&z=9>.

Louisiana Forts

- Fort Proctor
- Tower Dupre
- Fort Macomb
- Fort Pike
- Fort Jackson
- Fort Livingston
- Battery Bienvenue



Like Fort Pike, Fort Macomb is in nearly the same location as an earlier, less permanent defensive structure. In 1792, Governor Carondelet recommended the construction of a fort “at the cow ranch of Gilbert Antoine de Saint-Maxent” on Chef Menteur Pass, but there is no evidence that the fort was ever constructed.³⁷ General Andrew Jackson later identified the site as a prime entry point for invading British forces during the War of 1812 and ordered the construction of a battery there. Bernard and Poussin visited the site in 1817 and gave it first class status.

³⁷Casey, 112.

As with all of the Louisiana forts constructed or refitted during the Third System, Fort Macomb suffered numerous problems and construction delays. “High water flooded foundations, storms destroyed levees, and partially completed works, competent workmen did not want to go to the remote site, fever and other sickness caused deaths so that work could be carried out only in the healthy part of the year and materials, and sometimes engineer officers, were not available.”³⁸ Like its twin, Fort Macomb was built by both enslaved and paid laborers and sits on a floating foundation of cypress grillage and tabby.

Architecturally, the forts are nearly identical “slice of pie” shaped buildings with a single bastion at the intersection of the straight sides and demibastion at the intersections of the straight sides with the ends of the curved, waterfront wall. There are 13 casemates in the arc, five in the southwestern wall and four in the northwestern wall, exactly like Fort Pike, only slightly smaller because improvements in artillery allowed for smaller guns. The smaller casemates translate to a slightly smaller trace of the fort as a whole. Among the other small differences between the forts are changes to Fort Macomb’s sallyport, lowered ramparts, a triple arched entryway and smaller outworks. The citadel of Fort Macomb is an exact replica of that at Fort Pike made smaller to account for the smaller parade.

³⁸ Ibid, 112.

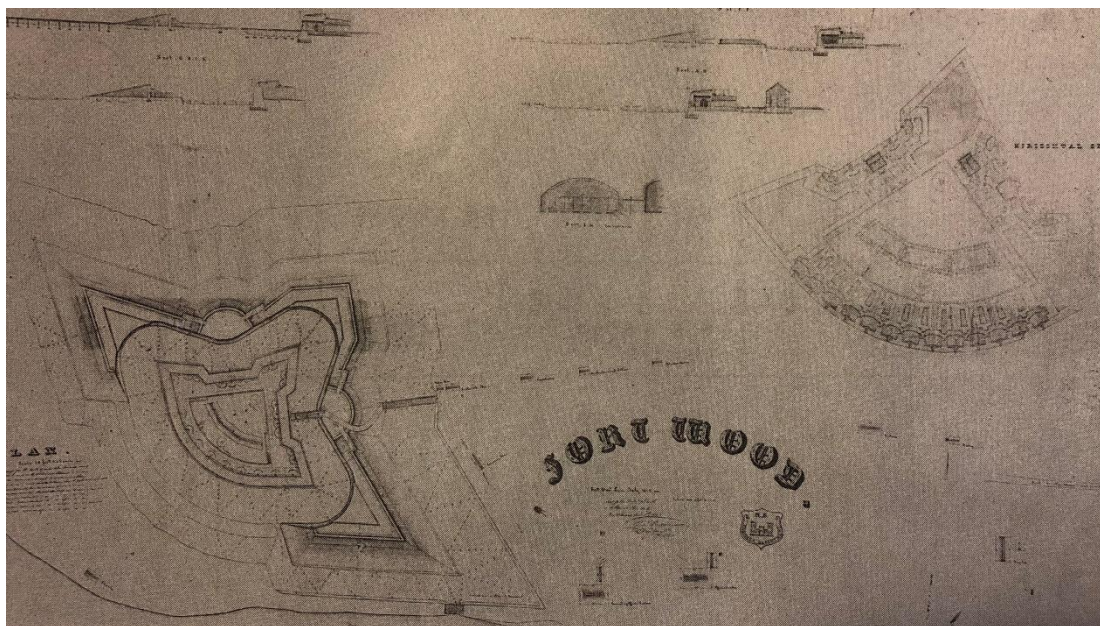


Figure 7: *Plan of Fort Wood (Fort Macomb)*. U.S. Army Corps of Engineers, Date Unknown. (Reproduced in Parkerson, 65)

Fort Macomb was garrisoned and staffed in 1828 and was in continuous operation by the United States Army until it was seized by the State of Louisiana in 1861. The fort was held by the Confederates until April 25, 1862 when the fort was abandoned by the Regiment of Regular Artillery of Louisiana and left for the occupying forces of the Union Army. Fort Macomb was not damaged to the extent that Fort Pike had been and was used as a training camp and supply store for the Union. Among the famous regiments and generals to serve at Fort Macomb are the 20th Infantry Corps d'Afrique and President Zachary Taylor.

Fort Macomb never saw combat, and after the Civil War was left in the hands of a caretaker who monitored storm and water damage until the mid-1880s. Some efforts at improvement were made at that time, but no evidence remains that work was carried out. The fort was officially abandoned and left vacant for many years during a property

dispute that lasted until 1927. The tract of land upon which Fort Macomb sits was eventually purchased by the State of Louisiana, leased long-term to a private corporation and then reacquired by the state in 1981.³⁹ Fort Macomb was added to the National Register of Historic Places on October 11, 1978.

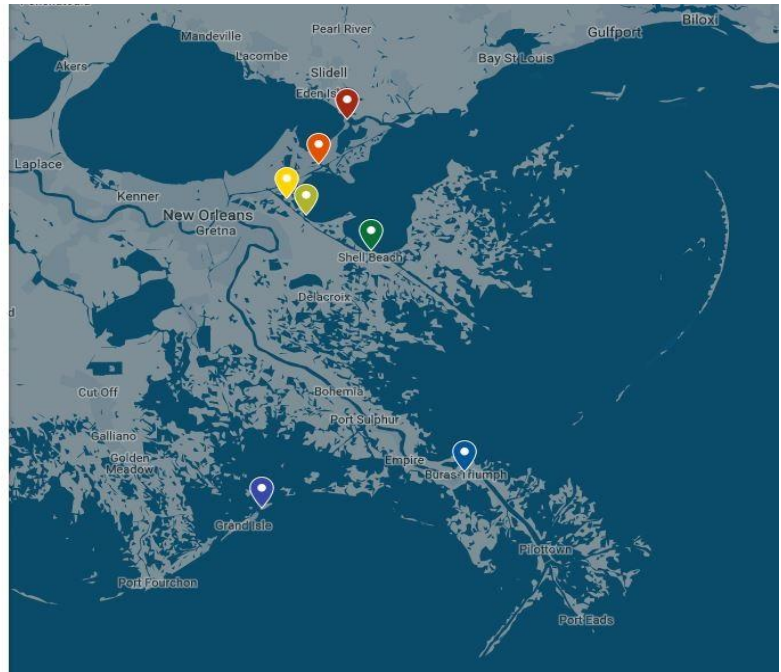
Fort Jackson

Fort Jackson was named for President Andrew Jackson, hero of the Battle of New Orleans. Construction began in 1824 and was completed in 1832. The fort is seventy miles downstream from New Orleans on the west bank of the Mississippi River in Plaquemines Parish at the site of a late 18th century Spanish redoubt called Fort Bourbon, which was destroyed by a hurricane in 1795 (Map 2). The soil under Fort Jackson is very similar to that at Forts Pike and Macomb, so the foundation structure follows the same model. A cypress 2x4 and log grillage frame topped with willow mats, rather than little shell tabby, supports the structure.

³⁹ Ibid, 115.

Map 2: *Third System Forts and Subsidiary Structures in Louisiana*. Digital Image courtesy of Google Maps. (Created by author July 30, 2017)

- Louisiana Forts**
- Fort Proctor
 - Tower Dupre
 - Fort Macomb
 - Fort Pike
 - Fort Jackson
 - Fort Livingston
 - Battery Bienvenue



Fort Jackson is a pure Vauban style pentagonal fort with full bastions at each of the five corners, 20 foot thick ramparts, 25 foot high walls and a wet moat crossed by a drawbridge. At the center of the fort's parade was a ten-sided citadel that served as both the central defensive point and as a barracks.⁴⁰ The fort's extensive outworks included three demilunes connected to the fort by wooden bridges that were to be burned in case of attack, a parapet and banquette as well as a sweeping glacis and water battery.

Additionally, Fort Jackson has the Third System's only "cavaliered" bastions. Cavaliered bastions are independently defensible because there was a wall separating the bastion

⁴⁰ Ibid, 80.

from the terreplein. Should the fort be taken by attackers, soldiers could retreat to the bastions and continue fighting.⁴¹

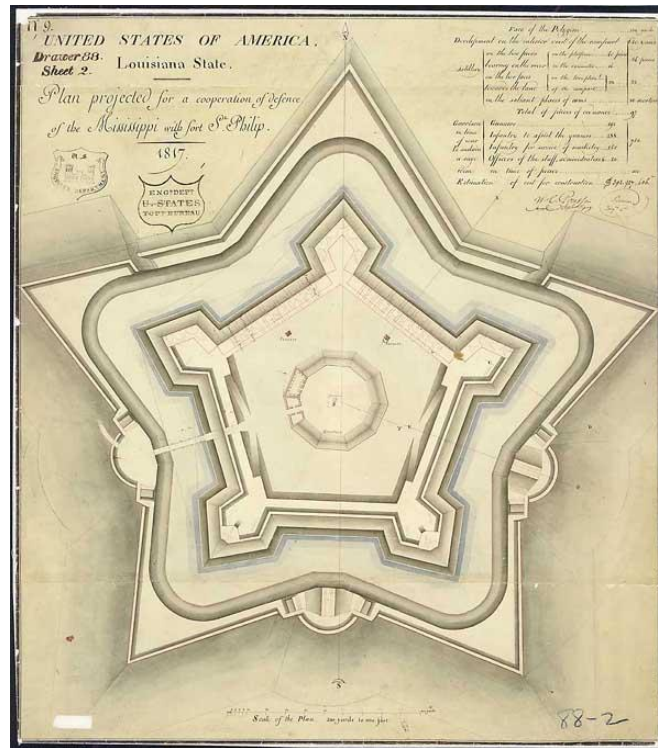


Figure 8: *Plan of Fort Jackson*, Guillaume Tell Poussin, 1817.
Library of Congress. Accessed July 30, 2017.
https://upload.wikimedia.org/wikipedia/commons/8/80/Plan_ft_st_philip.jpg.

The fort was garrisoned by the U.S. Army in 1832 and was taken by the Louisiana State Militia in 1861. The Confederates held Fort Jackson for a little over a year before being attacked by Admiral Farragut and the U.S. Navy in a battle that lasted ten days and heavily damaged the fort. The Southern soldiers mutinied and fled, and their commander officially surrendered Fort Jackson to Union troops on April 28, 1862.⁴² After the Civil

⁴¹ Weaver, 187.

⁴² Parkerson, 67-68.

War, monies were allocated for the repair and improvement of Fort Jackson, but the fort was officially abandoned in 1871. A caretaker was left in control of the fort, which was used as a training sub-post of Jackson Barracks through World War 1. The tract of land that contains Fort Jackson was sold into private ownership in 1927, but the fort and a few surrounding acres of land were donated to the Parish of Plaquemines to be used as a park.⁴³ Fort Jackson was designated a National Historic Landmark in 1960 and was added to the National Register in 1966.

Fort St. Philip

Fort St. Philip was a Spanish fort on the east bank of the Mississippi River about a half-mile northwest of Fort Jackson in Plaquemines Parish. It was nearly completed in 1793 when a hurricane toppled the walls and covered the site in silty mud. It was rebuilt only to be hit by a second hurricane in August of 1794. The fort sat in construction limbo until the Louisiana Purchase in 1803.⁴⁴ Fort St. Philip was then improved by the U.S. government and proved vital to the defense of New Orleans in the Battle of New Orleans in 1815. When Bernard toured the area, he believed the location and condition of Fort St. Philip to be good enough to warrant an improvement rather than a replacement of the structure.

The bulk of the Third system improvements done to Fort St. Philip took place between 1840 and 1850 under the supervision of P. G. T. Beauregard, and the fort did not resemble true Third System forts in either style or material. Like Fort Jackson, Fort St.

⁴³ Casey, 84.

⁴⁴ Ibid, 208.

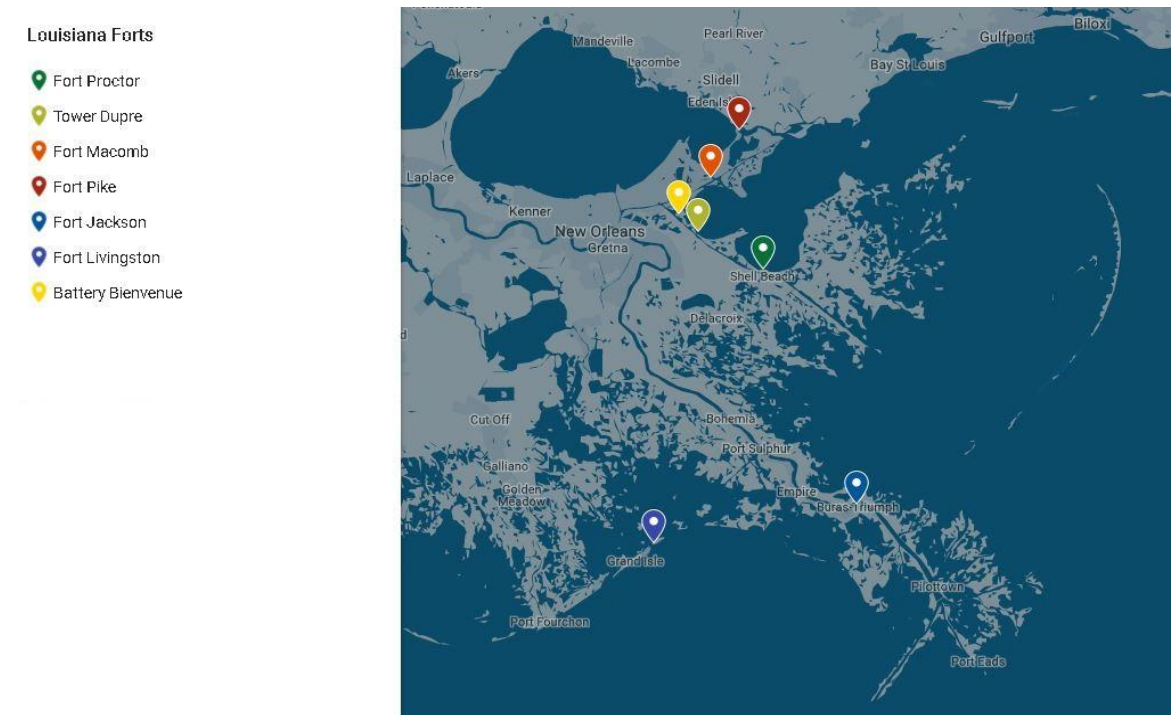
Philip was taken by the Louisiana State Militia in 1861 only to be retaken by Union forces in 1862 after a ten day battle between the Confederates and Farragut's ships. The fort was repaired and improved after the war, and was proposed to be armed with anti-aircraft guns in 1916. Fort St. Philip followed in Fort Jackson's wake becoming a training sub-post of Jackson Barracks before being completely abandoned.⁴⁵ Fort St. Philip was named a National Historic Landmark in 1960 and was placed on the National Register in 1966.

Fort Livingston

Fort Livingston was the last Third System fort to be built in Louisiana and is the only truly coastal fort in the state. Bernard planned Fort Livingston to be the triplet to Forts Pike and Macomb, but delays in land acquisition, funding and engineer staffing pushed its construction into the Totten years of the Fortifications Board, and sweeping changes were made to the plans. Fort Livingston is located on Isle Grande Terre, Jefferson Parish, at the mouth of Barataria Bay about forty-five miles south/south-east of New Orleans (Map 2). Access to New Orleans through Barataria Bay was by far the most difficult route an invading force could take, but Bernard and later Totten felt it was worth guarding against.

⁴⁵ Ibid, 209 & 213.

Map 2: *Third System Forts and Subsidiary Structures in Louisiana*. Digital Image courtesy of Google Maps. (Created by author July 30, 2017)



The land for Fort Livingston was purchased in 1833, and construction is reported to have begun in 1835. Lack of oversight left the fort languishing for five years until, in 1840, Captain of Engineers J.G. Barnard took over and work commenced in earnest. By then, Simon Bernard's plans for a pie slice shaped fort had been discarded in favor of Totten's trapezoidiform, or kite-shaped, "structure with an impressive array of counterscarp works on two sides."⁴⁶ This style of fort and counterscarp is also seen at Fort Barrancas in Pensacola, which was built at nearly the same time.

⁴⁶ Weaver, 189.

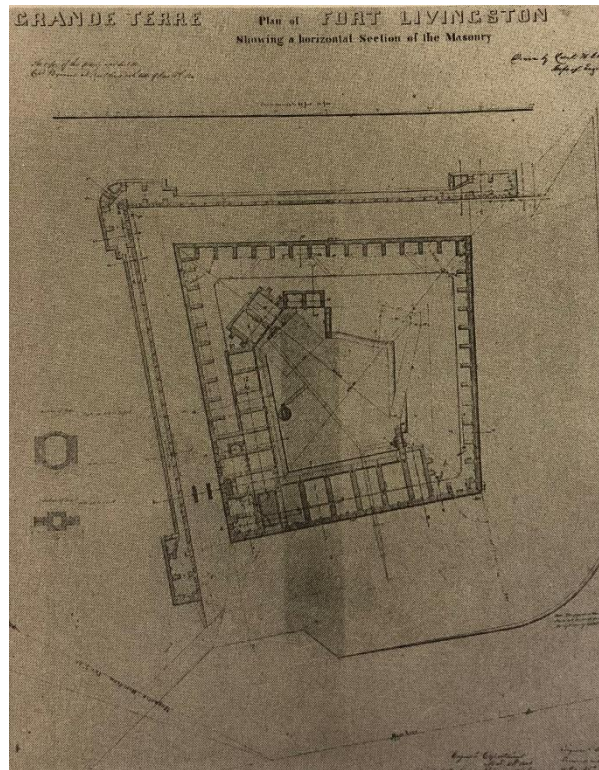


Figure 9: *Plan of Fort Livingston*. Courtesy of the Cartographic Division of the National Archives. (Reproduced in Parkerson, 78.)

Fort Livingston has two casemated, seaward facing walls that are unprotected, similar to Forts Pike and Macomb. The two landward, or bay-facing, sides were protected by a long counterscarp and full glacis. Within the fort was a small parade and place d'armes. The sallyport led to a drawbridge over a dry moat similar in style to Advanced Redoubt for Fort Barrancas, though Fort Livingston's would sometimes fill with water due to the tide. The foundation of Fort Livingston is also decidedly more beach-like than the other Louisiana forts as it sits atop a Native American shell midden. Shells and Native

American pottery fragments can even be found in the mortar and tabby used in the fort's masonry walls.⁴⁷

Construction at Fort Livingston was nearly complete by 1849, though it was not garrisoned for some time. From 1854 until the fort was taken by the 1st Regiment of Louisiana Regular Artillery in 1861, the bulk of the work done at Fort Livingston was cleaning up and repairing damage done by hurricanes. Fort Livingston saw no combat in the Civil War, was disarmed in 1889 and officially abandoned in 1892. The site was turned over to the State of Louisiana in 1923. Isle Grande Terre was designated a state Wildlife and Fisheries in 1955. Fort Livingston was added to the National Register of Historic Places in 1974 and made a State Commemorative Area in 1979.

Battery Bienvenue

Battery Bienvenue was built during the War of 1812 to protect New Orleans from British attack and sits at the junction of Bayous Bienvenue and Maxent about eleven miles east of New Orleans (Map 2). The battery was a long, somewhat rectangular defense with no casemates and no bastions that was reinforced and garrisoned as part of the Third System to support nearby Fort Macomb.

Tower Dupré

Tower Dupré was located on the south shore of Lake Borgne at the mouth of Bayou Dupré in St. Bernard Parish (Map2). The fort was part of Bernard's 1821 plan for New Orleans, but its third class status delayed construction until 1827. Tower Dupré was

⁴⁷ Parkerson, 78.

a classic, round Martello tower three stories tall. It was completed in 1830, but constant storms and flooding left the tower with a never-ending list of necessary repairs, including the construction of a levee in 1855 to protect against the already rising waters of Lake Borgne. Tower Dupré was manned and garrisoned, but never saw action and played no part in the Civil War. It was considered unserviceable in 1883 and passed into private ownership.⁴⁸

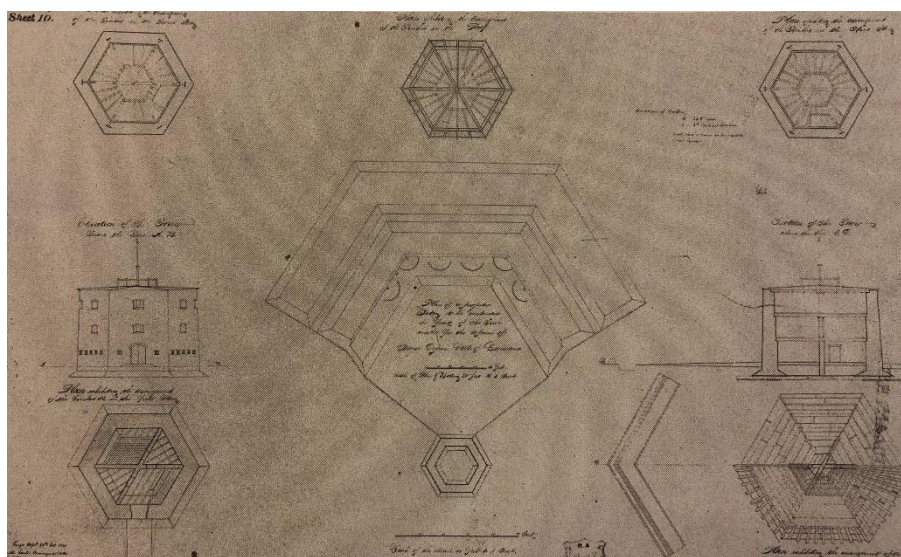


Figure 10: *Plan for Tower Dupré*. Courtesy of the Cartographic Division of the National Archives. Reproduced in Parkerson, 71.

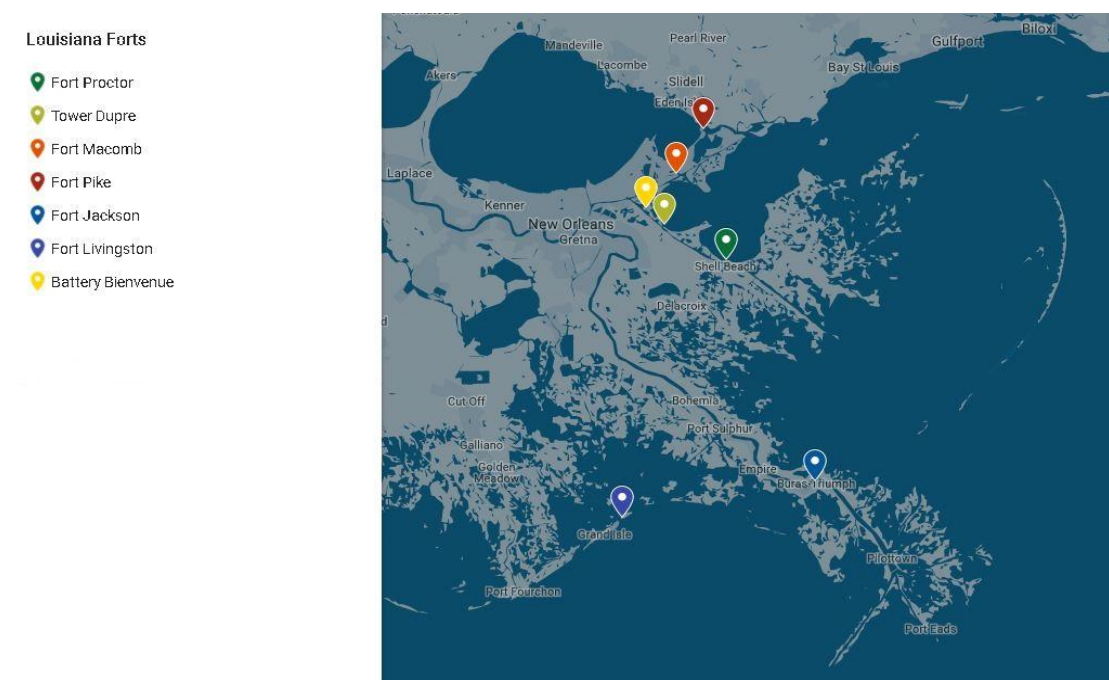
Fort Proctor

Fort Proctor is a fort in name only; it is more accurately labeled a subsidiary structure in the style of a late Third System Martello tower. Fort Proctor is located on the southwest shore of Lake Borgne twenty four miles east/southeast of New Orleans in an

⁴⁸ Casey, 57.

area then called Proctor's Landing. It is now named Shell Beach in St. Bernard Parish (Map 2). The land for Fort Proctor was purchased in March of 1856 from Mrs. Mary Screven, and construction began that same month with the dredging of a canal and the building of a levee.⁴⁹

Map 2: *Third System Forts and Subsidiary Structures in Louisiana*. Digital Image courtesy of Google Maps. (Created by author July 30, 2017)



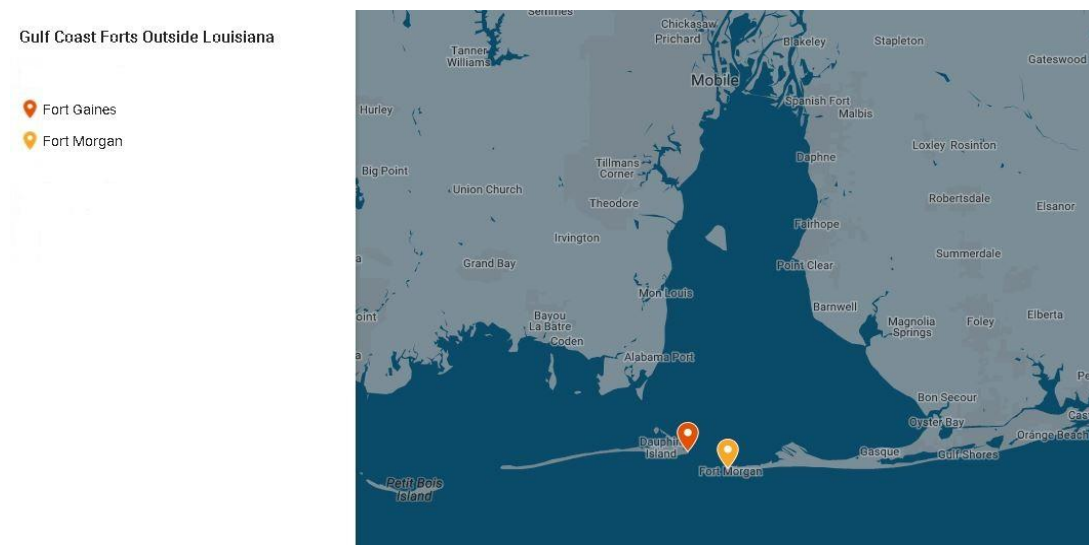
⁴⁹ Ibid, 180.

