Mississippi Valley Division,
Regional Planning and Environment Division South

Amite River and Tributaries Study East of the Mississippi River, Louisiana

Appendix F: Plan Formulation

March 2025

TABLE OF CONTENTS

Section 1 Introduction 1
Section 2 Management Measures 2
2.1 Nonstructural Measures 2
2.2 Structural Measures 3
2.3 Screening Criteria 4
2.4 Screening of Measures 4
Section 3 Initial Array of Alternatives 15
3.1 Development of Initial Array of Alternative 15
3.2 Screening Criteria 19
3.3 Screening of Alternatives 19
3.4 The Focused and Final Array of Alternatives 21
Section 4 Focused Array of Alternatives 25
4.1 No Action 25
4.2 Dry Dams along Tributaries 25
4.3 Large Scale 0.04 AEP Dam (Darlington Dam) 27
4.4 Nonstructural 29
4.5 2019 Economic Analysis 29

LIST OF TABLES

Table F-1 – Objectives and Constraints 1
Table F-2 – Management Measures 6
Table F-3 – Alternatives 22
Table F-3 – Focused Array of Alternatives 25
Table F-4 – Summary of Costs and Benefits for Focused Array of Alternatives based on 2019 Evaluation 30

LIST OF FIGURES

Figure F-1 – Management Measures Located in the Lower ARB....12
Figure F-2 