Forts in the State of Alabama

The two Third System forts located in the State of Alabama both protected the entrance to Mobile Bay. Fort Gaines sits on the easternmost point of Dauphin Island, on the bay's western side. Fort Morgan sits on the westernmost end of Mobile Point, a peninsula that protects the bay from the east (Map 3). Though the forts at Mobile Bay were considered indispensable in the defense of the United States, they were nonetheless classified as Second Class fortifications by Bernard, valued more for their potential role in protecting communication to and from New Orleans than in the protection of Mobile Bay, itself.⁵⁰ Forts Morgan and Gaines were designed as twins, but funding disagreements and government delays led to design changes and a much later date of completion for Fort Gaines.

Map 3: *Third System Forts of Mobile Bay, Alabama*. Digital Image courtesy of Google Maps. (Created by author July 30, 2017)

<https://www.google.com/maps/d/viewer?hl=en&hl=en&mid=18hM33AmjUwwcJo3W4LQ0TKejGmw&ll=30.44460398623115%2C-87.48289704332274&z=10>.



⁵⁰ Willard B. Robinson, "Military Architecture at Mobile Bay," *Journal of the Society of Architectural Historians*, Vol. 30, no. 2 (May 1971):119-139., p 95.

Fort Morgan

Fort Morgan is a classic fort of the Third System nearly identical to Fort Jackson in Louisiana, built slightly larger to accommodate its location. It is a pentagonal fort with a full bastion at each corner creating a traditional “star-fort” trace completely ringed by outworks. Fort Morgan sits atop a foundation of wooden grillage that supported “wide masonry footings which, on the interior, were stepped inward as the height increased until they were reduced to the width of the walls.”⁵¹ Outside the fort’s rampart was a dry moat ditch that was bound by counterscarp wall and covert way, which was protected and strengthened by the earthen glacis. Within the fort was an impressive ten-sided brick citadel that was the largest in any Third System fort.⁵²

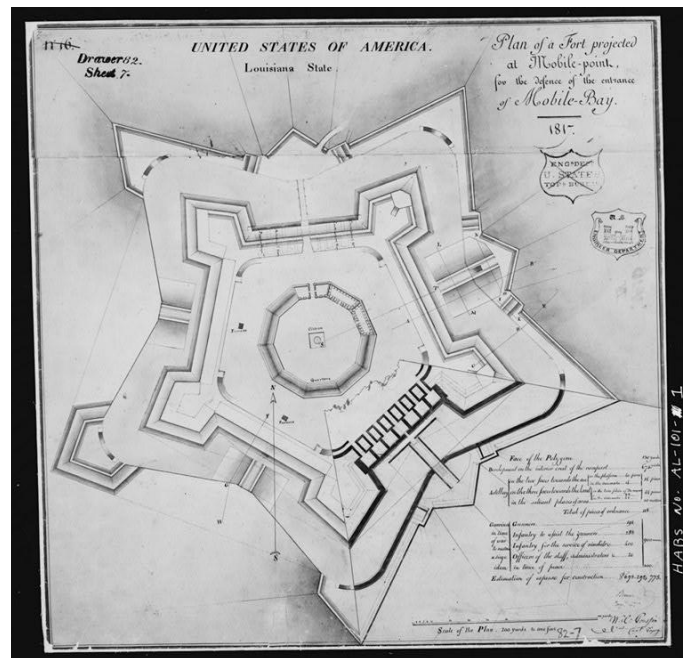


Figure 12: *Plan of Fort Morgan, 1817.* Library of Congress.
<http://hdl.loc.gov/loc.pnp/hhh.al0013/photos.001874p>

⁵¹ Ibid, 130.

⁵² Weaver, 173.

Construction began in 1819 and was not officially complete until 1834. The fort was seized by Alabama militiamen in early 1861 and was modified by Confederate engineers, predominantly with sand used as a strengthening agent for wall reinforcement. On August 9, 1864, Union troops began a siege and bombardment of Fort Morgan that lasted fourteen days. The Confederate troops surrendered, and the fort was once again property of the United States of America.⁵³ In the years following the Civil War, repairs and improvements were made to the fort, including the demolition of the original citadel to make room for the construction of an Endicott Era concrete battery. From 1900 to 1923, it was the largest military base in Alabama. The fort was ordered abandoned until 1941 when it was reoccupied and garrisoned as part of the U.S. military's surveillance of the Gulf Coast during World War II. Fort Morgan was officially decommissioned and abandoned in July of 1944.⁵⁴ Fort Morgan was added to the National Register of Historic Places in 1966.

Fort Gaines

Construction on Fort Gaines began at the same time as Fort Morgan, but the structure was not completed until 1862. Fort Gaines became a lightning rod for perceived overspending, mismanagement concerns and questions about the efficacy of the Third System in light of innovations in artillery. Controversy over Fort Gaines eventually led to Simon Bernard's departure from the Fortifications Board, which allowed Totten to assume the position of Brigadier General. Totten was a firm supporter of the Third

⁵³ Robinson, 138.

⁵⁴ "Fort Morgan State Historic Site: History." Accessed November 17, 2016. <http://www.fort-morgan.org/history/>

System and of the placement of a fort on Dauphin Island, but he was not in favor of Bernard's original plans for Fort Gaines. He lobbied Congress to appropriate funds for the project in 1853, and when the monies were confirmed, he scrapped the star-fort design in favor of a fort in the new French style of detached scarp walls.⁵⁵

Totten's design for Fort Gaines is five sided, but rather than the traditional, pentagonal form of previous Third System forts, it is a truncated hexagon with a full bastion at each corner. The detached scarp wall greatly changed the way the ramparts of the fort were constructed. Like many other Third System forts, Fort Gaines had a glacis that sloped upward to protect the covert way followed by a ditch. In previous designs of the fort, the ditch would have led directly to a fully connected rampart composed of a casemated scarp wall with a parapet, banquette and terreplein. In Totten's design, however, the ditch led to a sacrificial cart wall backed by a chemin-de-ronde and a steeply sloped wall to form the parapet. The new design allowed for prolonged sieges, but meant that the only place for casemates was in the bastions.

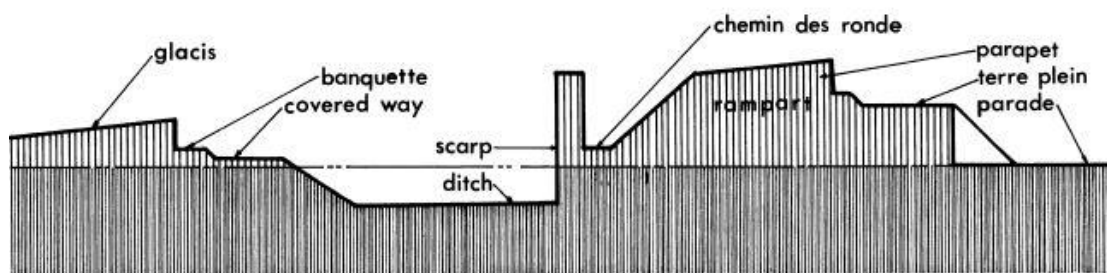


Figure 13: Robinson, Willard B. *Fort Gaines, Elements of Fortification in Profile*. (Robinson, 135)

⁵⁵ Weaver, 175.

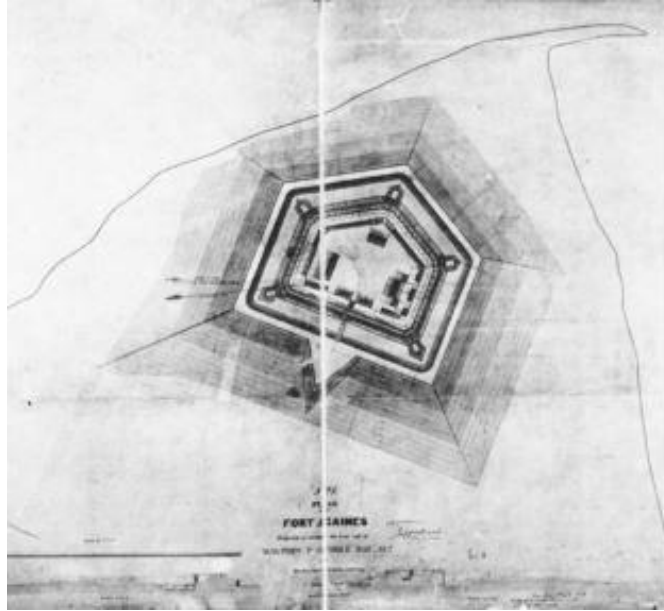


Figure 14: *Plan of Fort Gaines*, 1845. J.G. Totten, engineer. National Archives. (Reproduced in Robinson, 134)

Construction at Fort Gaines was ongoing when the fort was seized by the Alabama militia in January of 1861. The Confederates continued work at the fort, and declared it complete in 1862.⁵⁶ In August of 1864, Fort Gaines saw its only battle - the Battle of Mobile Bay. Union Navy troops led by Admiral Farragut and Union Army troops led by Major General Canby attacked Fort Gaines on August 5 and bombarded the fort for three days until the Confederate troops surrendered. Fort Gaines was repaired and strengthened in the years after the war and, like Fort Morgan, received an Endicott Era concrete battery within the enceinte. Fort Gaines was garrisoned in World Wars I and II for surveillance and protection of the Gulf of Mexico.

⁵⁶ Robinson, 136.

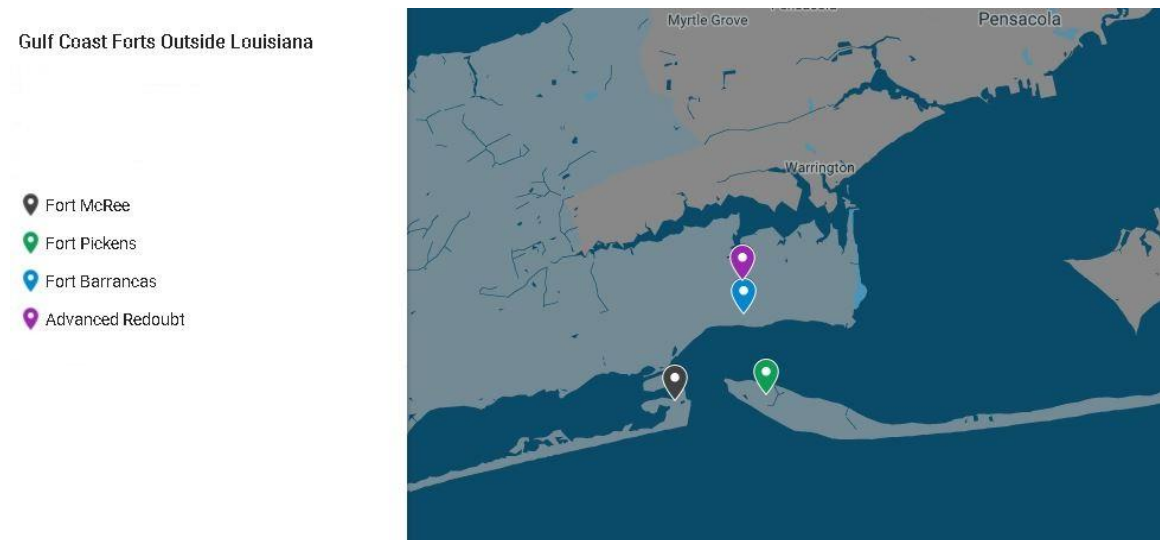
The United States sold Fort Gaines to the City of Mobile in 1926. The city in turn gave the property to the Alabama Department of Conservation, which later deeded it to the Dauphin Island Park and Beach Board.⁵⁷ Fort Gaines was added to the National Register of Historic Places in 1976.

Forts on the Gulf Side of Florida

Three Third System forts and one subsidiary structure were built on the Gulf Coast of Florida for the protection of Pensacola Bay. Two long, narrow barrier islands provide natural protection for most of the harbor making fort placement somewhat straightforward for Bernard. Fort Pickens was built on the westernmost point of Santa Rosa Island, and Fort McRee was built on the easternmost point of Perdido Key. These two forts were intended to cinch the channel mouth to Pensacola Bay. The third fort, Fort Barrancas, and its subsidiary structure, Advanced Redoubt, are located on the north shore of Pensacola Bay for backup water defense, should an enemy evade fire from the barrier island forts, and to provide defense from a land-based attack (Map 4).

⁵⁷ *Fort Gaines History and Tour Guide*. Dauphin Island Park and Beach Board.

Map 4: *Third System Forts and Subsidiary Structures of Pensacola Bay, Florida*. Digital Image courtesy of Google Maps. (Created by author July 30, 2017)
<https://www.google.com/maps/d/viewer?hl=en&hl=en&mid=18hM33AmjUwwcJo3W4LQ0TKejGmw&ll=30.33943560219485%2C-87.13506817827147&z=12>.



Fort Pickens

The construction of Fort Pickens began in 1829 under Totten’s guidance, but without design approval from Bernard, who was his superior. The two seaward sides were constructed by the time Bernard discovered the problem, and rather than demolish and restart the project, Bernard simply redesigned the rest of the fort to comply with his design theory. Fort Pickens is unique among Third System forts because it was designed by two engineers, not in collaboration, but in direct opposition. The fort was completed in 1834 by both enslaved and contract builders.

Fort Pickens was designed to be the “headquarters fort for the Gulf Coast, and therefore the largest of all Gulf forts” and provided the primary defense of Pensacola

Bay.⁵⁸ It is an irregular, five-sided brick fort in the form of a compressed pentagon. The long seaward walls are indicative of Totten's plan for a much larger fort, and dwarf Bernard's landward walls making the trace of the fort somewhat awkward compared to others in the Third System. The entire fort reads like an architectural disagreement.

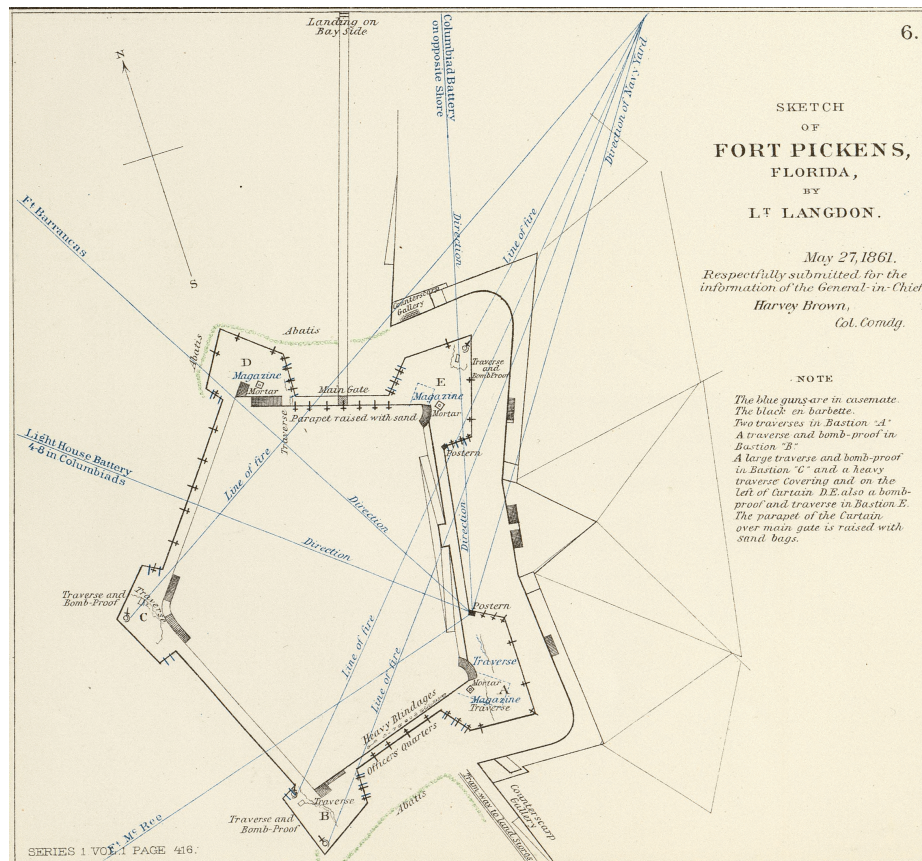


Figure 15: *Sketch of Fort Pickens, Florida*. Lt. Langdon, 1861. Accessed July 30, 2017. https://en.wikipedia.org/wiki/Fort_Pickens#/media/File:Fort_Pickens_map_1861.png.

⁵⁸ Weaver, 160.

The two seacoast fronts are over 1000 feet long and meet in a full tower bastion. At each end of the seacoast front is an oddly shaped bastion that speaks to the Totten-Bernard compromise. The other two bastions are entirely of Bernard's design and are typical of his other Third System forts. The seaward walls are both fully casemated with each casemate connected to its neighbor by an intersecting arch. One such arch is kept roped off from visitors with all the sand dug away to expose its inverted arch support. The landward side of Fort Pickens, which was later buttressed to support the bowing wall, is protected by a gorge and an impressive outwork that brackets the eastern face of the fort with three salient places d'armes and two, flanking rifle galleries.

Fort Pickens never saw major combat, but it has one of the most interesting histories of the Gulf Coast forts. Fort Pickens is one of the few southern forts that did not fall to Confederate forces during the Civil War, though some historians assert that the first shot of the war was fired at Fort Pickens, not Fort Sumter.⁵⁹ Like Fort Pike in Louisiana, it was used as a prison during the Indian Wars, and Apache warrior, Geronimo, was kept there from 1886-1887.⁶⁰ Fort Pickens received an extensive Endicott Era battery in the early 1890s and in 1899, a fire reached the north magazine and blew up the entire bastion at the intersection of the seacoast and landward walls. Fort Pike was garrisoned between World Wars I and II, but was abandoned soon thereafter. The fort is now part of the Gulf Islands National Seashore and is under the jurisdiction of the National Park Service (NPS). It was added to the National Register of Historic Places in 1972.

⁵⁹ Ibid, 13.

⁶⁰ National Park Service, "Apache Prisoners at Fort Pickens," March 2012.

Fort McRee

Fort McRee is the only Third System fort that has been entirely lost to time. Constructed from 1834 to 1839, Fort McRee was badly damaged by Union forces in 1861 and, though repaired, was completely lost to coastal erosion and a series of hurricanes in the late 1890s and early 1900s. Very little of Fort McRee remains today.

Fort Barrancas

Fort Barrancas was built on a site that had been home to numerous forts under both Spanish and British control and is the only hilltop Third System fort on the Gulf Coast. The site for Fort Barrancas was selected not only because of its military advantage, but also because of the late 18th century masonry Spanish water battery already located there. The fort was begun in 1839 and completed in 1844. Very similar to Fort Livingston in Louisiana, Fort Barrancas is kite-shaped in form with its two longer walls “pointed toward the probable route of a land attack...”⁶¹ The shorter seacoast walls of the fort point toward the bay and Fort Pickens just a mile and half across the water. Beyond the enceinte of Fort Barrancas is the old Spanish water battery, which was reinforced and garrisoned in the style of a Third System subsidiary structure, though it looks nothing like a typical Third System battery.

⁶¹ Weaver, 166.

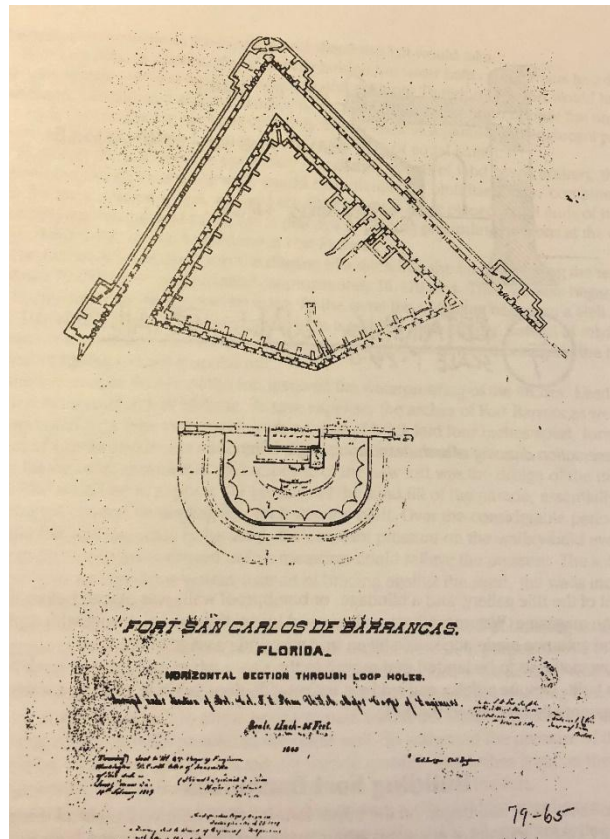


Figure16: *Fort Barrancas as Completed in 1844*. Surveyed by Brevet Colonel F.E. Prime, U.S. Army Corps of Engineers, 1869. Reproduced in “David P. Ogden, *The Fort Barrancas Story*.” (Eastern National, 2010), 7.

Fort Barrancas is unique among Gulf Coast forts in many ways and is an exemplary Totten design. All four walls of the fort are casemated and reinforced with earth and sand both at the ground level and on the wide terreplein. There are no bastions on Fort Barrancas, but plans from the 19th century show one bastion at the point of the counterscarp and an irregular bastion at both end points. Outside the ramparts is a dry ditch crossed by a drawbridge. The ditch runs directly into the counterscarp wall, which has no covert way and is entirely covered by the broad glacis. What an attacker would not know by looking, is that there is a tunnel under the ditch that connects the main fort to the

counterscarp galleries where soldiers could pepper invading forces with bullets from rifles, rather than cannon shot, as they tried to cross the ditch.⁶² There is a second tunnel that connects the water battery to the fort.

Fort Barrancas saw combat only during the Civil War. It was abandoned by Union forces early in 1861 in favor of Fort Pickens, which they correctly asserted was more defensible. Confederate forces took Barrancas and attempted an attack and bombardment of Fort Pickens that lasted a little over four weeks and ended unsuccessfully. Confederate troops abandoned Fort Barrancas in 1862. Like many other Third System forts, Fort Barrancas was used intermittently after the Civil War, but it did not receive an Endicott era concrete battery and thus remains very true to its original design. It was deactivated in the late 1940s and soon thereafter incorporated into Naval Air Station Pensacola. Fort Barrancas was included in the Gulf Islands National Seashore when it was created in 1971 and has been under the continuous management of the National Park Service since. It was designated a National Historic Landmark in 1960 and added to the National Register of Historic Places in 1966.

Advanced Redoubt

Advanced Redoubt is a misnomer. The structure is parallel to Fort Barrancas, not in advance of it. Likewise, a redoubt is an unbastioned work, and Advance Redoubt has two demibastions on its eastern face. Nevertheless, it was named Advanced Redoubt and is classified as such by most researchers. Construction began in 1845 and was completed in 1859, making Advanced Redoubt one of the latest projects completed in the Third

⁶² Ibid, 167.

System. It is also the only Third System structure designed exclusively for land defense and was connected to Fort Barrancas by an earthen trench.

The structure is now part of Naval Air Station Pensacola and the Gulf Islands National Seashore. It is managed by the NPS and is in excellent condition. The exterior of Advanced Redoubt is open daily, but the interior is only accessible as part of a ranger-led tour from Fort Barrancas. Advanced Redoubt is a fine example of Third System fortification and is an important component of the military theory of the Fortifications Board, but the structure itself is not a part of this thesis based on its land-bound location.

Fort Massachusetts, Ship Island, Mississippi

Fort Massachusetts is the only Third System fort built in the State of Mississippi, but its purpose was to protect New Orleans. Fort Massachusetts is on the western end of Ship Island, a barrier island with deep anchorage in the Mississippi Sound that the British used in 1814 to launch their attack on New Orleans⁶³ (Map 5). In 1856, Congress authorized construction on Ship Island as the final link in the chain of forts protecting New Orleans. Construction began in 1859, was halted for a short time during the Civil War and recommenced until 1866.

⁶³ Ibid, 191.

Map 5: *Fort Massachusetts, Ship Island, Mississippi*. Digital Image courtesy of Google Maps.
(Created by author July 30, 2017)
<https://www.google.com/maps/d/viewer?hl=en&hl=en&mid=18hM33AmjUwwcJo3W4LQ0TKejGmw&ll=30.123934370120224%2C-88.3617603779785&z=10>.



Fort Massachusetts is unique among Third System forts on the Gulf Coast as it is predominantly round in form with a flat, demibastioned eastern gorge. Land defenses were not paramount to the fort as its role was almost exclusively to control the harbor and repel enemy ships from making use of the deep anchorage there. There was no moat and no outworks, but there was a sallyport with a drawbridge over a dry pit. As one of the latest Third System forts constructed, Fort Massachusetts utilized several new technologies for the time. The casemate embrasures had “Totten shutters,” iron shutters that opened for cannon fire to be shot and immediately swung closed to protect the gunners. The wall fill at Fort Massachusetts is concrete rather than tabby or simply more masonry.⁶⁴

⁶⁴ Ibid, 193.

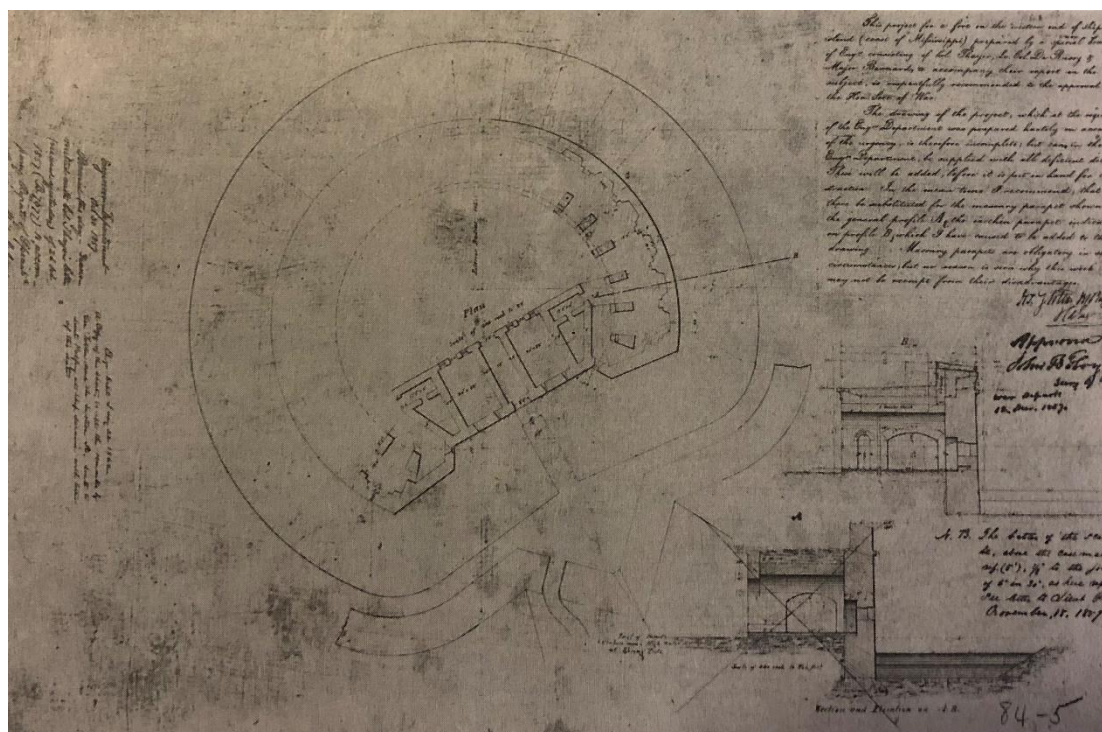


Figure 17: *Plan of Fort Massachusetts, 1857*. Courtesy of the Cartographic Division of the National Archives. (Reproduced in Parkerson, 84)

Fort Massachusetts architecture and historical events are more impressive than its war record. Confederate troops took the fort early in the war and had one uneventful exchange with a Union warship before they abandoned it as indefensible. Union troops retook the fort and continued construction where they had left off in 1861. Following the war, Fort Massachusetts was used as a prisoner of war camp during the Civil War and continued to serve as a prison until 1870. The fort was deactivated, but remained armed and ready until 1903.⁶⁵ Ship Island and Fort Massachusetts became part of the Gulf Islands National Seashore in 1971, and the fort fell under the management of the NPS. It was added to the National Register of Historic Places that same year.

⁶⁵ Parkerson, 86.

The following graph is a visual representation of the cultural and architectural significance of each Third System fort and subsidiary structure in Louisiana and on the Gulf Coast. Cultural significance was determined by a fort's original rank and construction priority; historic events that took place there; and/or the historic figures who designed, built, were stationed or imprisoned at the site. Architectural significance was determined by whether a fort was the first of its style in the Third System, showcases unique or innovative technology of the time, or is distinct from other Third System forts.

Table 1: *Ranking of Cultural and Architectural Significance of Third System Forts in Louisiana and the Gulf Coast.* Author, 2017.

State	Fort	Cultural Significance	Architectural Significance
Louisiana	Fort Pike	High	High
	Fort Macomb	Medium	Medium
	Fort Jackson	High	High
	Fort Livingston	Low	Low
	Battery Bienvenue	Low	N/A
	Tower Dupré	Low	N/A
	Fort Proctor	Low	Low
Mississippi	Fort Massachusetts	Medium	High
Alabama	Fort Gaines	High	Medium
	Fort Morgan	High	High
Florida	Fort Pickens	High	High
	Fort Barrancas	Medium	Medium
	Advanced Redoubt	Low	Low

CHAPTER 4

SEA LEVEL RISE AND COASTAL WETLANDS LOSS

Chapter 3 presented the history and cultural significance of each Third System fort in Louisiana and along the Gulf Coast. This chapter explores rates of sea level rise, land subsidence and coastal erosion in southeast Louisiana compared to the greater Gulf Coast and global averages. Analysis of the geological and anthropogenic causes of land loss and relative sea level rise highlights the precarious position of Louisiana's Third System forts and lays the groundwork for supporting the claim that land subsidence and sea level rise are their most significant threats.

Sea level rise is a quantifiable, global phenomenon, but the world's oceans are not all rising at the same rate. Wave patterns, ocean floor topography, coastal land hydrology, human interference and latitudinal location, among other things, all contribute to a local shoreline's relative rate of sea level rise. This section uses global sea level rise data as a contrast to data that focuses on the Gulf Coast as a whole and coastal Louisiana, specifically.

The National Aeronautics and Space Administration's (NASA) Global Climate Change webpage asserts, "Sea level rise is caused primarily by two factors related to global warming: the added water from melting land ice and the expansion of sea water as it warms."⁶⁶ According to NASA, the global rate of sea level rise from 1993 to the

⁶⁶ "Global Climate Change: Vital Signs of the Planet, Sea Level," *NASA*, accessed January 2, 2017, <https://climate.nasa.gov/vital-signs/sea-level/>.

present is 3.4 millimeters (mm) per year with a margin of error of ± 0.4 mm.⁶⁷ That is an increase of ~ 3.2 inches in global sea levels in just twenty-four years. Projections for future rates of sea level rise are sobering. The United States Geological Survey (USGS), citing research from numerous scientists, projects sea levels in the year 2100 to be at least ~ 0.6 to 1.5 meters (m) higher than current levels with some scientists forecasting a rise of as much as ~ 2 m “under extreme warming scenarios.”⁶⁸

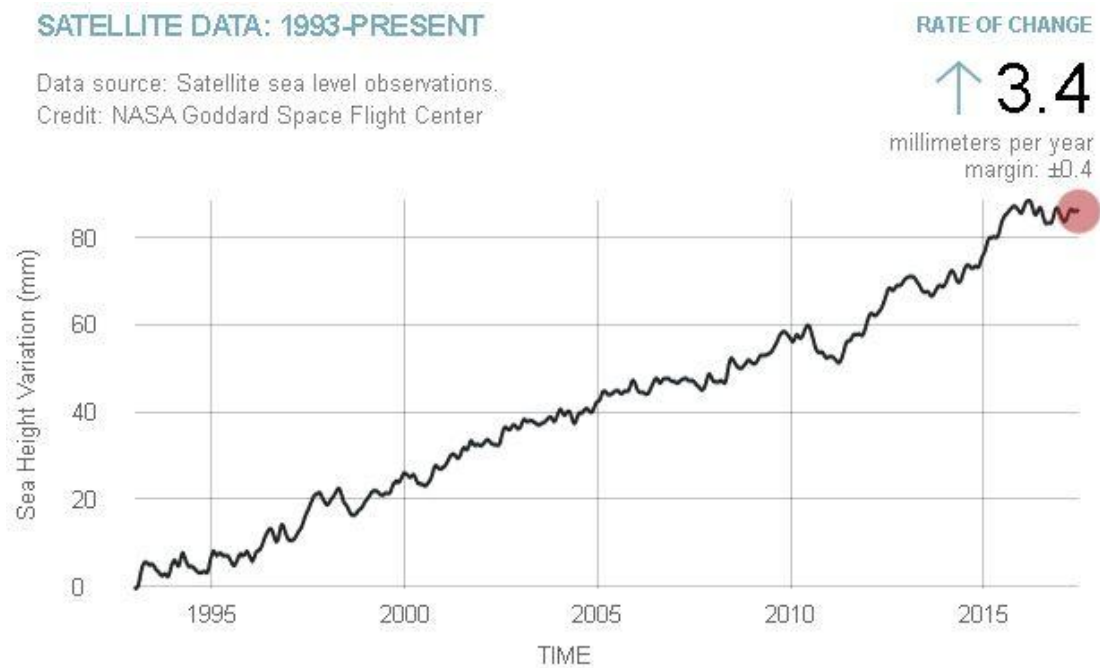


Figure 18: *Sea Level Rise in Millimeters over Time*. Digital Image courtesy of NASA. Accessed July 30, 2017. <https://climate.nasa.gov/vital-signs/sea-level/>.

Sea level rise alone is concerning enough, but there are two other geological processes that further contribute to rates of coastal land loss: land subsidence and coastal

⁶⁷ Ibid

⁶⁸ “Sea Level Rise,” USGS, accessed January 2, 2017, <https://wh.er.usgs.gov/slr/sealevelrise.html>

erosion. The USGS defines land subsidence as “a gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials.”⁶⁹ There are many reasons why land sinks: natural resource extraction, tectonic movement, soil compaction and liquefaction, among others. Like sea level rise, land subsidence is a global issue with rates of change that differ from location to location. In fact, some parts of the world are seeing land uplift, typically as the result of shifting tectonic plates. Concurrently, Glacier Bay National Park on the Gulf of Alaska is experiencing the some of the world’s fastest rates of land uplift and sea level decline,⁷⁰ while coastal Louisiana on the Gulf of Mexico is experiencing the some of the world’s fastest rates of land subsidence and sea level rise.⁷¹

Coastal erosion is land loss not due to sinking, but rather to sediment being washed away. The National Oceanic and Atmospheric Administration (NOAA) describes coastal erosion as “the process by which large storms, flooding, strong wave action, sea level rise, and human activities wear away beaches and bluffs along coastlines.”⁷² Coastal erosion is another global problem with rates that are relative to a shoreline’s location. Erosion, like land subsidence, is a process that is both incremental and catastrophic. Barrier islands, mainland shores and wetland estuaries lose sediment every day, but it is

⁶⁹ “Land Subsidence,” *water.usgs.gov*, last modified December 29, 2016, <https://water.usgs.gov/ogw/subsidence.html>

⁷⁰ Roman J. Motyka, Christopher F. Larsen, Jeffrey T. Freymueller and Keith A. Echelmeyer, “Post little Ice Age Rebound in Glacier Bay National Park and Surrounding Areas,” *fairweather.alaska.edu*, accessed February 21, 2017, <http://fairweather.alaska.edu/chris/motyka.pdf>

⁷¹ USGS, “Subsidence and Sea-Level Rise in Southeast Louisiana: Implications for Coastal Management and Restoration,” March 2000, <https://pubs.usgs.gov/of/2000/0132/report.pdf>

⁷² “Coastal Erosion,” *U.S. Climate Resilience Toolkit*, last modified July 6, 2016, <https://toolkit.climate.gov/topics/coastal-flood-risk/coastal-erosion>

not necessarily an obvious loss. At other times, such as after storms, significant losses of sand and wetlands are easily observable.

Even conservative estimates for sea level rise leave coastal landscapes and structures in jeopardy. As sea levels increase, coastal areas will have to prepare for more frequent and more impactful flooding, increased storm frequency and intensity, as well as ecosystem degradation from sea water intrusion. Such activity often leads to the stress and possible failure of infrastructure systems including water and waste management, roads and bridges, and the communication and power grids.⁷³ As evidenced by Hurricanes Katrina and Sandy, unusually strong storms and flooding in densely populated, urban areas can lead to catastrophic losses of buildings, ecosystems and human lives.

Focusing on the Gulf Coast, rates of sea level rise are more extreme than the global average. The extremity of relative sea level rise along the Gulf Coast is the result of many factors. The coastline sits at a latitude of roughly 30°N, where the water is warmed so that it expands in volume to raise sea levels and is capable of sustaining extremely strong hurricanes for extended periods of time. Those storms, in turn, have the potential to devastate barrier islands and mainland coast line, thus allowing the ocean a farther reach inland. Additionally, the landscape of the gulf is very flat. Unlike coastlines in Oregon and Northern California where water can be hundreds of feet below the land level and sea level rise is less noticeable, the coastline running from Louisiana to Florida

⁷³ “Climate Impacts in the Southeast,” *United States Environmental Protection Agency*, accessed January 9, 2017, <https://www.epa.gov/climate-impacts/climate-impacts-coastal-areas#ref6>

has a slope of as little as 0.02% to as much as 0.5%.⁷⁴ Even minimal sea level rise is immediately noticeable on a beach so flat.

Higher than average rates of relative sea level rise in the Gulf of Mexico are the result of more extreme coastal erosion and land subsidence, both of which are due to a series of natural processes and human interferences which overlap to encourage, in some areas, extreme land loss. At its most basic level, coastal erosion is “initiated by the movement of water in the form of high waves and strong currents.”⁷⁵ In terms of natural processes, the Gulf of Mexico has a distinct loop current that pushes northward between the Yucatan Peninsula and the west end of Cuba, sometimes simply curving around Cuba and exiting the Gulf below the southern tip of Florida. Other times, the loop current protrudes up toward the panhandle of Florida, and once or twice per year, the bulging loop will shed “a clockwise rotating ring of warm water,” or eddy, that acts as a fuel source for potential hurricanes.

⁷⁴ E. Robert Thieler and Erika S. Hammar-Klose, “National Assessment of Coastal Vulnerability to Sea-Level Rise: Preliminary Results for the U.S. Gulf of Mexico Coast,” *USGS.gov*, (2000) <https://pubs.usgs.gov/dds/dds68/reports/gulfrep.pdf>

⁷⁵ Robert A. Morton, “An Overview of Coastal Land Loss: With Emphasis on the Southeastern United States,” (St. Petersburg, FL: USGS Center for Coastal and Watershed Studies, 2003), 3.

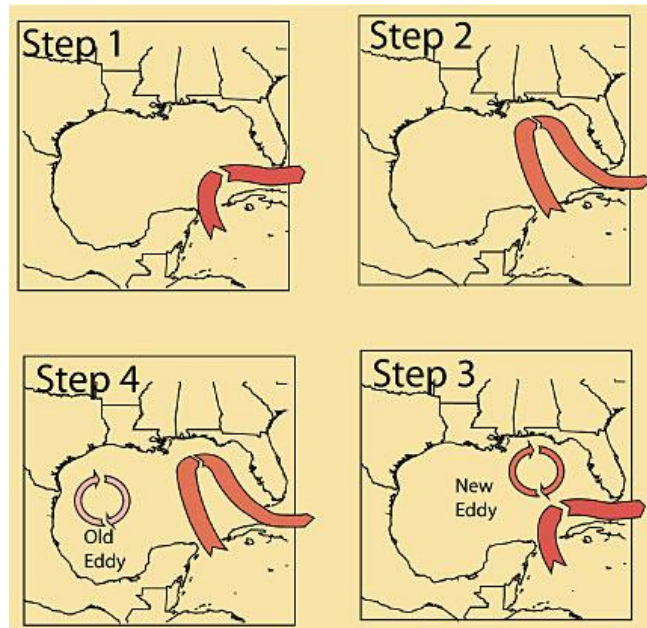


Figure 19: *Gulf Loop Current*. Digital Image courtesy of NOAA. Accessed July 30, 2017. http://oceanexplorer.noaa.gov/explorations/02mexico/background/currents/media/gulf_loop.html.

Both Hurricanes Katrina and Rita passed over such an eddy in the summer of 2005 and went on to become two of the most damaging Category 5 storms ever to hit the Gulf Coast.⁷⁶ Dauphin Island, site of Fort Gaines, was cut in half by Hurricane Katrina. Farther west, the Chandeleur Islands of Louisiana lost 85% of their visible sand from the same storm.⁷⁷

Some amount of land subsidence in the Gulf of Mexico would occur with or without human interference because of flexing and faulting of the lithosphere, which is

⁷⁶ Jeffrey Masters, "The Gulf of Mexico Loop Current: A Primer," *WeatherUnderground.com*, accessed February 27, 2017, <https://www.wunderground.com/hurricane/loopcurrent.asp>

⁷⁷ Asbury Sallenger, Wayne Wright, Jeff Lillycrop, Peter Howd, Hilary Stockdon, Kristy Guy, and Karen Morgan, "Extreme Changes to Barrier Islands Along the Central Gulf of Mexico Coast During Hurricane Katrina," *USGS Circular 1306* (2007), https://pubs.usgs.gov/circ/1306/pdf/c1306_ch5_c.pdf.

the rigid crust and upper mantle of the earth. As the earth formed and tectonic plates shifted, sediments were deposited in varied and uneven strata for millions of years creating areas of uneven compressive strength. Flexing of the lithosphere is generally related to volcanic activity, a geological process not present in the Gulf of Mexico. As such, the USGS attributes less than 1mm/year of land subsidence in the Gulf to flexure of the lithosphere. Faulting, on the other hand, is considered a “potentially large factor” in land subsidence, particularly in coastal Louisiana.⁷⁸

Growth faults are common in the Gulf Coast and are defined by the USGS as “fault(s) along which movement occurs as sediments are deposited on and above the fault scarp.”⁷⁹ Such faults are often present at the edges of continental shelves, exactly where the Gulf Coast lies, and are a good indication of oil and gas deposits – an important factor that will be discussed later. As the weight of upper layers of sediment presses on the uneven and possibly less dense layers below, a break or fault is created that allows an entire section of the lithosphere to slip down and away from another section. Faults not at the boundary of separate continental plates are smaller in scale and “may occur in discrete areas... (and) is the more frequent case in Louisiana.”⁸⁰

⁷⁸ “Subsidence and coastal Geomorphic Change in South-Central Louisiana,” *USGS.gov*, last modified December 5, 2016, <https://coastal.er.usgs.gov/geo-evo/research/la-subsidence.html>.

⁷⁹ “Glossary of Terms,” *USGS.gov*, accessed March 3, 2017, <https://pubs.usgs.gov/mf-maps/mf1136/mf1136/glossary.htm>.

⁸⁰ Brendan Yuill, Dawn Lavoie and Denise J. Reed, “Understanding Subsidence Processes in Coastal Louisiana,” *Journal of Coastal Research*, Special Issue No. 54. Geologic and Environmental Dynamics of the Pontchartrain Basin (Fall 2009), 23-36., p 25.

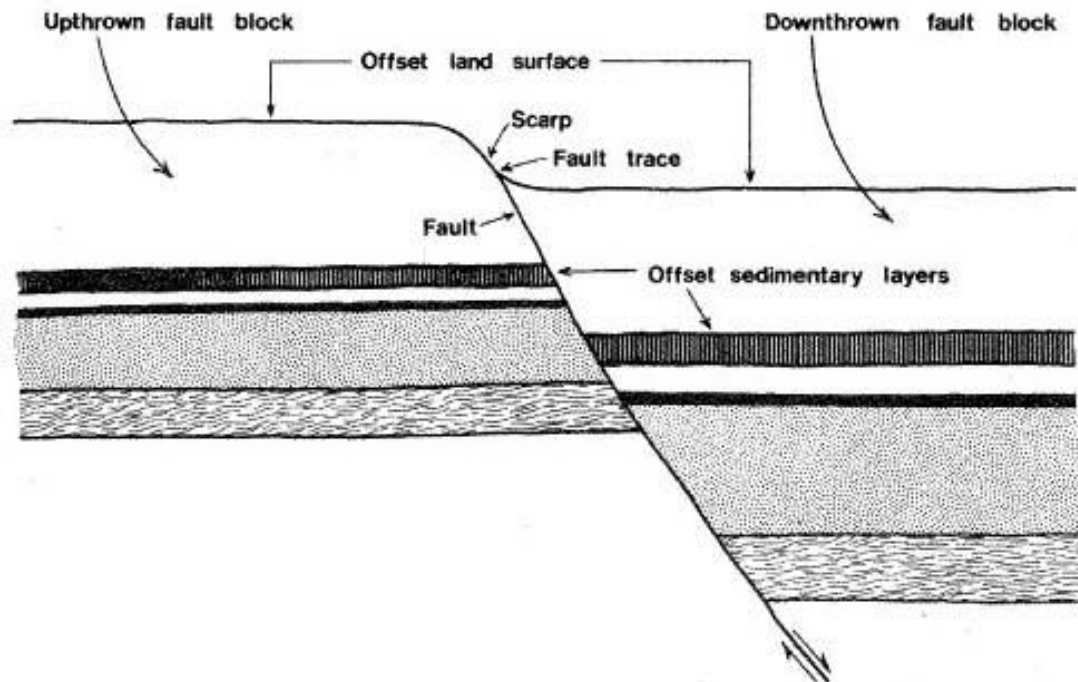


Figure 20: *Vertical Section Through a Hypothetical Fault*. Digital Image courtesy of USGS. Accessed July 30, 2017. <https://pubs.usgs.gov/mf-maps/mf1136/mf1136/fig8.htm>.

Faults exist across the entire Gulf Coast, both on the land within the continental shelf and in the ocean as part of the oceanic shelf, but the number of faults and rates of fault-related subsidence are higher in and around coastal Louisiana. The increased number of faults on the eastern side of the Gulf coast is due to subterranean salt deposits and the Mississippi River delta. Deep below the ground in both shelves are pockets of salt known as salt diapirs. Deposits of salt are less dense than the sediments surrounding them, so they migrate upward in a dome creating “new radial fault zones extending

outward” very slowly over millennia. The fault lines are where gravitational slumping and subsidence eventually occurs.⁸¹

The Mississippi River delta naturally contributes to growth faults by its mere existence. As the river was forming, it flowed southward and deposited sediment across the northern Gulf in the early Paleocene era, 56 to 66 million years ago. “Large scale shifts in Mississippi River hydrology associated with glacial cycles have stripped and redeposited sediment in the Gulf many times” creating deposits with an “east-west orientation, perpendicular to the direction of delta growth... that may induce detachment and the formation of fault zones.”⁸² Additionally, the weight of the water and suspended sediment compress the softer delta soil and exacerbate weak points leading to fault slips.

Worldwide, relative sea level rise is among the worst at river deltas with “localized maximum rates of sea level rise... from four feet per century in part of the Mississippi Delta... to ten feet per century on some small deltas on the Pacific Coast of Colombia,” and these numbers cannot be attributed to faults and flexing of the lithosphere, alone.⁸³ The anthropogenic reasons for extreme relative sea level rise at river deltas are numerous as stated by Duke Professor Emeritus of Geology and Earth and Ocean Sciences, Orrin H. Pilkey,

The sinking of land causing such high rates of sea level rise is due to the natural compaction of muds, often exacerbated by oil and water extraction, and the construction of dams upstream, which reduce sediment supply. The construction

⁸¹ Ibid, 25.

⁸² Ibid, 25.

⁸³ Orrin H. Pilkey and Keith C. Pilkey, “Global Climate Change: A Primer,” (Durham and London: Duke University Press, 2011), p 93.

of canals on deltas removes sediment-trapping marshes and mangrove swamps that help to add land and elevation on deltas.⁸⁴

The Mississippi River has all of the risk factors listed by Pilkey. Decades of oil extraction has led to compacting mud and land subsidence. The upper Mississippi River has 29 locks and dams trapping sediment and altering water flow, and the delta is home to numerous man-made canals where once there was thriving marshland.⁸⁵

Before human interference, the Mississippi River changed course every “several hundred or several thousand years... (and) writhed sideways across the delta seeking a new and more efficient course to the sea.”⁸⁶ The change of course benefitted South Louisiana and the Gulf of Mexico in two main ways. First, it diversified the locations of sediment deposits allowing for the creation and replenishment of barrier islands. Second, it moved the compressive weight of the river and its suspended sediment so that the earth’s crust below was less likely to fault and subside. Naturally, the lower Mississippi River is a curvy, meandering river, which is excellent for flood-related sediment deposition, but not very useful for people wanting to ship goods to the American interior. Additionally, the Mississippi carries so much sediment and moves so slowly at times, that flooding was a common occurrence. Flooding was beneficial for adding fertile sediment to the soil, but bad for established crops and developed urban areas. To the early colonizers of Louisiana, levees and canals were the answer.

⁸⁴ Ibid, 93.

⁸⁵ “Locks & the River: A boater’s Guide to safe travel on the Upper Mississippi River & the Illinois Waterway,” *U.S. Army Corps of Engineers*, accessed March 3, 2017, <http://www.mvr.usace.army.mil/Portals/48/docs/Nav/LocksAndRiver.pdf>.

⁸⁶ Abby Sallenger, *Island in a Storm: A Rising Sea, A Vanishing Coast, and a Nineteenth Century Disaster That Warns of a Warmer World*, (Philadelphia, PA: Public Affairs Press, 2009) , 42

The Lake Pontchartrain Basin is a section of southeast Louisiana that extends from the southeastern state line inward to Baton Rouge and from the northshore parishes of East Feliciana, St. Helena, Tangipahoa and Washington to the river parishes, terminating at farthest point of Plaquemines Parish. The Lake Pontchartrain Basin is the location of the earliest and most intensive human alterations to Louisiana's landscape and is home to all but one of the state's Third System forts. For the purposes of this thesis, the Lake Pontchartrain Basin will be the focus of study for anthropogenic factors relating to Louisiana's rates of land subsidence, coastal erosion, wetlands loss and relative sea level rise. Grand Terre Island, which lies just to the west of the basin, will be analyzed with the other barrier islands.



Figure 21: *Lake Pontchartrain Basin Map*. Digital Image courtesy of the Lake Pontchartrain Basin Foundation. Accessed July 30, 2017. <http://saveourlake.org/about-us/about-lpbf/management-plan/>.

The first man-made levee on the Mississippi River was constructed by 1727, and today, the lower Mississippi Valley is home to thousands of miles of levees, floodwalls, spillways and other control structures.⁸⁷ Prior to the levees, the flood-waters of the Mississippi River fed not only the somewhat higher ground that would be made into the first plantations, but also the low lying cypress bayous and swamps that define South Louisiana. The trees and plants growing in those swamps and bayous “shed tons of dead parts each year, adding to the soil base” and contributing to land accretion.⁸⁸ By forcing the river to maintain its 18th century course and by artificially limiting the rejuvenating floods, early Louisianans began a process that has resulted in some of the highest rates of land subsidence and coastal erosion in the world.

French colonizers selected the site for New Orleans based on its relatively high ground. Ironically, that high ground was the result of regular flooding. Abby Sallenger, Ph.D., former chief scientist of the USGS Center for Coastal Geology and current leader of the USGS Storm Impact Research Group writes:

When the river swelled over its banks, sediments fell from the water and built the ground vertically. Most of the sediment accumulated close to the channel, leaving the ground highest there. With each successive overflow, the accumulated sediments grew progressively higher, developing into rims that could contain small floods but were overwhelmed by large ones.⁸⁹

⁸⁷ “Evolution of the Levee system Along the Mississippi,” *Missouri University of Science and Technology*, last accessed March 3, 2017, <http://web.mst.edu/~rogersda/levees/Evolution%20of%20the%20Levee%20System%20Along%20the%20Missi%20ssippi.pdf>.

⁸⁸ Bob Marshall, “Louisiana is Drowning, Quickly,” *ProPublica* and *The Lens*, last modified 2014, <http://projects.propublica.org/louisiana/#>.

⁸⁹ Sallenger, *Island in a Storm*, 14.

The millennia of overflows created both high land and natural levees, the latter of which was artificially augmented almost as soon as the city began to be developed.

More available land meant more people, more development, and eventually the need for canals to get people and goods across the city without having to navigate the curving and sometimes sediment-locked Mississippi River. The first canal was begun in 1794. The Carondelet Canal, named for Governor Carondelet connected Bayou St. John to the French area of town. The second canal, the New Basin Canal, was completed in 1838 to serve the American section of New Orleans. The canals contributed to economic growth that inspired great numbers of people to migrate to the area, which in turn required the construction of more levees and the expansion of land development into what had been cypress swamps to the north and west of the original Vieux Carré.

Outside of New Orleans, the Lake Pontchartrain Basin was a sparsely populated area of indigo and later sugar plantations that fronted the Mississippi River. There were more than 1300 sugar plantations by 1850, and many of those were in the “core of sugar production” of the basin between New Orleans and Baton Rouge.⁹⁰ “The plantation-based economic corridor established along the river was a threatened asset that escalated the construction of more-continuous, higher, and more institutionalized levees.”⁹¹ Plantation owners preferred controlling the river to avoid crop losses and virtually guarantee profit to replenishing the land with flood waters. Following the Civil War, Mississippi River flood control became a federal priority. The U.S. Army Corps of

⁹⁰ Ibid, 29.

⁹¹ John A. Lopez, “The Environmental History of Human-Induced Impacts to the Lake Pontchartrain Basin in Southeastern Louisiana since European Settlement–1718-2002,” *Journal of Coastal Research*, Special Issue No. 54. Geologic and Environmental Dynamics of the Pontchartrain Basin (Fall 2009):1-11., 5.

Engineers was brought in to manage the river, and by the late 1920s the construction of modern levees and the Bonnet Carré and Morganza Spillways resulted in successful river management.⁹²

Successful river management from an economic standpoint does not equate success for the ecosystem. An estimated 348,000 acres of wetlands in the delta area lost their “hydrologic connection to the river.”⁹³ For thousands of years the Mississippi River flooded and fed the surrounding wetlands with fresh water to sustain plants and sediment, which counteracted the natural process of subsidence with accretion. Breaking that connection has led to profound and ongoing consequences. According to John A. Lopez, Coastal Program Coordinator at Lake Pontchartrain Basin Foundation, “severing the river from Louisiana wetlands in the 19th century is a primary cause of wetland degradation seen in the 20th century.”⁹⁴ The wetlands no longer had a fresh water source, and there was no geological process to counter natural land subsidence.

Following the Civil War and the decline of Louisiana’s plantation-based economy, a new boom and bust economy was formed around commercial logging in the Lake Pontchartrain Basin. By 1890, the demand for lumber in the burgeoning East Coast paired with innovations in logging technology led to massive deforestation of south Louisiana’s cypress-tupelo and longleaf pine forests. Once the land was completely deforested, owners no longer had an interest in investing and left the land to become fresh marshes or pasture, “permanently changing the structure and plant community” of the

⁹² Ibid, 5.

⁹³ Ibid, 5.

⁹⁴ Ibid, 5-6.

basin.⁹⁵ The last stand of old growth cypress in Louisiana was reportedly logged in mid 1950s, and because reforestation was not a part of the logging industry at the time, 2,783,000 acres, or 45% of the basin, was negatively impacted by logging, which led to further wetlands loss.⁹⁶

At the same time that cypress-tupelo swamps were being logged, oil derricks were springing up across the state of Louisiana, particularly the coastal south. Natural oil springs had been used by people in Louisiana for hundreds of years. Native Americans used crude oil as medicine, Hernando DeSoto and his fellow sailors used the bubbling crude to patch their ships, and by the early 1800s, Louisianans were using the oil that oozed from the ground to lubricate wagon wheels.⁹⁷ By the late 1890s, however, the industrial use of petroleum made what had been an unimpressive geologic feature into a magnet for enterprising oilmen.

Early success at derricks in southwestern Louisiana led to exploration within the Lake Pontchartrain Basin, which was rich with oil deposits, as the aforementioned growth faults and salt diapirs would indicate. By the 1930s, oil companies were rushing to southeast Louisiana and were building oil derricks as quickly as possible. Unfortunately, extracting oil and natural gas from the earth has lasting implications for the structural integrity of the ground. “Evidence suggests that areas that experienced the highest rates of hydrocarbon production in the past also experienced the highest rates of subsidence.”⁹⁸

⁹⁵ Ibid, 6.

⁹⁶ Ibid, 6.

⁹⁷ Kenny A. Franks and Paul F. Lamber, *Early Louisiana and Arkansas Oil: A Photographic History 1901-1946*, (College Station, TX: Texas A&M University Press, 1982), 3-4.

⁹⁸ Yuill, Lavoie and Reed, “Understanding Subsidence Processes in Coastal Louisiana,” 30.

As large amounts of hydrocarbon along with fluid groundwater are withdrawn from the earth, the weight of the land above presses down to fill the newly emptied space, and whether imperceptible or catastrophic, the land subsides.

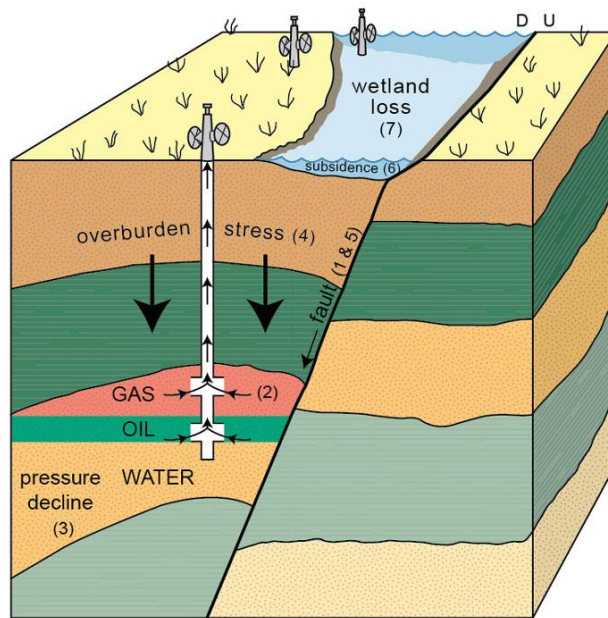


Figure 22: *Sequence of Production-Related Subsurface Events That May Induce Land Subsidence and Reactivate Faults*. Digital Image courtesy of USGS. Accessed July 30, 2017, <https://coastal.er.usgs.gov/gc-subsidence/induced-subsidence.html>.

The oil extracted from the earth had to be transported to a refinery, so canals were dredged through delicate wetlands with no thought to the ecosystem they were disturbing. “When companies dredged canals, they dumped the soil they removed alongside, creating ‘spoil levees’ that could rise higher than ten feet and (sprawl) twice as wide.”⁹⁹ The compressive weight of the spoil levees caused the soft marsh ground to sink, often leaving just enough of the spoil levee to block floodwaters that would have supplied

⁹⁹ Marshall, “Louisiana is Drowning, Quickly,” <http://projects.propublica.org/louisiana/#>.

needed sediment.¹⁰⁰ Dredged canals also funneled sea water much farther inland than it would reach naturally, killing the fresh water plants, robbing the land of a chance at accretion and allowing vast expanses of wetlands to be swallowed by the sea.



Figure 23: *Canals Dredged by the Energy Industry South of Lafitte*. Riedell, Jeff. Digital Image courtesy of The New York Times. Accessed July 30, 2017. <https://www.nytimes.com/interactive/2014/10/02/magazine/mag-oil-lawsuit.html>.

Hoping to increase profits by extracting oil not only from the Lake Pontchartrain Basin, but from offshore deposits as well, oil companies moved work to the Gulf of Mexico beginning in 1938, eventually building more than 7,000 offshore oil and gas rigs

¹⁰⁰ Ibid

there.¹⁰¹ Those rigs required additional oil and gas transport, and Congress authorized the U. S. Army Corps of Engineers to dredge an additional 550 miles of navigation channels through the south Louisiana wetlands. The canals averaged twelve to fifteen feet deep and 150 to 500 feet wide with a statewide coastal wetlands loss of 369,000 acres.¹⁰² Extensive oil industry canal dredging is responsible for an estimated range of wetlands loss within the Lake Pontchartrain Basin from 30% to nearly 100% based on the cumulative negative impacts the canals created.¹⁰³

The final major anthropogenic factor leading to wetlands loss in the Lake Pontchartrain Basin area of Louisiana is water pollution, much of it related to the oil and gas industry. According to Lopez, by 1951, 45 oil and gas fields were in operation along the Mississippi River in what was called the “petrochemical corridor.” Until the 1980s, these oil and gas fields “were allowed to discharge saline ‘produced water’ directly into wetlands” killing freshwater plants and animals.¹⁰⁴ Large scale fish kills and the near extinction of the state bird led to environmental activism and eventual progress in the form of protective legislation. Passage of the Clean Water Act in 1972 and the Oil Spill Act of 1980 greatly reduced, but did not eradicate the disposal of known pollutants into wetlands areas. As recently as 2005, an estimated 40 billion gallons of toxic flood waters were pumped into Lake Pontchartrain in an effort to drain and clean New Orleans in the aftermath of Hurricane Katrina. The lake was studied in the months after the disposal,

¹⁰¹ “Artificial Reef Program,” *Louisiana.gov*, accessed March 14, 2017, <http://www.wlf.louisiana.gov/fishing/artificial-reef-program>

¹⁰² Marshall, “Louisiana is Drowning, Quickly,” <http://projects.propublica.org/louisiana/#>.

¹⁰³ Lopez, 9.

¹⁰⁴ Ibid, 9.

and it was discovered that the contaminants and debris had exited the lake by way of the Pass Rigolets, home of Fort Pike; Chef Menteur Pass, site of Fort Macomb; and the wetlands between Lakes Pontchartrain and Borgne.¹⁰⁵

Moving east from the Lake Pontchartrain Basin to the states of Mississippi, Alabama and Florida, the geologic and anthropogenic histories do not result in the same rates of land loss and sea level rise that they do in Louisiana. The two factors that contribute most to these three states' better relative rates of sea level rise and land subsidence are the absence of a major river delta and fewer growth faults near their coastlines. The land is naturally higher and has fewer valuable, coastal oil and gas deposits. Both Mississippi and Alabama have oil and gas deposits off shore, and both have a significant number of offshore oil rigs within sight of their respective barrier islands, but the numbers pale in comparison to those in the Gulf of Mexico south of Louisiana. Likewise, the pipelines connecting those rigs to refineries on shore are minimal in comparison to Louisiana's. The panhandle of Florida has never been a major oil producer, so rigs and wells have always been few. A 2006 moratorium on offshore drilling and exploration in the eastern Gulf of Mexico further protects Florida from petroleum industry related damage.¹⁰⁶

¹⁰⁵ P. Thomas Heitmuller and Brian C. Perez, "Environmental Impact of Hurricane Katrina on Lake Pontchartrain," *USGS Circular 1306* (2007), https://pubs.usgs.gov/circ/1306/pdf/c1306_ch7_g.pdf

¹⁰⁶ Gulf of Mexico Energy Security Act of 2006, 109 U.S.C. § 3711 (2006), <https://www.boem.gov/GOMESA/>

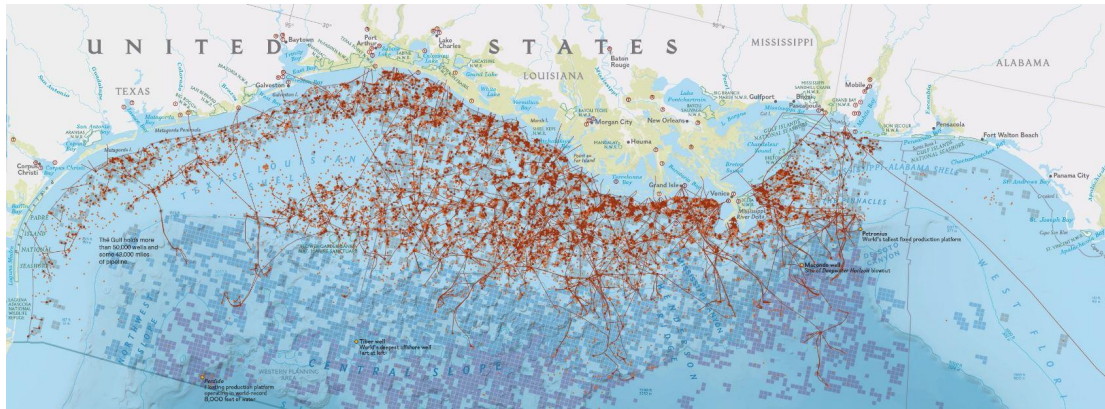


Figure 24: *Map of Oil and Gas Wells, Pipelines and Platforms Found in the Gulf of Mexico*. September 2010. Digital Image courtesy of National Geographic. Accessed July 30, 2017. <https://www.nationalgeographic.org/hires/gulf-mexico-geography-offshore-oil/>.

According to research published by NOAA, the waters at Pensacola, Fla., location of Forts Pickens and Barrancas, rose at a rate of 2.25mm/year from 1923 to 2015, accounting for ~8 inches of sea level rise in ninety-two years, actually less than the global average. Dauphin Island, Ala., site of Fort Gaines, saw an average yearly sea level rise of 3.3mm from 1966 to 2015, equivalent to a 1.08 foot increase in sea level per one hundred years, in line with the current global average. Grand Isle, La., neighboring barrier island to Fort Livingston's Grande Terre, has the worst rates of sea level rise of the three sites studied. From 1947 to 2015, the average rate of relative sea level rise was 9.05mm/year, accounting for an increase of 2.97 feet in one hundred years. Inland Louisiana proves that sea level rise is not solely a coastal problem. New Canal Basin on Lake Pontchartrain at

the north end of New Orleans saw a 4.71mm/year rise in water levels from 1982 to 2015, a change that indicates an increase in water level of 1.55 feet in 100 years.¹⁰⁷

Focusing on the Third System fort locations outside of Louisiana, it is also important to note that they lie not in areas of coastal wetlands, but rather on barrier islands and long, narrow peninsulas. Barrier islands are interesting geological features formed over thousands of years in places where the coastline has a gentle slope and where a constant supply of sediment was provided. They likely began as mainland beaches or raised shoals with marshes fed by freshwater from the rivers on the landward side. When their respective rivers changed courses, the marshes lost their freshwater supply, starved, and subsided leaving the sand on the gulf side as a long band of beach with the ocean on one side and a bay on the other.¹⁰⁸ In the Gulf of Mexico, each of the barrier islands studied sits on a bay at the mouth of a river.

Barrier islands are constantly changing form. Sediment is transported by waves and winds in somewhat predictable ways so that a barrier island will subtly change shape or even location over time, but that predictable movement is dependent on the movement of sand, or littoral drift. Through wave action, gulf sands flow east to west, naturally replenishing the islands it passes as it drifts. Mobile Bay is a naturally shallow waterway that has been dredged since the early 20th century to create a channel that allows very large cargo ships to enter the harbor. The channel runs right through the pass between Forts Gaines and Morgan and is three times the depth of the natural bay. The long,

¹⁰⁷ "Tides & Currents: Sea Level Trends," NOAA.gov, accessed February 27, 2017, <https://tidesandcurrents.noaa.gov/sltrends/sltrends.html>.

¹⁰⁸ Sallenger, *Island in a Storm*, 43.

trough-like channel interrupts the littoral flow of sand from the beaches of Perdido Key and Gulf Shores to Dauphin Island, starving the land of necessary sediment and leading to extensive erosion. Historically, the dredged sand has been deposited deep off shore, where it misses the westward, coastal currents that would carry it to Dauphin Island's shores.¹⁰⁹ Dauphin Island is now dependent on riprap and artificial beach nourishment.

Strong storms also have the power to alter barrier islands in extreme and unpredictable ways. Hurricane Camille split Ship Island, site of Fort Massachusetts, in two in 1969. East and West Ship Islands are now separated by the "Camille Cut." The same thing happened to Fort Gaines' Dauphin Island in 2005 when it received the "Katrina Cut" directly through its center. In Louisiana, an entire island was lost to an unnamed hurricane in 1856. Gulf Coast barrier islands are in serious danger from sea level rise and coastal erosion. Their low slopes and lack of significant sand dunes provide little resistance to the onslaught of a category 4 or 5 hurricane.

Relative sea level rise in the Gulf of Mexico is the greatest threat to the area's Third System forts. Land subsidence and sea level rise in Louisiana have already claimed Fort Livingston, the state's only coastal fort, as well as three subsidiary structures and have left the remaining three forts in serious jeopardy. Hurricane action and sea level rise almost put Mississippi's Fort Massachusetts in the ocean, and only through artificial beach nourishment is the structure above water. The eastern end of Dauphin Island, Ala., where Fort Gaines is located, has seen erosion at the rate of nine feet per year.¹¹⁰ Beach

¹⁰⁹ "Dauphin Island Restoration: Mobile Outer Bar Channel Dredging," *dauphinislandrestoration.org*, accessed March 3, 2017, <http://www.dauphinislandrestoration.org/erosion/dredging.htm>.

¹¹⁰ "11 Most Endangered Places: Fort Gaines," *savingplaces.org*, accessed March 5, 2017, <https://savingplaces.org/places/fort-gaines-1#.WM8xtm8rJhF>.

nourishment and riprap walls have been used to protect the fort and the sediment-starved island. The remaining forts in Alabama and Florida are relatively stable. Alabama's Fort Morgan will be negatively impacted by a one or two foot rise in sea levels, but not lost until a four foot rise. Forts Pickens and Barrancas are the highest and safest of the Gulf's Third System forts. At a six foot rise in sea levels, Fort Pickens is still visible, and Fort Barrancas is untouched.¹¹¹

¹¹¹ "Sea Level Rise Visualization for Alabama, Mississippi, and Florida," *USGS.gov*, last modified September 16, 2011, <https://gom.usgs.gov/slr/slr.aspx>.

CHAPTER 5

CURRENT METHODS OF ENVIRONMENTAL CONSERVATION, RESTORATION AND PROTECTION OF THE GULF COAST

The previous chapter explored the main causes of land loss in southeast Louisiana and used global and local rates of relative sea level rise as the first step in supporting the thesis statement that land subsidence and sea level rise are the greatest risks to Third System forts in that state. This chapter explores state and federal responses to those problems through current and proposed methods of land conservation, restoration and protection in Louisiana and the Gulf Coast. In order to further support the thesis, it will be noted which projects protect, have the potential to protect or will not protect Louisiana's Third System forts.

People have long built cities along seacoasts for fishing, farming, transportation, shipping and entertainment. The trend continues today, and in America coastal population density is increasing at a substantial rate. According to 2010 U.S. Census data, "39% of the U.S. population is concentrated in counties (and parishes) directly on the shoreline," which is less than 10% of the total U.S. land area excluding Alaska. Even more concerning, "52% of the total population lives in counties (and parishes) that drain into coastal watersheds," which account for less than 20% of total U.S. land area

excluding Alaska. In 2010, American coasts were home to 123,000,000 people, and the expectation is that they will be home to 134,000,000 people by the year 2020.¹¹²

The value of American seacoasts, both in human and capital investment, has always been apparent. The protection of coastal cities was important enough for the United States to change its long-held opinion on a standing military and to invest millions of dollars in Third System fortifications in the early to mid-19th century. Today, America's coastal cities need a different kind of protection. Relative sea level rise, wetlands loss, land subsidence, coastal erosion and storms threaten lives, jobs, infrastructure systems, historic and natural resources, business investments, and ecological systems. State and federal governments are constantly working to mitigate the effects of relative sea level rise and to protect vital coasts, harbors and cities from rising waters and stronger storms.

Louisiana

The Lake Pontchartrain Basin has been home to manmade levees for almost three centuries, and their effect on the landscape is significant. However, for the purpose of this thesis, levees constructed before the establishment of the Coastal Protection and Restoration Authority (CPRA) in 2005 will not be included as methods of environmental conservation, restoration or protection of the area from relative sea level rise. The levees and seawalls built prior to the establishment of CPRA were designed primarily for the control of river floods in specific areas rather than as a comprehensive system of

¹¹² “NOAA, U.S. Census report finds increases in coastal population growth by 2020 likely, putting more people at risk of extreme weather,” *NOAA.gov*, last modified March 25, 2013, http://www.noaanews.noaa.gov/stories2013/20130325_coastalpopulation.html.

protection from the constant threat of relative sea level rise. Proposed plans to alter the extant levee system will be analyzed later.

Hurricane Katrina struck southeastern Louisiana on August 29, 2005, making landfall at the site of Forts Jackson and St. Philip in the town of Buras-Triumph in Plaquemines Parish. The storm continued northward in a path that struck every Third System fort and subsidiary structure in the state other than Fort Livingston, which lies to the west on the barrier island of Grande Terre. Storm surge filled Lake Borgne, Lake Pontchartrain, Pass Rigolets, the Mississippi River and the network of channels and canals that weave their way through the basin, eventually leading to the catastrophic failure of levees throughout the area. Less than one month later, Hurricane Rita struck southwest Louisiana obliterating coastal marshland and forcing the permanent evacuation of several rural communities. According to NOAA, the combined cost of these two storms is estimated at \$176.6 billion, with Hurricane Katrina identified as the costliest single weather or climate related catastrophe in the history of the United States with \$153.8 billion in damage.¹¹³

The state and federal responses to the impact of Hurricane Katrina were numerous and include the creation of CPRA, the approval of Louisiana's first comprehensive coastal master plan and large scale industrial land protection projects. The most significant of the industrial projects was the construction of the Inner Harbor Navigation Channel (IHNC) Lake Borgne Surge Barrier, the largest surge barrier in the world. The IHNC barrier was authorized by Congress in 2006, begun in 2008 and completed in 2013.

¹¹³ "Billion-Dollar Weather and Climate Disasters: Table of Events," *NOAA.gov*, last modified July 2017, <https://www.ncdc.noaa.gov/billions/events>.

The nearly two-mile-long wall sits at the confluence of the Gulf Intracoastal Waterway (GIWW) and the now-decommissioned Mississippi River Gulf Outlet (MRGO) at the point where storm surge waters from Katrina funneled into the city breaking the first levees and flooding the Lower 9th Ward of New Orleans.

The IHNC Lake Borgne Surge Barrier, known locally as “the wall,” is about a mile and half inland from the site of Battery Bienvenue and is strikingly similar to the battery in shape, though tremendously larger in scale. The 10,000 foot long wall is a line of cast concrete piles driven more than 100 feet into the marsh soil with angled batter piles on the populated side as reinforcement. There is a compound gate for large vessels along the GIWW and one for private boats at Bayou Bienvenue, otherwise the barrier is an impenetrable wall reaching 26 feet about the average waterline. It is the largest design-build civil works project in the history of the U.S. Army Corps of Engineers.¹¹⁴

“The wall” works in combination with several other major post-Katrina U.S. Army Corps of Engineers projects, including the IHNC Seabrook Floodgate Structure on the Industrial Canal at its intersection with Lake Pontchartrain, the West Closure Complex in the GIWW about seven miles south of New Orleans, the Company Canal Closure Structure on Bayou Segnette, and a series of pumping stations, levee expansions and flood wall reinforcements. When combined with the existing levees and floodwalls, the post-Katrina projects create a perimeter of storm surge flood protection modeled to withstand a 100-year storm. The perimeter is large, protecting all of Metro New Orleans from the eastern landbridge west to Kenner, and from the shore of Lake Pontchartrain

¹¹⁴ U.S. Army Corps of Engineers, “2-IHNC-Lake Borgne Surge Barrier,” Published January 15, 2010, YouTube Video, Duration 5:03, <https://www.youtube.com/watch?v=StfzeAXVz1I>.

south to most of the developed areas of the West Bank. Of the state's many Third System structures, only Fort Macomb lies within the perimeter of the post-Katrina protection projects.



Figure 25: *The Wall*. Digital Image courtesy of Google Maps. Accessed September 2, 2017. <https://www.google.com/maps/@30.0038379,-89.9127162,4179m/data=!3m1!1e3>.

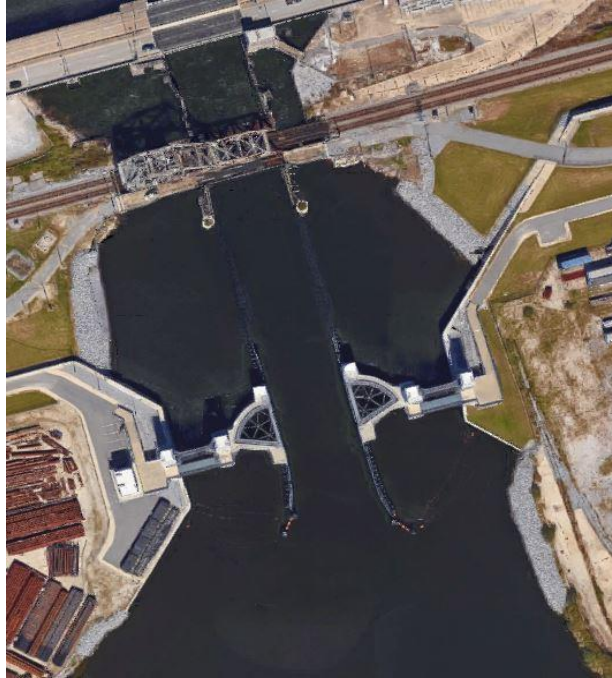


Figure 26: *IHNC Seabrook Floodgate Structure on the Industrial Canal*. Digital Image courtesy of Google Maps. Accessed July 30, 2017.
<https://www.google.com/maps/@30.030307,-90.0344537,425m/data=!3m1!1e3>.



Figure 27: *New Orleans Metro Area Hurricane Protection System*. Digital Image courtesy of Nola.com. Accessed October 21, 2017.
http://www.nola.com/hurricane/index.ssf/2014/05/new_orleans_area_hurricane_pro_6.html.

Louisiana's response to coastal management in the years since Katrina has not been exclusively focused on flood protection for the greater New Orleans area. There have been two approved master plans for the state's coast, the first passed in 2007, and the second in 2012. Each combined large, industrial projects with environmental conservation and restoration plans in an attempt to create a sustainable coast. The master plans are revised every five years, and as of the writing of this thesis, the State of Louisiana is in the process of approving the "2017 Comprehensive Master Plan for a Sustainable Coast." The draft plan is the most ecologically focused that the state has yet produced. It relies heavily on community input and balances proposed funding between ecologically focused "restoration" projects and industrially focused "risk reduction" projects.¹¹⁵

Louisiana's 2017 draft of the coastal master plan declares that the asset value of the Mississippi Delta is up to \$4.7 trillion in ecological systems and \$1.3 trillion in natural capital. The document states,

Coastal Louisiana's contribution to the nation's economy runs into the hundreds of billions of dollars each year, and our coastal wetlands are central to these contributions. From an economic standpoint alone, restoring the wetlands makes sense, whether you look at it from the vantage point of an economist, an ecologist, or a coastal resident who knows the value of the landscape first hand.¹¹⁶

The draft master plan is an economics-based proposal to maintain and improve Louisiana's profit potential by conserving wetlands, restoring barrier islands, protecting shorelines, creating marshes, diverting sediment and constructing and improving

¹¹⁵ "Louisiana's Comprehensive Master Plan for a Sustainable Coast, 2017 Draft Plan Release," *coastal.la.gov*, http://coastal.la.gov/wp-content/uploads/2016/08/2017-MP-Book_2-page-spread_Combined_01.05.2017.pdf, ES-19.

¹¹⁶ *Ibid*, ES-12-ES-13.

industrial levees and floodgates. The plan makes no mention of specific historic structures in the affected areas, but wetlands protection and marsh creation have the potential to mitigate some negative effects of sea level rise and land subsidence for Third System forts and other historic resources in coastal Louisiana.

Previous coastal master plans for Louisiana focused on structural protections of the coast for the benefit of industry in the area, particularly oil and gas. The 2017 draft plan, by contrast, takes into consideration the cultural heritage of coastal Louisiana, small community preservation and the importance of ecological systems. The highest concentration of in-process and planned projects is within the Lake Pontchartrain Basin. Structural projects, such as levees, floodgates, seawalls and pumping stations; shoreline protection; and marsh creation represent the majority of projects there, but barrier island restoration, ridge restoration and hydrologic restoration projects are also included.

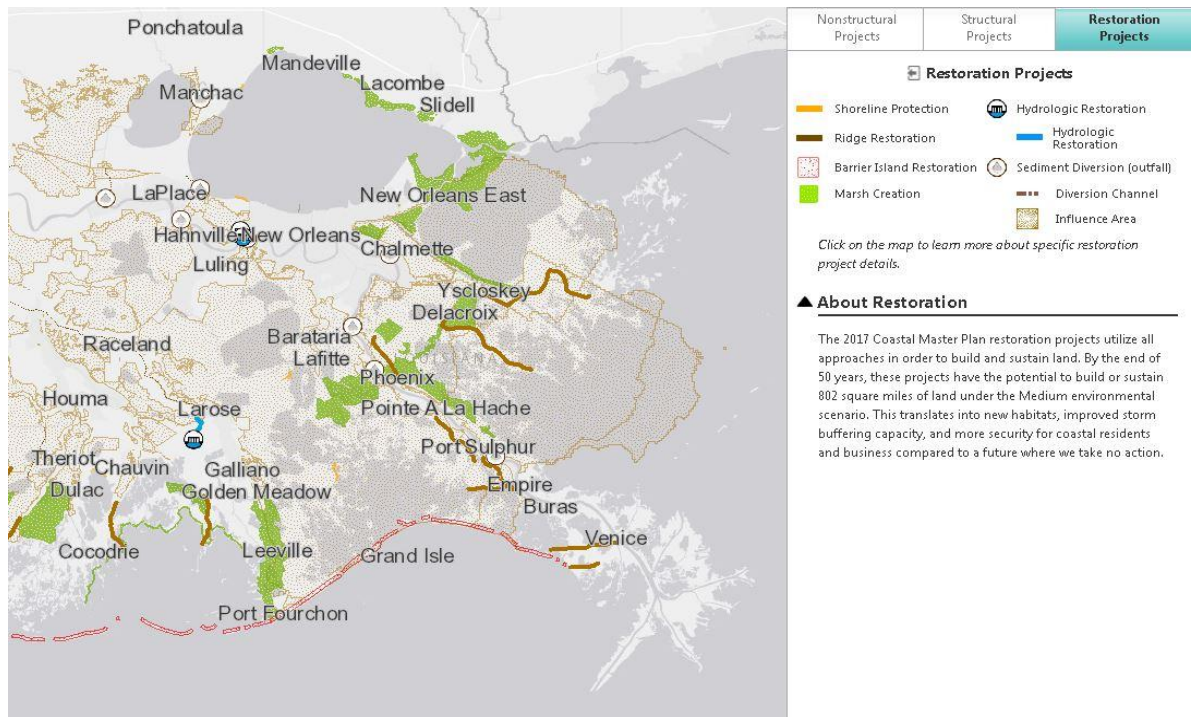


Fig 28: *Restoration Projects of Louisiana's 2017 Coastal Master Plan*. Digital Image courtesy of CPRA. Accessed October 21, 2017. <https://cims.coastal.louisiana.gov/masterplan/>

Shoreline protection “provided by near-shore rock breakers reduces wave energies on shorelines surrounding open bays, lakes, sounds and bayous, including navigation channels.”¹¹⁷ Lake Borgne has already received extensive shoreline protection. Fort Proctor was included in the first phase of the shoreline protection project so that the border of shoreline rock breakers that lines Lake Borgne extends from the marsh opposite Shell Beach to encircle the unfinished fort on all but a small portion of the southwest side.

¹¹⁷ Ibid, 62



Figure 29: *Aerial Photo of Fort Proctor and Shoreline Protection*, Digital Image courtesy of Google Maps. Accessed July 30, 2017. <https://www.google.com/maps/@29.8668374,-89.6788652,419m/data=!3m1!1e3>.

Rock breakers, also called “riprap,” are thought to be an unattractive but effective and minimally invasive option for shoreline protection. Riprap is critiqued by some for interrupting littoral drift and potentially contributing to coastal erosion rather than limiting it. Lake Borgne, however, is not truly coastal and does not have sandy beaches in need of littoral drift sand supply. Additionally, the rock barriers placed at Lake Borne are not a single, fixed line. Individual sections or the entire barrier can be removed if it is

proven to be contributing to erosion, negatively impacting wildlife or restricting the expansion of marsh lands.¹¹⁸

Marsh creation, which establishes new wetlands in open water areas through sediment dredging and placement, is slated to take place in areas of significant wetlands loss within the Lake Pontchartrain Basin.¹¹⁹ Focusing on areas where Third System forts are located, marsh creation projects on the banks of Lake Borgne and on the New Orleans East Landbridge have the potential to provide protection from storm surge to Forts Pike and Macomb. New marshes could also reclaim the land surrounding Battery Bienvenue. Historically, these areas would have been impacted by flood waters when the Mississippi River overflowed her banks and would have received fresh water and sediment to feed plants and contribute to land accretion. Anthropogenic marsh creation from sediment dredged from the Mississippi River is the state's attempt to recreate the positive effects of flooding without the detrimental loss of human lives and property.

Ridge restoration is related to marsh creation and "uses dredging, sediment placement and vegetative plantings to restore natural ridge functions in basins."¹²⁰ Ridge restoration was not prevalent in the Lake Pontchartrain Basin in previous coastal master plans, but is slated for ten locations within the basin between 2017 and 2047. "Ridge" is a relative term in an area as flat as coastal Louisiana, but according to the plan, the sites chosen will be restored to an elevation of five feet providing wave and storm surge

¹¹⁸ "Orleans Landbridge," *coastal.la.gov*, accessed March 13, 2017, <http://coastal.la.gov/project/orleans-landbridge/>.

¹¹⁹ "Louisiana's Comprehensive Master Plan for a Sustainable Coast, 2017 Draft Plan Release," 62.

¹²⁰ *Ibid*, 62.

attenuation and promoting a return to natural hydrology.¹²¹ The root systems of the transplanted vegetation will provide habitats for native animals and are expected to combat soil loss from erosion. The plants themselves will shed leaves and branches, which will decompose and contribute to land accretion.

Hydrologic restoration is imperative to restoring wetlands because it “conveys fresh water to areas that have been cut off by man-made features” and helps to “prevent the intrusion of saltwater into fresh areas through man-made channels and eroded wetlands.”¹²² Only one such project is slated for the Lake Pontchartrain Basin. By 2027, the state plans to construct a pump-siphon structure on the Mississippi River with a mile long conveyance system to move fresh water from the river to the LaBranche Wetlands. The fresh water and silt will replenish the starved wetlands and hopefully lead to their expansion and localized land accretion. Because the state’s coastal master plan is revised every five years, success at the LaBranche station could encourage similar siphon and conveyance structures throughout the Lake Pontchartrain Basin and elsewhere in coastal Louisiana.

Barrier island restoration is “the creation of dune, beach, and back barrier marsh to restore or augment offshore barrier islands and headlands.”¹²³ At least some form of restoration has been completed on most of Louisiana’s barrier islands since 2007, predominantly by way of beach nourishments from sand taken from the ocean floor farther into the Gulf. Isle Grand Terre, the only Louisiana barrier island with a Third

¹²¹ Ibid, 118.

¹²² Ibid, 62.

¹²³ Ibid, 66.

System fort, is the recipient of several restoration projects completed and in the planning stage. The western end of Grand Terre, site of Fort Livingston, was facing erosion so extreme that the southern scarp wall of the fort collapsed and was eventually washed away. The western end of the beach has since been given a riprap border that has been so effective in protecting the sand from wave action that the beach and ground vegetation has expanded more than 200 feet from the location of the collapsed scarp wall. The state is restoring back barrier marsh on the landward side of the island's western end, behind Fort Livingston, and providing beach and dune nourishments across the entire gulf side of the island.¹²⁴



Figure 30: *Aerial Photo of Fort Livingston*. Digital Image courtesy of Google Maps. Accessed July 30, 2017. <https://www.google.com/maps/@29.2730598,-89.9462657,502m/data=!3m1!1e3>.

¹²⁴ “West Grand Terre Beach Nourishment and Stabilization,” *coastal.la.gov*, accessed March 14, 2017, http://coastal.la.gov/wp-content/uploads/2014/11/RESTORE_West-Grand-Terre-Fact-Sheet_11.10.14.pdf.

Louisiana's 2017 draft coastal master plan is a step forward in terms of acknowledging and supporting natural coastal processes in the fight against relative sea level rise. For decades, the state relied on taller levees and stronger pumps without understanding that such projects were doomed to failure in a time of rising waters and stronger storms. The network of canals dredged and widened for convenience and profit eventually funneled in the costliest natural disaster in American history. The greater New Orleans area continues to rely on an impressive network of levees, floodwalls and pumps, but the state has also recognized the importance of wetlands, barrier islands and ridges

Alabama

The State of Alabama does not currently have a comprehensive coastal master plan similar to Louisiana's, though it is in the process of drafting one. In its place, the state has programs designed to encourage the restoration and conservation of its coastal landscapes. Notable among them is the Wetlands Reserve Program (WRP), which is administered by the USDA's Natural Resources Conservation Service to provide "eligible landowners the technical and financial assistance they need to address wetland, wildlife habitat, soil, water and related natural resource concerns on private agricultural land."¹²⁵ The program has an easement option with a cash incentive for enrollment, as well as an option to have some natural wetlands restoration work paid for without the restrictions of an easement on the owner's property.

¹²⁵ "Wetlands Reserve Program," *outdooralabama.com*, accessed March 22, 2017, <http://www.outdooralabama.com/wetlands-reserve-program>.

The state also has an active beach nourishment and dune protection program with dredged sand placed at both Dauphin Island, home of Fort Gaines, and at Gulf Shores/Orange Beach, about ten miles east of Fort Morgan. In 2016, Alabama allotted \$7 million to offshore sand dredging and pumping to restore the beaches of Dauphin Island from Fort Gaines to the start of residential development, about one mile west along the gulf front shore.¹²⁶ The eastern end of the island, site of Fort Gaines, has also been given shoreline protection with a segmented riprap seawall and a feature known as groins. Beach groins are wave control devices, typically made of stone, crushed concrete or wood pilings, that extend perpendicular to the shoreline. The riprap groins around Fort Gaines extend from the curved end of the island like spokes from the hub of a wheel. Groins are somewhat contentious because while they are successful in slowing erosion at the place they are built, the spokes act like dams catching sand that would otherwise drift farther down the beach for natural replenishment. Evidence of such sand trapping is visible in aerial photographs of the groins.

¹²⁶ Alexa Knowles, "\$7 million project underway to restore Dauphin Island beach," *Fox 10*, last modified February 29, 2016, <http://www.fox10tv.com/story/31346810/7-million-project-underway-to-restore-dauphin-island-beach>.



Figure 31: *Aerial Photo of Fort Gaines*. Digital Image courtesy of Google Maps. Accessed July 30, 2017. <https://www.google.com/maps/@30.2482912,88.074712,1407m/data=!3m1!1e3>.

Interestingly, the ability of rock piles to catch drifting sand has also benefited Dauphin Island. When Hurricane Katrina passed over the island in 2005, it cut the island in two. By 2010, the “Katrina Cut” was over one mile wide creating an East and West Dauphin Island, similar to the “Camille Cut” that created East and West Ship Island in Mississippi. Following the settlement for the Deepwater Horizon Oil Spill in April 2010, Alabama used a portion of the fines allotted to them to lay a strip of rock connecting the two halves of the island. By November of 2014, littoral drifting sand had been caught in

the rocks and accumulated enough to recreate the beach uniting Dauphin Island once again.¹²⁷

Dune protection is active on Dauphin Island, but more extensive on Gulf Shores. The Coastal Alabama Dune Restoration Cooperative, a coalition that includes the cities of Gulf Shores and Orange Beach, the State of Alabama, the U.S. Fish and Wildlife Service and the Bureau of Land Management leads an active dune restoration and protection program.¹²⁸ The Alabama Dune Restoration Project, also funded from oil spill money, aims to “prevent erosion by restoring a ‘living shoreline,’ a coastline protected by plants and natural resources rather than hard structures.”¹²⁹ The project includes planting native grasses on dunes to prevent wind erosion, installing sand fencing to deter people crossing dunes and to aid sand accumulation, and displaying informative signs to educate the public about dune protection and habitat restoration.

¹²⁷ Associated Press, “Alabama's Dauphin Island is whole again 9 years after Hurricane Katrina,” *al.com*, last modified November 9, 2014,

http://www.al.com/news/beaches/index.ssf/2014/11/alabamas_dauphin_island_is_who.html.

¹²⁸ “Alabama Dune Restoration Project,” *NOAA.gov*, last modified April 2012,

<http://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/2012/04/AlabamaDuneRestorationF.pdf>.

¹²⁹ *Ibid.*



Figure 32: *Dune Protection and Warning Signs*. Dauphin Island Beach. (Photo by author, July 2017)

Florida and Mississippi

For this analysis of coastal preservation policies, the states of Florida and Mississippi will be assessed together because the Third System forts of both states are within the Gulf Islands National Seashore and are owned and managed by the National Park Service. Preservation planning for the Gulf Islands National Seashore has been conducted since 2003 with analysis and preservation frameworks made available to the public in July of 2014 as the “General Management Plan/Environmental Impact Statement, Gulf Islands National Seashore.” It is important to note that the NPS plan differs from state plans in two distinct ways: it includes site interpretation and does not entertain the financial implications of cultural and natural resource preservation other than what funding will be required. The General Management Plan for the Gulf Islands

National Seashore is a plan for a park comprised of undeveloped land surrounded by highly developed commercial and residential areas and as such is less far reaching than the Louisiana Comprehensive Master Plan.

The General Management Plan for the Gulf Islands National Seashore is a holistic analysis of the resources under NPS control from Cat Island, Mississippi to Santa Rosa Island, Florida. It assesses both natural and historic resources with special attention paid to the three Third System forts within the boundaries of the national seashore. Four alternative management plans are presented: Alternative 1 is no new action taken; Alternative 2 is minimal new action; Alternative 3 is the NPS preferred option; Alternative 4 is the most resource-heavy option. Each of the four alternatives is presented as a recourse for solving problems related to preserving coastal ecosystems, enhancing public access, storm recovery and sustainability, and climate change. The report analyzes the potential impact of each of the four alternatives upon every major resource within the national seashore and is the only plan consulted as part of this thesis that specifically aims to preserve Third System forts and their surroundings.

The report states that “The urban development adjacent to Gulf Islands National Seashore boundaries has reduced habitat for some threatened and endangered species. This creates additional demands on the National Park Service to mitigate this loss and to protect threatened and endangered species and habitat within the national seashore.”¹³⁰ The park has become a refuge to several endangered species and species of concern, but must balance the desire to protect the animals and their endangered habitats with the

¹³⁰ “Gulf Islands National Seashore, Florida and Mississippi: Final General Management Plan/Environmental Impact Statement,” *nps.gov*, last modified July 2014, <https://www.nps.gov/guis/learn/management/upload/Gulf-Islands-GMP-EIS-JULY-2014.pdf>, p.10.

“strong public interest in improving access to more undeveloped beaches within the national seashore.”¹³¹

The explanation of climate change concern is the longest in the report. The NPS defines climate change as “any substantial changes in average climatic conditions (such as average temperature, precipitation, or wind) or climatic variability (such as seasonality or storm frequencies) lasting for an extended period of time (decades or longer) and asserts that “climate change is occurring and is likely to accelerate in the coming decades.” Recognizing that the major causes of climate change are beyond the control of the NPS, the report goes on to state that “some climate change impacts are already occurring or are expected to occur in Gulf Islands National Seashore in the time frame of this General Management Plan” and that these impacts to the national seashore could serve as an opportunity to educate the public about climate change.¹³²

The proximity of active oil and gas drilling and extraction is a concern for the national seashore, and the NPS states unequivocally that

The National Park Service is opposed to such activities near the national seashore because of a variety of possible and known threats to national seashore resources and values. These threats include impacts on natural processes and cultural resources such as subsidence, natural resources such as marine and terrestrial wildlife and species of special concern, air and water quality, night sky, natural sound; cultural resources such as archeological sites and historic structures, wilderness character and visitor experience, and NPS operations and seashore management.

As evidence of “known threats,” the plan cites the April 2010 Deepwater Horizon oil spill that leaked more than 4 million barrels of oil into the Gulf of Mexico. It states that

¹³¹ Ibid, 10.

¹³² Ibid, 13.

as of November 2012, 1700 tons of oiled debris was removed from Mississippi barrier islands and 600 tons from those in Florida.¹³³

At the heart of each alternative is coastal wilderness preservation and public education as the NPS seeks to balance the public's desire to access undeveloped land with the agency's mission to preserve natural and cultural resources for future generations. Currently, the Gulf Islands National Seashore is preserved through beach nourishment at West Ship Island as well as dune restoration and protection projects throughout the park. Natural resources, including wildlife, are monitored and recorded by NPS staff and volunteers from mid-March to September. When necessary, delicate habitats, such as sea turtle nests, are given extra protection from visitor interference. Each of the Third System forts managed by the NPS receives all required stabilization efforts and some level of guided interpretation. Interpretation for the park as a whole is also offered to foster public awareness and appreciation of the park's many natural and cultural resources.

Under Alternative 1, little would change for Forts Pickens, Barrancas and Massachusetts or their surrounding areas. The forts would continue to receive "stabilization efforts," and the landscapes would remain open to campers and beach goers with designated walkways from parking lots to beaches for dune protection. Beach nourishment for Fort Massachusetts at Ship Island would continue. Alternative 2 offers a bit more to both forts and landscapes. "The current condition of the historic masonry forts, artillery batteries, and associated structures would be documented, stabilized, and

¹³³ Ibid, 12.

preserved.” However, the report goes on to state that in the event of a storm of natural disaster, “recovery efforts would be limited to repair and stabilization, and as possible, data acquisition from the impacted element.”¹³⁴ Beach nourishment near Fort Massachusetts would continue on Ship Island, and a 300-yard “non-motorized zone” would be designated along the northern shoreline to minimize impacts on seagrass beds.¹³⁵ Additionally, if roads were damaged by storms, they would not be repaired or replaced. The Fort Pickens area of Santa Rosa Island would be accessible only by ferry.

Alternative 3, the NPS preferred plan, conceptualizes the Gulf Islands National Seashore “as an outdoor classroom for exploring the natural and human history of the northern Gulf Coast while providing seashore recreational opportunities. Collaboration and cooperation between a consortium of academia, visiting scientists, conservation organizations, and other agencies would be actively pursued to enhance resource management, stewardship, and understanding of the northern gulf coastal environment.” This alternative focuses on monitoring and evaluating the full spectrum of resources within the natural seashore to “accelerate the awareness of the national seashore’s ecological health and vitality, anticipate/adapt to the effects of climate change, promote restoration of disturbed sites, improve communication with the public about the dynamic natural processes of the area” and to inform expanded educational programs.¹³⁶

Each of the forts within the national seashore “might be rehabilitated to portray their historic appearance and function with incorporated interpretive media to enhance

¹³⁴ Ibid, 94.

¹³⁵ Ibid, 109.

¹³⁶ Ibid, 112-113.

visitor understanding.”¹³⁷ Fort Massachusetts is singled out in the plan for potential cannon firing demonstrations. Under Alternative 3, the landscapes surrounding the forts are given additional seagrass bed zones along their northern shores. Santa Rosa Island is slated to have a canoe route from Perdido Key running eastward, as well as the continuation of the Florida National Scenic Trail. Visitor access would be limited during critical nesting periods for shorebirds and turtles. Beach nourishment would continue at Ship Island, and dune preservation and restoration would be enhanced throughout the national seashore. Transportation avenues would remain as they are currently with the possible addition of a passenger ferry across Pensacola Bay.

Alternative 4, while still collaborative and educational, focuses more on outdoor recreational opportunities than the previous three alternatives. It would encourage a “high level of visitor use” with a “diversity of visitor opportunities.” The national seashore’s three forts would see a distinct change under Alternative 4. In cases where the forts’ historic integrity would not be compromised, all or parts of the forts could be adaptively reused “to support a diverse range of recreational, interpretive, and educational opportunities.”¹³⁸ Additionally, all accessioned objects would be consolidated with the national seashore’s natural history collections to create a “multipark” centralized museum interpreting everything from early fortification history to barrier island ecology.

All beach nourishment, seagrass bed zone, and dune restoration and preservation projects would continue according the Alternative 1, but visitor traffic and access would increase from proposed shuttle service on Santa Rosa Island, new back country campsites

¹³⁷ Ibid, 118.

¹³⁸ Ibid, 133-134.

on West Ship Island, and the Pensacola Bay passenger ferry. Alternative 4 also calls for bike, canoe and paddleboard rentals at both West Ship Island and Santa Rosa Island.

An energy assessment and a separate ecological assessment of the four alternatives shows that environmentally, Alternative 2 is the best choice. Energy requirements would be reduced while protecting “wilderness values” and protecting, enhancing and restoring Gulf Coast ecosystems. However, the potential loss of roads to Fort Pickens and Santa Rosa beach could negatively impact visitors. Alternative 4 is the most energy consumptive but provides the best visitor quality and socioeconomic benefits to nearby communities, neither of which preserves natural and cultural resources for future generations. Alternative 3 increases energy consumption over current standards and only excels at improving the efficiency of NPS operations. Alternative 1 did not provide the best for any of the factors considered in the assessments.¹³⁹

The General Management Plan for the Gulf Islands National Seashore offers several viable options for preserving the natural and cultural resources of the Gulf Coast’s barrier islands in the face of potentially severe climate change. Unfortunately, the park does not control all of the land and water from Cat Island to Santa Rosa Island. Dauphin Island, Mobile Bay, Gulf Shores, Pensacola Bay and the surrounding offshore waters are managed by an array of stakeholders who do not always do what is best for the Gulf barrier island ecosystem. Both bays are regularly dredged, and offshore oil rigs are visible from many parts of the national seashore.

¹³⁹ Ibid, 165 & 394.

CHAPTER 6

MANAGEMENT, PROTECTION AND CURRENT STATUS OF THIRD SYSTEM FORTS OF THE GULF COAST

The history and cultural significance of Third System forts of Louisiana and the Gulf Coast were explored in Chapter 3 of this thesis. Chapters 4 and 5 presented the causes and challenges of land subsidence and sea level rise in Louisiana and the Gulf Coast as well as state and federal responses to those challenges. This chapter combines those avenues of inquiry and further supports the thesis statement by assessing the current status of Third System forts in Louisiana and the Gulf Coast in terms of recent and historic hurricane damage and land loss in their surrounding landscapes. Further, the management structure and current preservation efforts, if any, of each fort and select subsidiary structures are included. The chapter concludes with a comparative chart that ranks the forts' risk of loss from the effects of land subsidence and sea level rise as well as the risk from poor management and neglect.

Fort Pike

Fort Pike was a common field trip location for school children of New Orleans and the surrounding parishes. The area is a state park that operated from 1934 until 2015 when state funds for parks were cut so drastically by Governor Bobby Jindal that Fort Pike could no longer be staffed and was permanently closed to the public; there are no

plans to reopen it. All research visits to Fort Pike were completed before the February 2015 closure.

Fort Pike was severely damaged by Hurricane Katrina in 2005, then again by Gustav in 2008 and Isaac in 2012. Visits to the fort in 2013 showed severe cracks in the masonry, brick spalling at water level and casemates so full of storm debris that some embrasures were partly obscured. According to Ladd Ehlinger, architect for the “2012 Fort Pike Hurricane Katrina Repairs Project,” soil compression and the structural load of thick masonry walls are the leading preservation challenges for the fort. Ehlinger asserts that years of uneven settlement at the heaviest portions of the walls, the bastion and demibastions, created fissures and cracks that were torn wide open by the Katrina storm surge. His \$7.9 million plan for the preservation of Fort Pike consists of three main projects: a breakwater to protect the lower masonry from wave action, excavation and backfill of bastion points, and perimeter brick repair.

Ehlinger’s preservation plan for Fort Pike is divided into segments by cost and priority. The lowest cost project in his plan is for the breakwater, which increases the size and strength of the current riprap barrier. This alone would protect the lower lying masonry from wave action erosion, and should more money be allocated, allow for draining the moat to repair submerged masonry and wood grillage. At a little over \$2 million, his plan for excavating and backfilling the bastion and demibastions is not a low-budget item, but according to Ehlinger, it is the most critical of all the preservation projects in his proposal. Highly compressive soil beneath walls that weigh up to 4200

PSF has led to structural subsidence of up to 2.5 feet in some areas.¹⁴⁰ The plan to alleviate the rapid subsidence is to excavate the soil-filled bastion points to 50% and backfill them with styrofoam. The rigidity of the styrofoam would lessen the outward thrust of soil infill against the masonry walls and would lighten overall weight of the structure. Topsoil and sod would be placed atop the styrofoam creating a historically accurate terreplein.

The third major component of the project is brick repair to the outer walls of the fort. At nearly \$4.9 million, it is the single most expensive repair in the proposal. Ehlinger aims to remove all unstable brick, salvaging historic brick where possible and burying new brick within walls and below the water level. Other projects included in the proposal, but not necessary to the structural integrity of Fort Pike, are citadel repairs and the repair and construction of retaining walls. In a March 2015 conversation about Fort Pike, Ladd stated that if only one of his projects received funding, the excavation and backfill of the bastions should be that project. To date, no funding has been allotted.

¹⁴⁰ Ehlinger & Associates, P.C., "Hurricane Katrina Repairs, Military Fort, Fort Pike State Historic Site, April 9, 2012, 4-5.



Figure 33: *Fort Pike Casemate with Marsh Grass Debris.* (Photo by author, March 8, 2013)



Figure 34: *Storm Debris in Moat at Fort Pike.* (Photo by author, March 8, 2013)



Figure 35: *Hurricane Katrina Damage to Northern Bastion of Fort Pike.* (Photo by author, March 8, 2013)



Figure 36: *Current Riprap Barrier on Seaward Arc of Fort Pike.* (Photo by author, March 8, 2013)



Figure 37: *Destroyed Outworks and Storm Debris at Fort Pike.* (Photo by author, March 8, 2013)

Fort Macomb

Fort Macomb is under the jurisdiction of the Louisiana State Parks Board, but is not a state park and is not open to the public. The driveway is blocked by a locked fence, and the sallyport is covered by a locked gate. My visit to Fort Macomb in early 2013 revealed a fort overrun by marsh plants. A machete was required to access the sallyport and to clear a walking path across the parade. Fort Macomb's similarity to Fort Pike offered an interesting comparison. The weight and soil dynamics are nearly identical to Fort Pike's, and Fort Macomb exhibits the same cracking and shear at the bastion points. It also suffers similar spalling at water level due to wave action by boats from a local marina. What sets Fort Macomb apart is that the environmental damage it has suffered is the result of land more so than water. Though it was subject to damage by Katrina, Gustav and Isaac, Fort Macomb is somewhat better protected than Fort Pike because it sits deep in the marsh of the landbridge, rather than out at the bridge's farthest point.

The overgrowth at Fort Macomb is so bad that it is ripping the masonry walls apart. Seeds that years ago took hold in the soil of the terreplein are now plants large enough to have root systems that push brick out and away from the walls exposing the tabby within. Unlike Fort Pike, there is no proposal for the repair and restoration of Fort Macomb, and the site has not been assessed by the state architect or a structural engineer. Without such information, it is hard to state what work needs to be completed for the preservation of the fort. Cutting back the marshy overgrowth is a logical first step in preserving the structure, but extracting the larger plants is likely to further damage cracking walls. It is best to cut the plants at the stems, treat what is visible and allow the roots to decay in place.



Figure 38: *Parade and Citadel of Fort Macomb*. (Photo by author, March 8, 2013)



Figure 39: *Vegetation Destroying Masonry Walls at Fort Macomb.* (Photo by author, March 8, 2013)



Figure 40: *Masonry Damage from Roots and Vines at Fort Maccomb.* (Photo by author, March 8, 2013)

Fort Jackson

The fort and surrounding land are still owned by the parish and were a public park until 2005 when the fort was hit directly by Hurricane Katrina in August and again by Hurricane Rita the next month. Fort Jackson sat flooded for weeks, suffered structural damage and is still in the process of repair. Numerous visits to Fort Jackson showed the fort to be in relatively good condition, though evidence of flood waters was still visible on many fort walls. Like Forts Pike and Macomb, shear and cracking is apparent at the bastions. There are also numerous embrasures with cracks that reach all the way up to the terreplein. Beyond storm damage, Fort Jackson is at risk of wall collapse from extensive tree growth in the terreplein and parade. Between visits in 2013 and 2015, more than fifteen large oak trees were removed from Fort Jackson by helicopter because conventional tree removal equipment would have damaged the masonry walls.

The fort itself is no longer open to the general public, though its grounds and extant outworks are. Fort Jackson has been cleaned of storm debris and is open twice a year – once for the Plaquemines Parish Orange festival and once for the Fourth of July celebration. What sets Fort Jackson apart from its fellow Louisiana forts is the sincere public interest in the site. Residents of Plaquemines Parish love Fort Jackson and want it to be open to the public again. Several residents and local elected officials reached out when they learned that research was being conducted on the fort. People well into their 80s shared stories of childhood visits to Fort Jackson and of how it has been an important place for area gatherings for generations.

Even with the fort closed all but two days a year, it is still a major draw for the public. The 2015 Orange Festival attracted over a thousand people in an area with a

population of only about 1200. The love of Fort Jackson has led Plaquemines Parish historian Rod Lincoln to advocate for making the site part of the National Park Service (NPS). He and parish president Amos Cormier, Jr. have done extensive work to bring the area to the attention of the NPS. In December of 2014, the NPS announced a special resource study of the “Lower Mississippi Area,” which includes Fort Jackson and Fort Saint Philip. The special resource study began in June of 2016 with a town hall meeting in Plaquemines Parish and is ongoing.



Figure 41: *View of Fort Jackson from Battery Millar Showing Tree Growth on Terreplein.* (Photo by author, March 9, 2013)



Figure 42: *Fallen Trees at Fort Jackson.* (Photo by author, March 9, 2013)



Figure 43: *View of Moat and Sallyport of Fort Jackson showing Katrina Flood Waterlines on Masonry.* (Photo by author, March 9, 2013)



Figure 44: *Tree Growth and Collapsed Outwork at Fort Jackson.* (Photo by author, March 9, 2013)



Figure 45: *Crack in Northwest Bastion of Fort Jackson.* (Photo by author, March 9, 2013)

Fort Livingston

Historian Codman Parkerson wrote in 1990, “Gulf storms, hurricanes and an unstable foundation worked together to deteriorate the fort, which was consequently always in need of repair... The receding shoreline has caused the fort wall to collapse and practically wash away.”¹⁴¹ Nearly thirty years later, the shoreline is further deteriorated, particularly after a series of tropical storms and hurricanes that hit the area from 2002 to 2005. The State of Louisiana installed a riprap barrier around the seaward sides of Fort Livingston to protect both the fort and the western end of the island from erosion, but there are no plans for the preservation of the fort itself. Aerial photographs of Fort Livingston show extensive vegetative overgrowth and a general lack of maintenance. Fort Livingston was not visited as part of this thesis.



Figure 46: *Aerial Photo of Fort Livingston*. Digital Image courtesy of Google Maps. Accessed July 30, 2017. <https://www.google.com/maps/@29.2730598,-89.9462657,502m/data=!3m1!1e3>.

¹⁴¹ Weaver, 78.

Fort St. Philip

Fort St. Philip is privately owned and is inaccessible without permission and a boat or helicopter. The fort has had many reincarnations since its time as a defensive structure, including its years as a farming commune. The area has been hit by numerous storms including Hurricanes Katrina and Rita, and the fort is currently in a state of extreme deterioration from weather and vegetative overgrowth. Fort St. Philip was not visited as part of this thesis. Little of the original trace is visible from aerial photographs, but two Endicott batteries are very prominent.



Figure 47: *Aerial Photo of Fort St. Philip*. Digital Image courtesy of Google Maps. Accessed October 28, 2017. <https://www.google.com/maps/@29.3639501,-89.4629502,419m/data=!3m1!1e3>

Battery Bienvenue

Today, the ruins of Battery Bienvenue are accessible only by boat and are so overgrown with vegetation and wildlife that visiting is discouraged. Battery Bienvenue was not visited as part of this thesis.



Figure 48: *Aerial Photo of Battery Bienvenue*. Digital Image courtesy of Google Maps. Accessed October 28, 2017. <https://www.google.com/maps/@29.9848854,-89.8820648,342m/data=!3m1!1e3>

Tower Dupré

As recently as 1990, the tower was used as a fishing camp by its owner, and the lake had risen enough to keep the fort surrounded by water at all times.¹⁴² Until 2005, Tower Dupré had two of its three original stories, but the entire structure was destroyed

¹⁴² Parkerson, 71.

by Hurricane Katrina and is now a pile of rubble barely above the water. The site was not visited as part of this thesis.



Figure 49: *Tower Dupré in 2004*. White, Matthew. Digital Image. Accessed July 30, 2017. Reproduced at <https://irishmartellotowers.wordpress.com/other-countries/>.



Figure 50: *Tower Dupré after Hurricane Katrina*. White, Matthew. Digital Image. Accessed July 30, 2017. <http://rigolets.blogspot.com/>.

Fort Proctor

At the time of its construction, Fort Proctor was one hundred and fifty feet inland, but the construction of the Mississippi River-Gulf Outlet Canal along with damage from Hurricane Katrina has left the structure entirely surrounded by the waters of Lake Borgne. Plans to preserve the fort have been drafted, but no action has occurred. Fort Proctor is accessible only by boat and was not visited as part of this thesis.



Figure 51: *Fort Proctor*. Crews, Billy. Digital Image. April 28, 2015. (Photo reproduced with permission)

Fort Massachusetts

Ship Island and Fort Massachusetts are part of the Gulf Islands National Seashore and are under the jurisdiction of the NPS. Ship Island is accessible only by private boat or passenger ferry, and the fort is open to visitors daily in the spring, summer and fall. There is no museum at Fort Massachusetts, but there are ranger-led tours and a magazine has been converted into an interpretation area with historical information and images. The fort is in extremely good condition considering it was hit directly by Hurricane Camille in 1969 and nearly directly by Hurricane Katrina in 2005, the two strongest hurricanes ever to make landfall in the United States. The fort was filled with hurricane debris like the Louisiana forts, but with NPS funding, it was cleaned out quickly with all necessary repairs made in good time. Additionally, Fort Massachusetts' truncated circular shape has no bastion points to shear and crack, so the masonry is in much better condition than earlier star and kite shaped forts.

Beach nourishments projects on the northwest side of Ship Island have saved Fort Massachusetts from the encroaching ocean. Where once the water reached the scarp wall of the fort, there is now over one hundred feet of sandy beach.



Figure 52: *Aerial Photo of Fort Massachusetts Before Beach Nourishment.* Webster, Bob. Digital Image courtesy of Wikipedia.org. Accessed July 30, 2017. [https://en.wikipedia.org/wiki/Fort_Massachusetts_\(Mississippi\)#/media/File:FortMass20020410.jpg](https://en.wikipedia.org/wiki/Fort_Massachusetts_(Mississippi)#/media/File:FortMass20020410.jpg).



Figure 53: *Aerial Photo of Fort Massachusetts After Beach Nourishment.* Digital Image courtesy of hotelsinbiloxims.com. Accessed July 30, 2017. <http://hotelsinbiloxims.com/2017/07/27/vacation-guide-to-biloxi-ms/>.

Fort Gaines

Today, Fort Gaines is a popular tourist destination on Dauphin Island and is owned by the Dauphin Island Park and Beach Board. There is a museum and gift shop on site, as well as historic reenactments offered many times per year. The fort is open to visitors daily, except holidays, and is well publicized. Fort Gaines has been listed on the National Trust for Historic Preservation's "11 Most Endangered" list, as well as the Civil War Preservation Trust's "10 Most Endangered Civil War Battlefields" list. Three research visits were made to the fort, and each time it was full of visitors and all areas of the fort were open. The exterior masonry shows no major cracks, even at the bastions, and the foundation bricks show minimal spalling. There is a major crack the covert way, but the area is structurally sound and open to visitors.



Figure 54: *Fort Gaines Eastern Wall*. (Photo by author, May 2013)



Figure 55: *Crack in Fort Gaines' Covert Way Masonry.* (Photo by author, May 2013)



Figure 56: *Fort Gaines Southeast Bastion with Seawater in Moat.* (Photo by author, July 2017)



Figure 57: *Seaward Side of Fort Gaines.* (Photo by author, July 2017)



Figure 58: *Sand Accumulation at Intersection of Groine and Riprap Shore Protection in Front of Fort Gaines.* (Photo by author, July 2017)

Fort Morgan

Fort Morgan is managed by the Alabama Historical Commission. The fort is in very good condition, and the outworks are the “best preserved of any Third System fort.”¹⁴³ There is an informative museum on site with artifacts from all eras of the fort’s long history. The museum and fort are open to visitors daily, and there are regular historical reenactments, costumed interpreters and special events. The fort is very well publicized in local tourist pamphlets and websites. Post Third System batteries, including a large Endicott battery on the parade and two smaller outwork batteries alter the original plan of the fort, but do not diminish its significance.

Three research visits were made to Fort Morgan, and like Fort Gaines, it was filled with tourists each time. The area around Fort Morgan is part of an extensive dune restoration project, which has so far been successful. The beach surrounding the fort is healthy with no signs of erosion to threaten the structure. At its narrowest point, the beach between Fort Morgan and the Gulf of Mexico is over 500 feet wide. Fort Morgan shows few major cracks in the exterior masonry, though there is some significant mortar loss in the arches of the casemates. Overall, it is one of the best preserved forts on the gulf.

¹⁴³ Weaver, 174.



Figure 59: *Fort Morgan Northeast Bastion*. (Photo by author, July 2017)



Figure 60: *Fort Morgan Sallyport*. (Photo by author, July 2017)

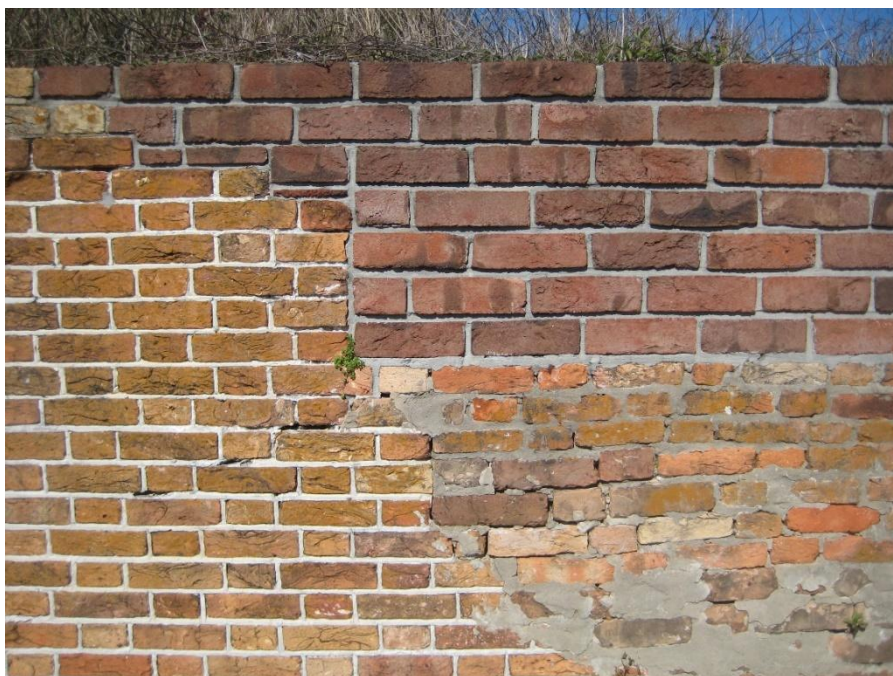


Figure 61: *Signs of Inconsistent Masonry Repair at Fort Morgan.*
(Photo by author, March 2013)



Figure 62: *Evidence of Rising Damp and Salt Accumulation in Masonry Walls of Fort Morgan.* (Photo by author, March 2013)

Fort Pickens

Fort Pickens is part of the Gulf Islands National Seashore and is under the jurisdiction of the NPS. The current state of the fort differs a good deal from the original construction. The exploded north demibastion is completely gone and a huge Endicott battery monopolizes the parade, but Fort Pickens is in good condition and is very well maintained. In addition to interpretation within the fort, there is a museum in the old officers' quarters nearby with exhibits on local flora and fauna, climate change statistics as they relate to Santa Rosa Island, and a scale model of the fort with architectural and historical highlights. The fort and museum are open daily to visitors for a small fee and are well publicized by the NPS, Visit Pensacola and the Official Florida Tourism Industry Marketing Corporation.

Like Gulf Shores, Santa Rosa Island receives extensive dune restoration and protection work. The beach surrounding Fort Pickens is thriving with no signs of erosion to threaten the structure. At its narrowest point, the beach between the fort and the bay is over 700 feet wide. The beach between the fort and gulf is over 800 feet wide.

Other than the loss of the northern demibastion and the related damage to the adjacent casemates, the masonry at Fort Pickens is in good shape. There is some cracking along the scarp wall, particularly at the bastions, but it is not extensive. Evidence of rising damp and salt accumulation is more obvious at Fort Pickens than at any other fort visited for this thesis. Interior walls throughout the structure drip with steady streams of water. Water weeping or evidence of past weeping was found at every fort visited, but none so much as at Fort Pickens where small stalactites and stalagmites of leached calcium hang

from the ceilings and rise from the floors, and swaths of calcium cling to casemate arches throughout the fort.



Figure 63: *Destroyed Bastion and Interpretive Center at Fort Pickens.* (Photo by author March 2013)



Figure 64: *Landward Side of Fort Pickens.* (Photo by author, March 2013)



Figure 65: *Calcium Leached From Masonry Walls at Fort Pickens.* (Photo by author March 2013)

Fort Barrancas and Spanish Water Battery

Fort Barrancas is maintained by the NPS, is in excellent condition and receives regular preservation care. There is a small museum on site with artifacts and interpretation related to the fort and the people who lived and worked there. The fort and museum are open to visitors Thursday through Monday with ranger-led and self-guided tours. Fort Barrancas is very well publicized in local tourist publications and by the NPS.



Figure 66: *Scale Model of Fort Barrancas and the Spanish Water Battery*. Taken in the Fort Barrancas interpretive area. (Photo by author, August 2015)



Figure 67: *Evidence of Preservation Monitoring at Fort Barrancas.* (Photo by author, August 2015)



Figure 68: *Bastion Damage and Repair at Fort Barrancas.* (Photo by author, August 2015)

The following graph is a visual representation of the risk of loss from land subsidence and sea level rise to Third System forts in Louisiana and along the Gulf Coast. Risk levels were determined by damage already incurred from hurricanes, storm surge and encroaching water; the presence of flood, storm and/or erosion mitigation; management and funding restrictions that limit preservation and repair work; and rates of relative sea level rise at each fort location.

Table 2: *Ranking of Risk of Third System Fort Loss Due to Sea Level Rise and Land Subsidence.* Author, 2017.

State	Fort	Risk of Loss from Climate Change	Risk of Loss from Neglect
Louisiana	Fort Pike	Extreme	High
	Fort Macomb	High	High
	Fort Jackson	Extreme	Medium
	Fort Livingston	Already Lost	N/A
	Battery Bienvenue	Already Lost	N/A
	Tower Dupré	Already Lost	N/A
	Fort Proctor	High	N/A
Mississippi	Fort Massachusetts	Medium	Very Low
Alabama	Fort Gaines	Medium	Very Low
	Fort Morgan	Low	Very Low
Florida	Fort Pickens	Low	Very Low
	Fort Barrancas	Very Low	Very Low
	Advanced Redoubt	Very Low	Very Low

CHAPTER 7

SURVEY OF SIMILAR SITES

Louisiana and the Gulf Coast have complex physical, geological and anthropogenic qualities that contribute to their rates of sea level rise and land subsidence and complicate the long term preservation of Third System forts. In order to identify potential best practices for structural preservation and land conservation of south Louisiana and the gulf region, three comparable sites were selected. The first site is Rotterdam, Netherlands chosen for its geographic parallels to New Orleans, Louisiana. The second is Hurst Castle in Hampshire, England chosen for its striking similarities to Third System forts in design, construction and location. The third site is the Atchafalaya National Heritage Area in central and south-central Louisiana, chosen for its proximity to the Lake Pontchartrain Basin and the potential for expansion to include the state's Third System forts. This chapter will survey policies and practices related to climate change mitigation at each site with an analysis of what can and cannot be replicated at forts and landscapes in southeast Louisiana and the larger Gulf Coast.

Like the Gulf Coast, the Delta Coast of the Netherlands has suffered numerous large-scale storms and floods, the dates of which are etched into their culture's collective memory. A 2007 case study prepared for presentation to the United Nations assesses the history of Dutch flood management through responses to such disasters. The study states that reactionary measures were recognized as inadequate to prepare Rotterdam and the

rest of the Netherlands for flooding and that the country chose radical innovation as the path to sustainable living in the face of climate change.

The Netherlands' current flood protection measures are a result of three major flood events in the 20th century. A great storm surge and its ensuing flood in 1916 led to the nation's first modern system of flood control, but it was the storm surge of 1953 that fundamentally altered the Netherlands' thinking about disaster preparedness. The storm of 1953, still known as "the disaster," and its resulting flooding covered 535,575 acres of land and destroyed 26,000 homes and 300 farms.¹⁴⁴ It was a storm that bore a striking resemblance to Hurricane Katrina 52 years later.

The Dutch authorities had not conceived of a storm with the power to overtake their levees, but in 1953, just as it would happen in New Orleans in 2005, the storm surge forced its way into the Netherlands and "the elaborate system of dikes and pumps gave way." Water overtopped the levees resulting in 80 breaches, unimaginable flooding, and eventually miles of mandatory repairs or replacements. What is most heartbreaking and eerily similar to Katrina is that the government's inability to imagine a storm strong enough to overtake the levees meant that an evacuation order was made too late. Much like in New Orleans, the Dutch people fled to attics and roofs only to wait days for rescue or to drown. In the end, the storm of 1953 claimed 1,835 lives.¹⁴⁵ Katrina claimed 1,833.¹⁴⁶

¹⁴⁴ Bart Orr, Amy Stodghill and Lucia Candu, "The Dutch Experience in Flood Management: A History of Institutional Learning," *unhabitat.org*, last modified 2007, <https://unhabitat.org/wp-content/uploads/2008/07/GRHS.2007.CaseStudy.Netherlands.pdf>, p.4.

¹⁴⁵ *Ibid*, 4.

¹⁴⁶ "Hurricane Katrina Statistics Fast Facts," *cnn.com*, last modified August 28, 2017, <http://www.cnn.com/2013/08/23/us/hurricane-katrina-statistics-fast-facts/index.html>.

For the Dutch, “the disaster” was a culture changing event. The newly formed Delta Commission proposed the 1957 Delta Act, which advised a comprehensive “series of primary and secondary dams to strengthen flood defences” as well as the shortening of the coastline.¹⁴⁷ The policy grew and changed with time, and projects that would have had negative impacts on the ecology of particular areas or the livelihoods of the people who lived there were altered or omitted. For example, a plan to dam a portion of the coastline roughly 40 miles southwest of Rotterdam was scrapped and in its place, the largest surge barrier in the Delta Works was constructed. The Oosterscheldekering, or Eastern Scheldt storm surge barrier, was completed in 1986.

The last of the major Delta Works projects was the construction of the Maeslantkering storm barrier that directly protects Rotterdam from North Sea storm surge. The barrier is a marvel of engineering. Completed in 1997, the barrier is made of two enormous swinging arches that are kept entirely on land until they are needed. When sea levels trigger the barrier’s computer system, the arches swing out from their holding places, floating along the water until they meet. Hollow sections of the barrier walls are then allowed to fill with water so that they sink down into the river bed creating a watertight, impenetrable wall. The Maeslantkering cost more than \$500 million, but is projected to protect the Netherlands against even a 10,000 year storm with the added benefit that it works with the local ecology and did not displace or disenfranchise local people who live and work nearby.¹⁴⁸

¹⁴⁷ Orr, et.al, 5.

¹⁴⁸ Ibid, 6.



Figure 69: *Maeslantkering at Port of Rotterdam*. Digital Image courtesy of Google Maps. Accessed September 2, 2017.
<https://www.google.com/maps/@51.9546215,4.1650623,2255m/data=!3m1!1e3>.

The Maeslantkering was built 20 years ago when the Dutch were primarily concerned with keeping seawater out. “Since 1953, the Dutch had focused on protecting themselves from the North Sea’s storms and flooding, but had largely ignored the rivers, as the last river flood had been nearly seventy years earlier.”¹⁴⁹ River floods in 1993 and 1995 forced the evacuation of hundreds of thousands of people and, as happened with the storm of 1953, changed Dutch policy. They recognized the water could not be kept out

¹⁴⁹ Ibid, 7.

forever and enacted two major pieces of policy. In 1998, France, Germany, Belgium and Luxembourg joined the Netherlands to adopt the “Action Plan on Flood Defence for the Rhine,” which set guidelines for nations upstream along the Rhine to protect those nearest the delta. In 2000, the Dutch presented “Room for the River,” an innovative plan for living with water often touted as the future of flood control.

Rather than building levees higher and higher, the Dutch are letting the water in strategically. According to the Dutch government’s website, “measures are taken to give the river space to flood safely... the measures are designed in such a way that they improve the quality of life of the immediate surroundings.”¹⁵⁰ “Room for the River” is an avant-garde plan, but there are traditional flood control techniques within it. Levees are not abandoned under the policy, rather; they are relocated farther from the river they are designed to control. This allows for a larger floodplain which holds more water and better protects the city. A related measure is the excavation of land within the enlarged floodplain to allow for the retention of even more flood water. Of course, “Room for the River” is more than floodplain alterations. In Rotterdam, parking garages and plazas now double as retention ponds in times of flooding, the government incentivizes removing hardscaping in residential and commercial properties, and citizens are educated about how to stay safe in the event of a disaster.

Rotterdam is often cited as a city whose flood control infrastructure New Orleans should emulate because the cities share many characteristics. Both are below sea level—

¹⁵⁰ “Room for the River,” *ruimtevoorderiver.nl*, accessed August 4, 2017, <https://www.ruimtevoorderivier.nl/english/>.

New Orleans at roughly 50% below, and Rotterdam at 90% below.¹⁵¹ Both cities sit in alluvial plains at major ports that are critical to domestic and international trade, particularly that of petroleum. New Orleans and Rotterdam each developed livable land by draining marshes and continue to utilize that land with complex pumping systems. There are, however, several important differences that affect the applicability of Dutch flood control to New Orleans, and it is important to recognize these differences when defining potential best practices.

First is that Rotterdam is built around the Nieuwe Maas, a distributary of the Rhine River, the total length of which is only about 15 miles. At its widest point in Rotterdam, the Nieuwe Maas is just over 1,000 feet. New Orleans, by comparison, is home to the Mississippi River, whose total length is 2,350 miles and whose watershed is roughly 1.2 million square miles. Its widest point in New Orleans is over 2,600 feet, and the average flow rate is over 600,000 cubic feet per second.¹⁵² Second are the differing landscapes surrounding each city. The City of Rotterdam has the Nieuwe Maas, is about 15 miles east of the North Sea and two miles north of the Oude Maas, a smaller distributary of the Rhine. New Orleans is bound on nearly every side by a body of water. The city is bordered on the north by Lake Pontchartrain, on the east by Lake Borgne and to the south by numerous bayous and wetlands, all with the Mississippi River running

¹⁵¹ Stephen A. Nelson, "Why New Orleans is Vulnerable to Hurricanes: Geologic and Historical Factors," *tulane.edu*, Fall 2012, http://www.tulane.edu/~sanelson/New_Orleans_and_Hurricanes/New_Orleans_Vulnerability.htm; and Michael Kimmelman, "The Dutch Have Solutions to Rising Seas. The World Is Watching," *nytimes.com*, June 15, 2017, <https://www.nytimes.com/interactive/2017/06/15/world/europe/climate-change-rotterdam.html>.

¹⁵² "Mississippi River Facts," *nps.gov*, accessed August 2, 2017, <https://www.nps.gov/miss/riverfacts.htm>.

right through the center, a complex network of natural bayous and engineered canals woven throughout, and the Gulf of Mexico a little under 40 miles away.

This is not to say that Dutch style flood control would not work for New Orleans and coastal Louisiana, rather, that an oversimplified “copy and paste” concept is not feasible. New Orleans must learn from Dutch innovation to think critically about what currently exists and creatively about what could exist in the future. Luckily, there are agencies in the area doing just that. The Water Institute of the Gulf, a not-for-profit applied research and technical services institution formed to help coastal and deltaic communities prepare for climate change, has been working with Dutch and New Orleanian engineers to create a more resilient city.

The earliest comprehensive project to reach completion is a conversion to “green infrastructure” in the Gentilly Resilience District (GRD). The project was funded in part by the Department of Housing and Urban Development and in part from winning the National Disaster Resilience Competition.¹⁵³ The GRD echoes the creative measures found in the Netherlands’ “Room for the River” program. A demolished convent was converted into a “water garden” capable of storing up to 10 billion gallons of stormwater, medians of major streets were also redesigned to store water, and neighborhood parks were reimagined to “incorporate stormwater management as a key component of neighborhood revitalization.” New Orleans sees the GRD as a “model for how other

¹⁵³ Laura Bassett, “New Orleans Looks to Amsterdam for a New Flood Plan,” *huffingtonpost.com*, last modified August 30, 2017, 2017, http://www.huffingtonpost.co.za/entry/new-orleans-netherlands-flood-plan_us_59a5a2d5e4b063ae34d93996.

neighborhoods in New Orleans, across the region, and across the country, can adapt to thrive in a changing environment.”¹⁵⁴

The GRD is an exciting step forward for flood control in New Orleans, and it speaks to a willingness to learn not only from the Dutch, but also from local, historical flood patterns. It is important to note, though, two significant problems related to both the possible application of Dutch flood control measures and existing flood control barriers as they relate to Third System forts. The first is that neither “Room for the River” nor the 40-year-long Delta Works campaign was designed for an area with cultural and historic resources so near the river and so far into the marsh. The levee beside Fort Jackson cannot be moved to create a larger floodplain without destroying the fort in the process. Likewise, no amount of parking garage reservoirs or swinging arm surge barriers could possibly protect Fort Pike or Fort Proctor from rising sea levels or a 1,000 year storm surge.

Second, the U.S. Army Corps of Engineers’ IHNC Lake Borgne Surge Barrier along with the circuit of floodgates, pumps and levee improvements are extremely limited in their capacity to protect. In addition to relying on higher levees and more walls, neither of which is championed by the Dutch, the post-Katrina system is only projected to withstand a 100-year storm and leaves many Louisianans and all but one of the state’s Third System forts outside the ring of defense. Fortunately, officials in state and federal government are recognizing that the hundred year standard is not enough for Louisiana. Input from The Water Institute of the Gulf, the Dutch Rijkswaterstaat and Netherlands

¹⁵⁴ “Gentilly Resilience District Fact Sheet,” *nola.gov*, last modified February 2017, <https://www.nola.gov/resilience/resources/fact-sheets/gentilly-factsheet/>.

Water Partnership was used in the 2017 draft Master Plan for a Sustainable Coast. Marsh creation, sediment deposition and freshwater diversion projects are part of what the Dutch call a “closed soft coast.”¹⁵⁵

The “closed soft coast” relies on salt marsh stabilization and freshwater marsh revitalization of roughly 1,500 square miles of marsh south and east of New Orleans to “afford some surge reduction and in particular, reduction in wave loads on the levees.”¹⁵⁶ The soft coast would then give way to a hard protection of New Orleans by means of levees, surge barriers and flood gates. More so than the traditional flood control infrastructure in place in New Orleans, it is marsh restoration that has the potential to protect Louisiana’s Third System forts. If land around the forts were able to reach out into the water rather than retreat from it, the forts could be spared constant wave action and might be afforded weaker storm surges.

The second site studied for potential best practices in the preservation of Third System forts was Hurst Castle in Hampshire, England. Hurst Castle was built in the 16th century on a shingle spit that extends 1.5 miles from Milford-On-Sea on England’s southern shore with marshland between the mainland and the beach. The fort was designed to prevent ships entering the Solent and the Southampton harbor. The original fort was a small, 12 sided stone tower with three rounded bastions at the northeast, northwest and southern points. The fort was renovated and modernized over the centuries, and in the early 1860s, work began on two large armored wings that extend

¹⁵⁵ U.S. Army Corps of Engineers, New Orleans District, Mississippi Valley Division, “Louisiana Coastal Protection and Restoration Final Report: Dutch Perspective Appendix,” June 2009, <http://www.mvn.usace.army.mil/Portals/56/docs/environmental/LaCPR/DutchPerspective.pdf>, p7.

¹⁵⁶ Ibid, 9.

from the central tower west and northeast along the curve of the beach. The parade view of the casemated wings bears a striking resemblance to those of Third System forts in both design and material.



Figure 70: *Hurst Castle, Hurst Spit and Keyhaven River*. Digital Image courtesy of Hurst Castle. Accessed August 2, 2017.
[http://www.hurstcastle.co.uk/gallery/#prettyPhoto\[postimages\]/18](http://www.hurstcastle.co.uk/gallery/#prettyPhoto[postimages]/18).

The siting of Hurst Castle is also remarkably similar to Third System forts. It is at the furthestmost projection of beach at a narrow between the English Channel and the

Solent. There is a battery directly opposite the fort on the Isle of Wight, and the two would have kept the channel safe from enemy ships just as Forts Morgan and Gaines were designed to do at Mobile Bay. Like Third System forts, the original Hurst Castle and the later armored wings were built very close to the water, and the overall form of the complete fort was dictated by the size and shape of the spit it is built upon. Additionally, Hurst Castle is located at a port that is regularly dredged for commercial and military ships as are both Pensacola and Mobile Bays, home to forts Barrancas, Morgan and Gaines.

The other unifying feature of Hurst Castle and Third System forts of the American Gulf Coast, particularly those on barrier islands, is beach erosion. The fort has a complex management structure, due in part to the severity of the beach erosion at Hurst spit. The site was given to English Heritage in 1956, but by 1993 management of the rapidly eroding spit was proving too costly for the organization and a deal was struck with a local family business to share management and related expenses. The business, Hurst Marine, is owned by a family with multigenerational links to Hurst Castle and a personal desire to keep the site open to the public. Working collectively with English Heritage, The Friends of Hurst Castle and the Association of Lighthouse Keepers, Hurst Marine has been able to complete extensive conservation work on both the fort and the beach.¹⁵⁷

There are three related problems facing Hurst Castle. The first is increased wave action, which erodes the beach. The second is wave overwashing, which contributes to

¹⁵⁷ “Hurst Castle Today,” *hurstcastle.co.uk*, accessed August 23, 2017, <http://www.hurstcastle.co.uk/hurst-castle-today/>.

saltwater intrusion in the Keyhaven Marsh on the lee side of the spit. The third problem is destabilization of the fort structure, itself, as result of problems one and two. The shingle at Hurst Spit has been declining since the 1940s, most likely as the result of groins installed in Christchurch Bay that negatively impact littoral drift. A major breach in the spit in 1996 caused severe damage and was the impetus for a large scale beach nourishment and protection strategy.¹⁵⁸ Tons of gravel were shipped in and deposited the length of the spit. The beach adjacent to mainland was given a large stone revetment, and the beach at the westernmost end of the fort received a smaller one. Moving eastward, the beach and fort are protected by a zig-zag, wooden seawall, short wooden pier groins and a line of deposited rock that does not quite constitute a revetment.



Figure 71: *Aerial Photo of Hurst Castle Shoreline Protection*. Digital Image courtesy of Google Maps. Accessed August 2, 2017. <https://www.google.com/maps/@50.7065475,-1.5524662,307m/data=!3m1!1e3>.

¹⁵⁸ Poole & Christchurch Bays Coastal Group, “Hurst Spit Management Unit CBY7,” last modified August 5, 2011, http://www.twobays.net/hurst_spit.htm.

The protection and nourishment plans were successful at stabilizing, but not revitalizing the beach, and in 2014 an extremely strong storm tore through the spit overwashing the beach and causing massive erosion that required additional dredged material to repair.¹⁵⁹ The beach is slated to receive another £300,000 “recharge” of beach material, and Hurst Castle itself has received a £1 million investment from English Heritage to restore vital parts of the structure.¹⁶⁰ The best practices gleaned from Hurst Castle are not necessarily related to structural preservation or landscape conservation, neither of which is significantly better or worse than that found at Gulf Coast Third System forts. Rather, it is the management structure that proves so successful.

By partnering with Hurst Marine, The Friends of Hurst Castle and the Association of Lighthouse Keepers, English Heritage was able to preserve a structure they would have otherwise deaccessioned. This innovative model of partnership unites a powerful national organization with highly engaged local citizens and could easily be replicated at several of the non-NPS managed forts along the Gulf Coast. Forts Gaines and Morgan have already been saved by the passion and hard work of local people who cared about their cultural history. Fort Jackson is not regularly open to the public, but remains a part of the local culture through annual festivals on-site and meetings of the parish historical society. A partnership among local non-profits, engaged citizens and the State of

¹⁵⁹ Ian West, “Chesil Beach, etc. - Hurricanes, Storms and Storm Surges: Geology of the Wessex Coast of Southern England,” accessed August 28, 2017, <http://www.southampton.ac.uk/~imw/chestorm.htm>.

¹⁶⁰ “Hurst Spit £300k coastal defence project - Guardian of the western Solent,” *nfdc.gov.uk*, last modified September 20, 2017, <http://www.nfdc.gov.uk/article/17838/Hurst-Spit-300k-coastal-defence-project---Guardian-of-the-western-Solent>, and English Heritage.; “English Heritage Invests £1 Million to Preserve Hurst Castle,” *english-heritage.co.uk*, last modified April 26, 2017, <http://www.english-heritage.org.uk/about-us/search-news/English-Heritage-invests-in-Hurst-Castle>.

Louisiana could be the answer to some of the preservation problems at Forts Pike and Macomb.

The third site studied is the Atchafalaya National Heritage Area in the state of Louisiana, which can be interpreted as large-scale version of the Hurst Castle partnership model. According to the National Park Service,

National Heritage Areas (NHAs) are designated by Congress as places where natural, cultural, and historic resources combine to form a cohesive, nationally important landscape. Through their resources, NHAs tell nationally important stories that celebrate our nation's diverse heritage. NHAs are lived-in landscapes. Consequently, NHA entities collaborate with communities to determine how to make heritage relevant to local interests and needs.

NHAs are a grassroots, community-driven approach to heritage conservation and economic development. Through public-private partnerships, NHA entities support historic preservation, natural resource conservation, recreation, heritage tourism, and educational projects. Leveraging funds and long-term support for projects, NHA partnerships foster pride of place and an enduring stewardship ethic.¹⁶¹

The Atchafalaya National Heritage Area (ANHA) was established in 2006 and is touted as being “among the most culturally rich and ecologically varied regions in the United States, home to the widely recognized Cajun culture as well as a diverse population of European, African, Caribbean and Native-American descent.”¹⁶²

The ANHA is large, stretching across 14 parishes from Concordia in the north down the Atchafalaya River Basin to the Gulf of Mexico, and covers nearly one million acres of land.¹⁶³ In addition to cypress swamps and coastal marshes, the ANHA includes the state capital, Baton Rouge, and three petroleum refineries. The ANHA is

¹⁶¹ “What is a National Heritage Area?” *nps.gov*, last updated December 1, 2016, <https://www.nps.gov/articles/what-is-a-national-heritage-area.htm>

¹⁶² Ibid.

¹⁶³ “Atchafalaya National Heritage Area,” *louisianatravel.com*, accessed November 5, 2017, <http://www.louisianatravel.com/areas/atchafalaya-national-heritage-area>

directly adjacent to the Lake Pontchartrain Basin and preserves remarkably similar landscapes, including a single major city, New Orleans; multiple refineries; and thousands of acres of inland swamps and coastal marshes.

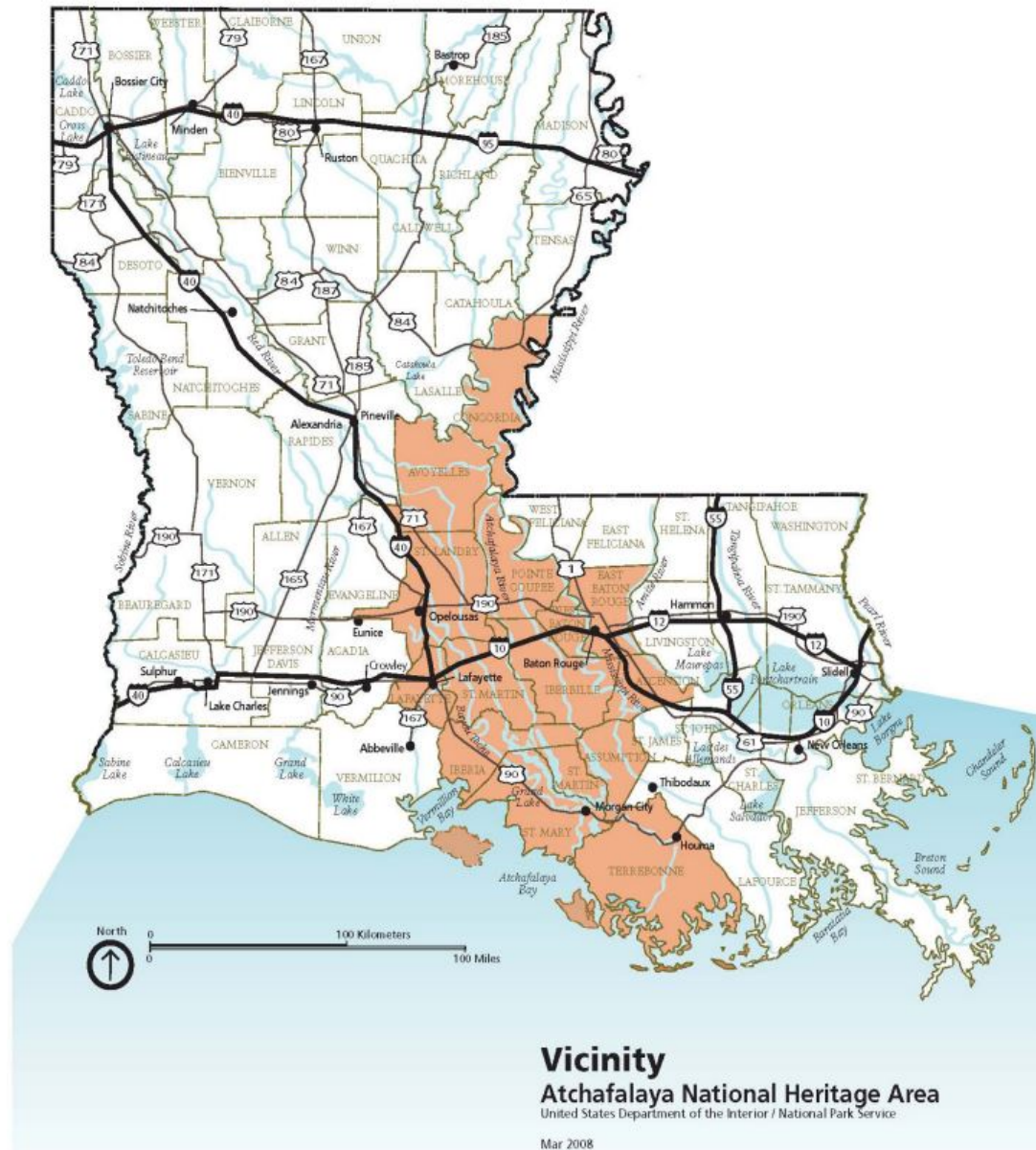


Figure 72: *Map of Atchafalaya National Heritage Area*. Digital Image courtesy of [atchafalaya.org](http://www.atchafalaya.org). Accessed November 5, 2017.
[http://www.atchafalaya.org/ckfinder/userfiles/files/FinalMP-1\(1\).pdf](http://www.atchafalaya.org/ckfinder/userfiles/files/FinalMP-1(1).pdf)

In 2011, then Lieutenant Governor Jay Dardenne presented the area's first Management Plan and Environmental Assessment. It was developed by Atchafalaya Trace Commission and is similar to the management plan for the Gulf Islands National Seashore. The plan identifies four goals for the ANHA: enhancing interpretation and awareness, supporting sustainable cultural economic development, increasing appreciation for cultural resources, and increasing appreciation for natural resources. It goes on to identify three interpretive themes: adaptation and survival, identity through a cultural blend, and the influence of the water on the land and the people. Finally, the plan offers four alternatives: no action; natural resource protection and recreation; protection and restoration of cultural resources; and reflection of the interrelationship of natural resources with culture and history, which includes all three interpretive themes and is the Commission's preferred alternative.

The management plan does not present specific policies for landscape preservation or climate change mitigation, rather it presents an interpretive plan based on ecotourism, youth and adult education, and culturally responsible business development to "support a healthier Atchafalaya ecosystem..." by increasing public knowledge and interest in the area's natural and cultural resources.¹⁶⁴ This broad plan is achieved through dynamic partnerships among local, state and federal agencies, as well as local businesses, non-profit organizations and schools. The primary partnership is the Atchafalaya Trace Commission (ATC), which is responsible for developing and implementing the

¹⁶⁴ Atchafalaya Trace Commission, *Atchafalaya National Heritage Area Management Plan and Environmental Assessment*, 2011, 56. [http://www.atchafalaya.org/ckfinder/userfiles/files/FinalMP-1\(1\).pdf](http://www.atchafalaya.org/ckfinder/userfiles/files/FinalMP-1(1).pdf)

management plan.¹⁶⁵ (Fig ?). In the 2011 plan, the ATC lists 31 potential partners; the 2017 website boasts 29.¹⁶⁶

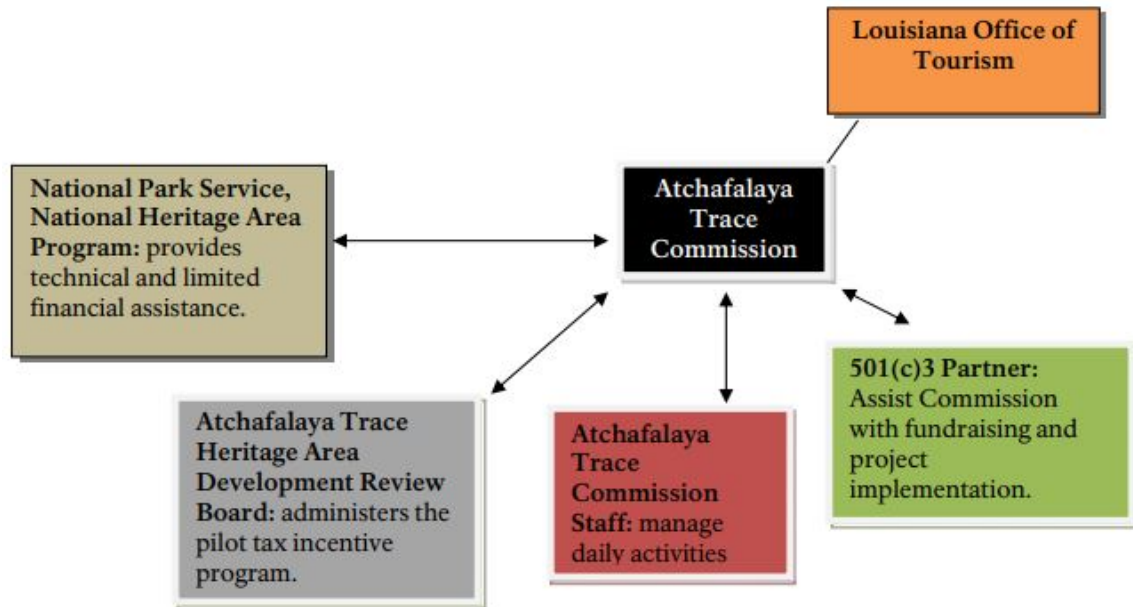


Figure 73: *Atchafalaya National Heritage Area Organizational Framework*. Digital image courtesy of [atchafalaya.org](http://www.atchafalaya.org). Accessed November 5, 2017. [http://www.atchafalaya.org/ckfinder/userfiles/files/FinalMP-1\(1\).pdf](http://www.atchafalaya.org/ckfinder/userfiles/files/FinalMP-1(1).pdf)

The ANHA is successfully implementing its mission. Since its creation in 2006, the ANHA has led to the establishment of the Atchafalaya Basin festival, which showcases local art and food, as well as Cajun language and music. In October of 2017, the ANHA and the Louisiana Department of Culture, Recreation and Tourism launched the Atchafalaya Water Heritage Trail, an “interactive, educational experience (that) leads

¹⁶⁵ Ibid, 58.

¹⁶⁶ “Sustaining Partners,” *atchafalaya.org*. Accessed November 5, 2017. <http://www.atchafalaya.org/partners-links>

both locals and visitors through a variety of water-related sites with natural, cultural or historical significance.”¹⁶⁷

Unfortunately, the National Heritage Areas Act of 2006 prohibits the adjustment of national heritage area boundaries, so the ANHA cannot be expanded to encompass the Lake Pontchartrain Basin or any Third System forts.¹⁶⁸ Rather, it can be used as a model for large-scale partnerships that preserve more than a single historic site and landscape. The Hurst Castle partnership is effective for Hurst Castle and its narrow spit, and could potentially be replicated for a single Third System fort in Louisiana. The ANHA model, on the other hand, offers insight into how all of Louisiana’s Third System forts and surrounding landscapes could be jointly interpreted and promoted as a cultural and eco-tourist destination.

Assessments of how similar sites have handled the challenges of climate change and sea level rise offer a path to create dynamic solutions for Third System forts in Louisiana and the Gulf Coast. Dutch designs for a “closed soft coast” have the potential to protect urban centers like New Orleans as well as more marsh-bound sites like Forts Pike and Macomb and Battery Bienvenue. Management strategies that incorporate stakeholders at the local, state and national levels have the potential to elevate otherwise underutilized resources and to save structures that face the risk of demolition by neglect.

¹⁶⁷ “About the Atchafalaya National Heritage Area,” *waterheritage.atchafalaya.org*. Accessed November 7, 2017. <http://waterheritage.atchafalaya.org/about-us>

¹⁶⁸ Public Law 109-338, National Heritage Areas Act of 2006.

CHAPTER 8

CONCLUSION AND RECOMMENDATIONS

New Orleans, coastal Louisiana and the rest of the Gulf Coast are home to more Third System forts than any other part of the country. These masonry forts were a marvel of engineering and constituted the United States' first step toward becoming the world's top military superpower. The forts did not achieve their goal of defending the US from an invading foreign force and were rapidly made obsolete by advances in weapons technology, but they are an important part of early America's story. The forts are valuable links to the past worth saving and worth sharing with future generations.

The final chapter of this thesis begins with a chart showcasing each fort's cultural and architectural significance; management and accessibility; current preservation issues; the rate of sea level rise in the surrounding landscape; and the risk for loss from the effects of climate change and/or neglect (Table 3). The chart's data provides support for the thesis statement that sea level rise and land subsidence are the greatest threats to these structures and that environmental conservation is the best way to preserve them. Additionally, the chart is the basis for recommendations for the management and preservation of the forts, which were informed by potential best practices from the three locations studied in the previous chapter. Collective recommendations for all Third System forts in Louisiana and the Gulf Coast are presented first, followed by recommendations specific to forts in Louisiana.

Table 3: Comparative Chart Ranking Risk of Loss from Multiple Factors. Author, 2017.

State	Fort	Cultural Significance	Architectural Significance	Management and Accessibility	Current Preservation Issues	Rate of Sea Level Rise of Surrounding Landscape	Risk of Loss from Climate Change	Risk of Loss from Neglect
Louisiana	Fort Pike	High	High	State owned/Closed	Severe structural damage/No plans for repair	~5.15 mm/year	Extreme	High
	Fort Macomb	Medium	Medium	State owned/Closed	Severe plant overgrowth/No plans for repair	~5.15 mm/year	High	High
	Fort Jackson	High	High	Parish owned/Closed	Moderate plant overgrowth/plans and funding for repair	Data not available	Extreme	Medium
Mississippi	Fort Livingston	Low	Low	State owned/Closed, but accessible	N/A	~9.1 mm/year	Already Lost	N/A
	Fort Massachusetts	Medium	Medium	NPS owned/Open to the public	Beach erosion near fort/Beach nourishment provided	~3.0 mm/year	Medium	Very Low
Alabama	Fort Gaines	High	Medium	Tourist Board owned/Open to the public	Beach erosion near fort/Riprap protection provided	~3.5 mm/year	Medium	Very Low
	Fort Morgan	High	High	Historical commission owned/Open to the public	No major issues	~3.5 mm/year	Low	Very Low
Florida	Fort Pickens	High	High	NPS owned/Open to the Public	No major issues	~2.31 mm/year	Low	Very Low
	Fort Barrancas	Medium	Medium	NPS owned/Open to the public	No major issues	~2.31 mm/year	Very Low	Very Low

Louisiana's forts have been the first lost to the combined forces of sea level rise and land subsidence. Fort Proctor was slowly inundated by the waters of Lake Borgne, and Fort Livingston was pulled apart by waves and storm surge on the eroded barrier island of Grande Terre. Hurricane Katrina arrived years later to damage Forts Jackson, Macomb and Pike and to destroy Tower Dupré. As the above chart shows, Louisiana's remaining forts, which are located in areas with the highest rates of relative sea level rise in the Gulf Coast, are the most damaged and the most likely to be lost due to climate change.

Third System forts of the Gulf Coast were built on islands, shoals and riverbanks, the very places that are first affected by wetlands loss and sea level rise. This is particularly apparent in the inundation of Fort Proctor on Lake Borgne, where marshland loss has left a structure once firmly on land nearly 200 feet from the shore. Fewer than 150 miles separate the three intact Louisiana forts from those in Pensacola, Florida, and yet the conditions of those forts are wildly different. In Louisiana, where rates of relative sea level rise are as high as three times the global average, Third System forts are sinking in rising waters, losing bricks and mortar to increased wave action, and being broken apart by hurricanes and storm surge. On the rest of the Gulf Coast, where rates of sea level rise are equal to or lower than the global average, Third System forts are in good shape and at relatively low risk of being lost to the effects of climate change.

It has been shown that Louisiana's rates of land subsidence and sea level rise are worse than the rest of the Gulf Coast for reasons both natural and anthropogenic. The Mississippi River helped form coastal Louisiana, but is now a major reason it is sinking as the weight of the river and its suspended sediment are pressing the land down. Human

interference in the landscape in the forms of river and flood control; cypress deforestation, oil and gas extraction, and canal dredging have added to the problem by restricting sediment deposits, destabilizing subsurface structures and killing protective marshland.

Sitting at the very edges of Louisiana's disappearing coastlines, Third System forts serve as harbingers of the effects of climate change on coastal historic structures. As waters rise around and land subsides beneath these forts, it is apparent that traditional hands-on preservation will not be enough to save them for future generations. It is imperative that their landscapes be conserved and restored as much as possible if Louisiana's Third System forts are to remain intact.

The first post-Katrina protections put in place in Louisiana were highly engineered, structural projects built to protect New Orleans by keeping water out without thought to the people, landscapes and cultural resources that lay outside the walls of protection. The State of Louisiana has come to recognize the importance of landscape restoration as a tool of climate change mitigation and storm protection and has added several environmental projects to the 2017 Master Plan for a Sustainable Coast. Mississippi River sediment diversion, ridge restoration, marsh restoration and barrier island beach nourishment projects are planned and funded and will act as complements to larger, structural U.S. Army Corps of Engineers projects such as the IHNC Lake Borgne Storm Surge Barrier and the Seabrook Floodgate.

After analyzing what the State of Louisiana is doing to protect and restore its coast, three relevant sites were studied for potential best practices in flood control, storm mitigation and management structures. The first site, Rotterdam, offered innovative flood

control and storm surge mitigation techniques that could benefit coastal Louisiana and the Lake Pontchartrain Basin area. The Dutch concept of a “soft closed coast” that includes floodplain expansions and marsh creation has the potential to slow hurricanes down and to hold more floodwater within levees to protect coastal landscapes and historic resources.

The second site, Hurst Castle is similar in style, material and location to Third System forts and is suffering many of the same problems. Stronger storms and a disappearing beach led to preservation challenges that were more than English Heritage could manage. Faced with the prospect of closing Hurst Castle, English Heritage partnered with a local business and two other local organizations to preserve the fort and its landscape while keeping it open to the public year round. Hurst Castle relies heavily on beach nourishment and shore protections to keep the fort safe from the effects of sea level rise and land subsidence, but its creative management partnership allows for public access, national attention and the funds necessary to preserve the site.

The third site studied was the Atchafalaya National Heritage Area, which lies just west of the Lake Pontchartrain Basin in the State of Louisiana. The ANHA has a partnership-based management system similar to that of Hurst Castle, but larger and more formalized. The area was created by an act of Congress and receives consultation assistance, though no funding, from the National Park Service. Blending natural and cultural resource education, eco-tourism and beneficial business development in the area, the ANHA is able to increase local and outsider interest in and access to the Atchafalaya River Basin while conserving the landscape for future generations. It is a model with the potential to benefit Third System forts of Louisiana and of the entire Gulf Coast.

Based on the three example sites and data from Table 3, recommendations are presented for Louisiana's intact Third System forts as well as the forts of Mississippi, Alabama and Florida:

Recommendations for Third System forts of Louisiana and the Gulf Coast

The first recommendation for the long-term preservation of the gulf's Third System forts is comprehensive documentation, regardless of risk level. Advances in laser scanning and 3D replication allow the forts to be precisely documented and digitally preserved for future generations. Digital heritage documentation is supported by UNESCO, the World Monuments Fund and the Smithsonian and has been used to preserve sites the world over, including the Sydney Opera House, Rapa Nui and Mt. Rushmore.¹⁶⁹ Louisiana's forts are at the most risk for loss and should be documented first to ensure they are preserved. More stable forts in Mississippi, Alabama and Florida should be scanned every 5 to 10 years or after severe weather events to assess structural changes.

The second recommendation is specific to forts outside of Louisiana. Forts in Mississippi, Alabama and Florida already have in place landscape conservation and restoration projects that are proving successful. Ship Island's beach nourishment project has saved Fort Massachusetts from inundation. Dauphin Island's riprap shoreline protection has stopped the rapid erosion of the beach near Fort Gaines. Dune protection and restoration is active near Fort Morgan on Gulf Shores and Fort Pickens on Santa

¹⁶⁹ "A 3D Documentation Primer for Cultural and Historic Sites," *voicesofthepast.org*. Last Updated May 18, 2017. <http://voicesofthepast.org/2017/05/18/3d-documentation-primer/>

Rosa Island. It is recommended that these projects continue for the long-term preservation of the forts.

The third recommendation is to treat all seven intact forts as a collective resource. Third System forts were designed and built as a cohesive unit. Their sites were scouted and chosen to establish a network of forts working to protect New Orleans, Mobile Bay and Pensacola Bay. The forts are no longer part of America's defense system, but they are important cultural resources with educational value that is not being fully utilized. As the forts were decommissioned, they changed hands from the U.S. Army to private citizens, state and local governments, tourism boards, and the National Park Service. After more than one hundred years under a single management structure, the forts were treated as individual entities with no thought to their relationships to each other.

Interpreting the forts as a collective resource can be done in two ways. One is to put all eight extant forts under combined local, state and federal control using the National Heritage Area model. The other is to cluster the forts based on the areas they were designed to protect and to build more localized management partnerships similar to that of Hurst Castle in England. The cluster method could be interpreted cohesively with the creation of a Gulf Coast Third System Forts Heritage Trail from Louisiana to Pensacola. Both methods have the potential to increase tourism to coastal Louisiana sparking interest in and potential funding for coastal restoration projects.

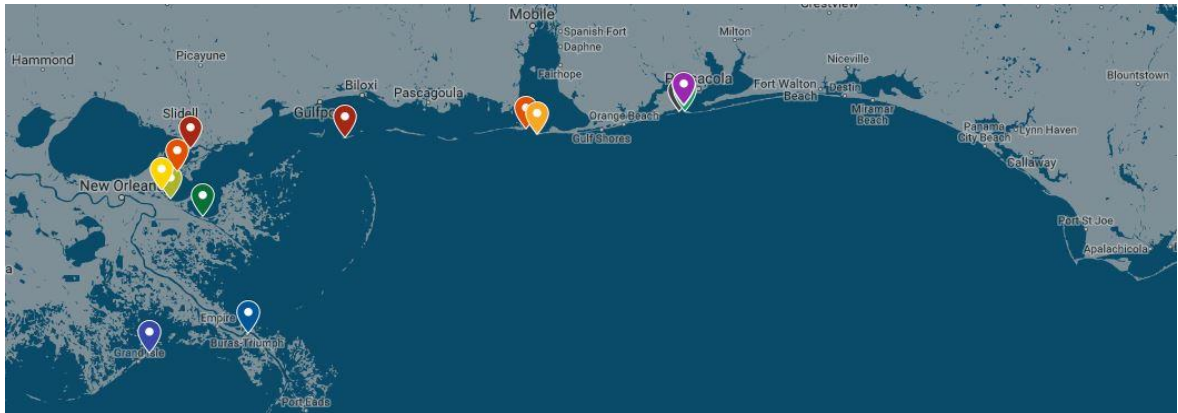
The NPS currently owns Forts Barrancas, Pickens and Massachusetts as part of the Gulf Islands National Seashore. Forts Barrancas and Pickens were built to protect Pensacola Bay, and it makes sense that they are owned by the same organization and interpreted together. Fort Massachusetts, though, is 100 miles west with Forts Morgan

and Gaines in the middle (Fig ?). Dauphin Island and Gulf Shores are too developed to be a part of the Gulf Islands National Seashore, but their respective forts are a key part of the interpretation of Third System forts on the gulf. National Heritage Areas are designed to include both rural and developed landscapes and, in this case, offer a viable management and interpretation solution for the forts.



Fig 74: NPS Map of Gulf Islands National Seashore Digital Image courtesy of National Park Planner.com. Accessed October 21, 2017. <http://npplan.com/wp-content/uploads/2016/02/GUIS-park-Guide.pdf>

Map 6: *Third System Forts and Subsidiary Structures of the Gulf Coast*. Digital Image courtesy of Google Maps. Accessed October 21, 2017.
<https://www.google.com/maps/d/edit?mid=18hM33AmjUwwcJo3W4LQ0TKejGmw&ll=29.80910843876165%2C-88.61633419999998&z=9>



The Gulf Islands National Seashore ends at Cat Island, just before the Louisiana border, and because none of Louisiana's three intact forts are on islands, they do not qualify to be part of the park. Creating the Gulf Coast Third System Forts National Heritage Area would circumvent that restriction. Being a National Heritage Area would have a strong positive effect on the forts in Louisiana by getting comprehensive site interpretation from the NPS, improving public access to closed forts, increasing available funds for preservation work and increasing tourism.

Under the second option, the forts would still be interpreted as a unit, perhaps as a Heritage Trail, but ownership and management would be more localized and would not require approval by Congress. In Louisiana, Plaquemines Parish, the State of Louisiana and other interested stakeholders could partner to stabilize, interpret and open Forts Jackson, Pike and Macomb. Fort Massachusetts was designed to protect New Orleans, so rather than be interpreted alone on Ship Island, it could be incorporated into the

Louisiana cluster of forts within the Gulf Coast Third System Forts National Heritage Area or Heritage Trail. In Mobile Bay, the Dauphin Island Park and Beach Board and the Alabama Historical Commission could interpret Forts Morgan and Gaines together. The ownership and management of Forts Barrancas and Pickens would not change under this plan, but interpretation would be expanded to include the six other Third System forts on the gulf.

The cluster option is preferred because it is more manageable and can be completed in a shorter timeframe. When discussing the possibility of a Lower Mississippi Area National Park, parish historian Rod Lincoln was glad that Fort Jackson might get the attention and the preservation work that it needs, but voiced concern at losing control of something so beloved by the community. A partnership model would alleviate such fears because Plaquemines Parish would still have a say in the management of Fort Jackson.

Recommendations for Forts in the State of Louisiana

Louisiana's Third System forts are at the most risk of loss from climate change. Rates of land subsidence and sea level rise are higher there than at any other part of the Gulf Coast.¹⁷⁰ Fort Livingston, Tower Dupré, Fort Proctor and Battery Bienvenue have already been lost. Recommendations for lost forts follow the "adaptation management options" presented in the University of Oregon Cultural Landscape Research Group's "Climate Change and Cultural Landscapes: A Guide to Research, Planning and

¹⁷⁰ "Tides & Currents: Sea Level Trends," NOAA.gov, accessed February 27, 2017, <https://tidesandcurrents.noaa.gov/sltrends/sltrends.html>.

Stewardship” and include documentation of what remains and interpretation of the site’s history and of climate change’s role in the destruction of the fort, if possible.¹⁷¹ Battery Bienvenue is too overgrown for visitors and Tower Dupré is a pile of rubble, but Fort Proctor and Fort Livingston are popular destinations for kayakers. Weatherproof interpretive panels at or near the forts could explain the history of the Third System and of how sea level rise and land subsidence are affecting coastal Louisiana, including the destruction of the two sites.

In the event that no preservation efforts are made at Forts Pike, Macomb or Jackson, the recommendation is to document the sites with laser scanning, prepare for loss and interpret the role of sea level rise and land subsidence in the loss of coastal resources on weatherproof panels at or near each fort site. The following recommendations are made for forts in the State of Louisiana in the absence of a National Heritage Area or Heritage Trail.

Fort Pike

Fort Pike is the most endangered of Louisiana’s intact Third System forts. Its position at the end of the landbridge in the Rigolets leaves it vulnerable to storm surge, flooding and constant wave action. Recommendations for Fort Pike include both environmental protections and hands on preservation due to the structural damage from Hurricane Katrina.

¹⁷¹ Melnick, Robert Z., Noah P. Kerr, Veronica Malinay, and Olivia Burry-Trice. *Climate Change and Cultural Landscapes: A Guide to Research, Planning and Stewardship*. Eugene, Oregon: Cultural Landscape Research Group, University of Oregon (2017), 29-32.

Following comprehensive documentation, the first recommended step in preserving Fort Pike is following the repair proposal prepared by Ladd Ehlinger. Fort Pike is in a precarious situation because another Katrina level hit could entirely remove a bastion or collapse all or part of a rampart. The top priority project is the excavation and styrofoam refilling of the bastions to lessen the weight of the structure. Next is a breakwater to limit wave action damage and, finally, perimeter brick repair to stabilize walls.

Recommendations for the site's long-term preservation incorporate the Dutch idea of a "soft closed coast" in the form of marsh creation and revitalization in areas that will protect Fort Pike from hurricane action. Luckily for Fort Pike, this recommendation is in the official planning stage. The 2017 draft Master Plan for a Sustainable Coast allots \$17.8 billion to marsh creation projects, a portion of which will reach from Lake Borgne, across the landbridge to the northshore encompassing both sides of the small peninsula where Fort Pike lies as well as the large marsh barrier between the Rigolets and Lake Borgne on Fort Pike's ocean facing side.¹⁷² Work on this project is slated to begin in the first ten years of the plan's implementation.¹⁷³

The final recommendation is that the site be reopened to the public. "Out of sight, out of mind" is a dangerous place for historic structures to be. Opening the fort will re-engage the local community and will mandate regular maintenance. Current damage to the fort can be interpreted to inform guests about climate change in Louisiana.

¹⁷² "Louisiana's Comprehensive Master Plan for a Sustainable Coast, 2017 Draft Plan Release," *coastal.la.gov*, http://coastal.la.gov/wp-content/uploads/2016/08/2017-MP-Book_2-page-spread_Combined_01.05.2017.pdf, ES-15-ES-19.

¹⁷³ Ibid, 120.

Fort Macomb

Following documentation, recommendations for Fort Macomb include a breakwater to protect the masonry from wave action and the permanent closure of the canal surrounding the fort to keep out boat traffic and vandals. Removal of vegetative overgrowth is necessary to expose the masonry and limit root damage to the structure. The site should be opened to the public and interpreted with Fort Pike. Marsh creation projects included in the 2017 master plan will benefit Fort Macomb, and it is within the proposed Lake Pontchartrain Barrier, which will offer protection from storm surge.

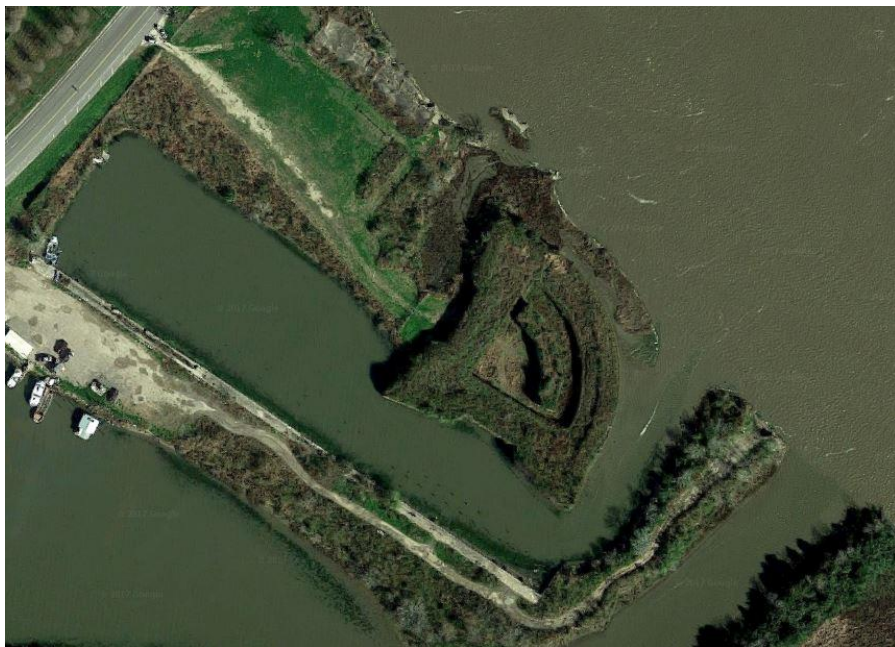


Figure 75: *Aerial Photo of Fort Macomb Showing Water Access*. Digital Image courtesy of Google Maps. Accessed July 30, 2017. <https://www.google.com/maps/@30.0648401,-89.8051075,419m/data=!3m1!1e3>.

Fort Jackson

Fort Jackson's greatest controllable threat is vegetative overgrowth, particularly oak trees. They surround the outworks, are growing in the terreplein and are even found in portions of the parade. Storms cause the trees to drop limbs or fall onto the fort where they damage historic masonry. The first recommendation for Fort Jackson is digital documentation followed by the careful removal of all trees with the capacity to damage the fort prioritizing dead or damaged trees, followed by trees in the terreplein, then those within the parade, and finally trees adjacent to the outworks.



Figure 76: *Aerial Photo of Fort Jackson Showing Tree Cover.* Digital Image courtesy of Google Maps. Accessed October 1, 2017. <https://www.google.com/maps/@29.3565858,-89.4560135,676m/data=!3m1!1e3>.

Fort Jackson should be open to visitors more than twice a year to maintain and increase local interest. Full time operation is not sustainable due to its rural location and small budget, but part time access for school groups, local community members and tourists would be beneficial. Interpretation of local land loss and Hurricane Katrina damage would be appropriate and would highlight the fort's uncertain future.

Fort Jackson is far beyond the protection of U.S. Army Corps of Engineers post-Katrina projects and, unfortunately, is not part of the 2017 coastal master plan's marsh creation areas. The city of Buras-Triumph, and by extension Fort Jackson, are in a no-man's-land south of the master plan's declared projects and north of what the plan labels an "area of opportunity."¹⁷⁴ Near Fort Jackson, the land on both sides of the Mississippi River is disappearing. Bay Pomme d'Or and Yellow Cotton Bay, once thriving wetlands, were officially removed from NOAA's maps in 2013.¹⁷⁵ In the absence of the "soft closed coast" provided by protective wetlands, storms will hit Fort Jackson with nothing to slow them down.

The first recommendation for the long term preservation of Fort Jackson is to lobby state officials to extend marsh creation projects from Port Sulphur to the end of the Mississippi River. The second recommendation is to continue to pursue inclusion in the National Park Service for better funding and more comprehensive site management or to pursue a partnership similar to that of Hurst Castle.

If neither recommendation for long term preservation is successful, Plaquemines Parish should document Fort Jackson, prepare for eventual loss, and interpret the role of

¹⁷⁴ Ibid, 35.

¹⁷⁵ Nikki Buskey, "As Coasts Erode, Names Wiped Off the Map," *houmatoday.com*, last modified May 1, 2013, <http://www.houmatoday.com/news/20130501/as-coast-erodes-names-wiped-off-the-map>.

sea level rise and land subsidence in the loss of Louisiana's coastline and coastal resources.

The Third System forts included in this thesis face challenges common to historic, masonry structures, with the added complication of being on the front lines of climate change. Their positions in marshes and on barrier islands make them some of the first cultural resources to be impacted by the threats of land subsidence and sea level rise. Rates of land subsidence, sea level rise and their accompanying damage vary from fort to fort, but every one of the forts must be prepared for a future that includes rising waters and stronger storms. Landscape conservation and restoration has the potential to preserve Third System forts beyond what traditional hands-on, structural preservation can do.

Research for this thesis was limited to Third System forts of inland Louisiana and the Gulf Coast. Further research could expand to include all of the United States' Third System forts. As is argued in this paper, the forts were built as a unit and could be researched and interpreted as such. A larger paper could accommodate research on the effects of sea level rise and land subsidence on all Third System forts as a collective resource.

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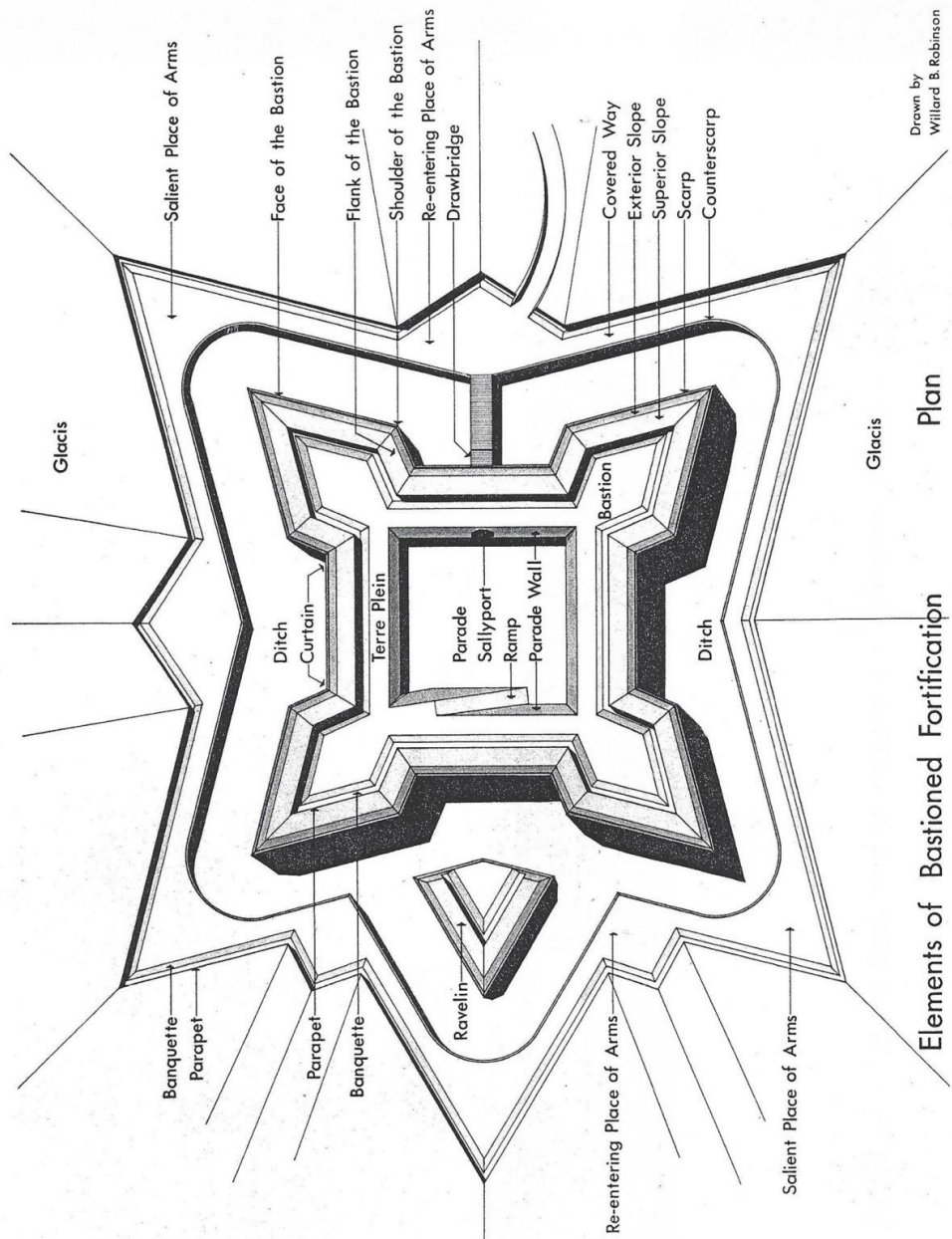
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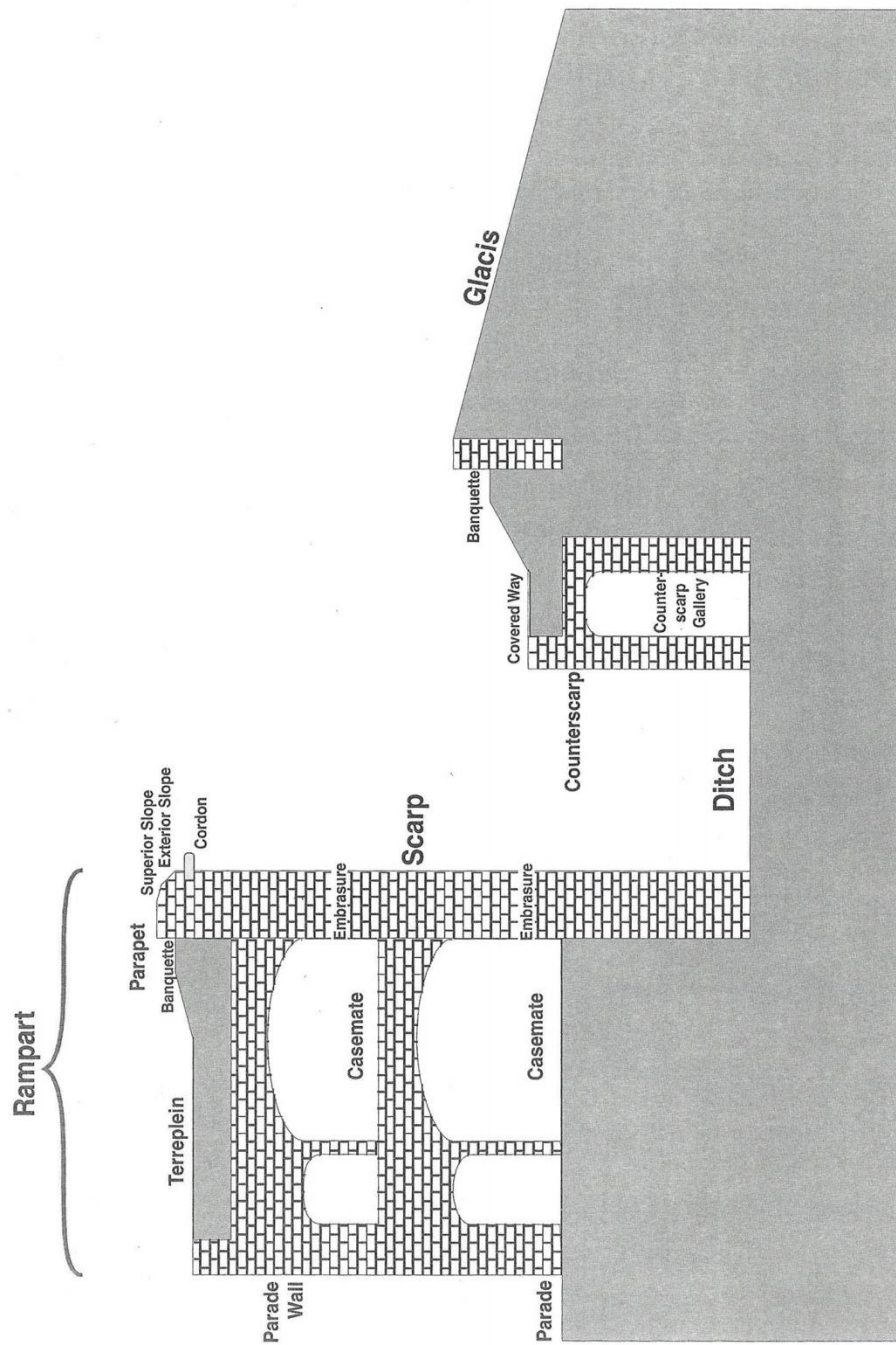
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APPENDICES

APPENDIX A



APPENDIX B



Fortification elements often found in Third System forts
Section View

APPENDIX C: GLOSSARY OF TERMS

ADVANCED WORK: Any work of fortification located outside the glacis yet within musketry range.

BANQUETTE: A continuous step or ledge at the base of a parapet on which defenders stood to fire over the top of the wall.

BASTION: A projection in the enceinte, made up of two faces and two flanks, which enabled the garrison to defend the ground adjacent to the enceinte.

BERM: A narrow, level space between the exterior slope and the scarp, which functioned to prevent earth of the rampart from sliding into the ditch.

BULWARK: Circular works of defense surrounded by walls or ramparts.

CASEMATE: A bombproof enclosure, generally located under the rampart, for housing cannons, which fired through embrasures in the scarp. Casemates were also used as quarters, magazines, and the like.

CAVALIER: In fortification, a raised work where artillery was placed to command the surrounding works or country. It was sometimes placed on the terreplein or bastion of a curtain.

CHEMIN DE RONDE: A narrow passage or berm located inside the scarp, at the base of the exterior slope of a rampart. The level of the path was below the top of the scarp and was thereby protected on the side facing the country. Functionally, it was used by officers to make their rounds, and it served as a place for defense against attempts at escalade.

CITADEL: A small but strong fort within, or situated to form a part of, a larger fortification. Usually located to dominate the area and other works surrounding it, it functioned as a place of refuge from which defense could be prolonged after the main works fell.

COUNTERSCARP: The exterior side of a ditch—the side away from the body of the place.

COUNTERSCARP GALLERY: A work located behind the counterscarp from which the ditch could be defended with reverse fire.

COVERED WAY: A road around a fortification between the ditch and the glacis. It was protected from enemy fire by a parapet, at the foot of which was generally a banquette enabling the coverage of the glacis with musketry. In addition to its function as an outer line of defense, it served as a place for sorties to assemble.

CURTAIN: A section of a bastioned fortification that lies between two bastions.

DEMIBASTION: A bastion with only one face and one flank.

DETACHED BASTION: A bastion which was separated by a space from the main body of the place.

DETACHED SCARP: A scarp wall separated from a rampart by a *chemin de ronde*. Also called a “carnot wall.”

DETACHED WORK: In general, a work which is beyond the range of musketry from the body of the place yet functionally related to its defense.

DITCH: A wide, deep trench around a defensive work, the material from the excavation of which was used to form the ramparts. When filled with water, it was termed a *moat* or *wet ditch*, otherwise it was called a *dry ditch*.

EMBRASURE: An opening in a wall or parapet through which cannons were fired. The sides, generally splayed outward, were termed *cheeks*; the bottom was called the *sole*; the narrow part of the opening, the *throat*; and the widening, the *splay*.

EN BARBETTE: An arrangement for cannons in which they were mounted on high platforms or carriages so that they fired over a parapet instead of through embrasures.

ENCEINTE: The works of fortification—walls, ramparts and parapets—that enclose a castle, fort or fortress.

FACE OF THE BASTION: The section of any bastion between the flanked angle and the shoulder angle. In a regular bastion, it was one of the two sides of the bastion which formed a salient angle pointing outward and which was situated on the lines of defense.

FLANK OF THE BASTION: The section of the bastion lying between the face and the curtain from which the ditch in front of the adjacent curtain and the flank and face of the opposite bastion were defended.

GLACIS: A broad, gently sloped earthwork built up outside the covered way. At the covered way it was terminated against a parapet, and in the direction of the field it was sloped downward until it generally blended into the natural level of the ground.

GORGE: In a bastion, the interval or space between the two curtain angles. In other works that were open at the rear, it denoted the opening. In some five-sided forts the designation applied to the rear section of the enceinte.

HORNWORK: A work made up of a bastioned front—two half bastions and a curtain—and two long sides termed *branches*. It functioned to enclose an area adjacent to, but not contained within, a fort or fortress.

LUNETTE: A work with two faces and two parallel flanks generally used as an advanced fortification. The term also sometimes denotes a work used on the side of a ravelin.

MAGAZINE: A place for storage of gunpowder, arms, provisions, or goods.

MOAT: *see ditch*.

OUTWORK: A work inside the glacis, but outside the body of the place.

PARADE: An area, usually centrally located, where troops were assembled for drill and inspection.

PARAPET: In fortification, a work of earth or masonry forming a protective wall over which defenders fired their weapons.

RAMPART: A mass of earth formed with material excavated from the ditch to protect the enclosed area from artillery fire and to elevate defenders to a commanding position overlooking the approaches to a fort or fortress.

RAVELIN: A work consisting of two faces forming a salient angle which was closed by a gorge. Ravelins were separated from the main body of the place by ditches and functioned to protect curtains.

REDOUBT: An enclosed fortification without bastions.

REENTERING PLACE D'ARMES: A space along the covered way formed outside the reentering angle of the counterscarp by providing a salient in the parapet. Its function was to provide space for forming sorties and a means of flanking defense of the glacis.

REVTMENT: The facing of the sides of a ditch or parapet.

SALIENT: An angular work which protects outward from the interior.

SALIENT PLACE D'ARMES: A space along the covered way formed by rounding the trace of the counterscarp opposite the flanked angle of the bastion.

SALLYPORT: A passage, either open or covered, from the covered way to the country; or a passage under a rampart, usually vaulted, from the interior of the fort to the exterior, primarily to provide for sorties.

SCARP: The interior side of the ditch.

SORTIE: A sudden attack on besiegers by troops from a defensive work. The main objective was to destroy siege works that had been constructed by the aggressors.

TERREPLEIN: A level space on the rampart between the parapet and the parade face.

TRACE: The outlines of the horizontal configurations of a fortification.¹

¹ Willard B. Robinson, *American Forts: Architectural Form and Function*, (Chicago: University of Illinois Press, 1977), 197-205.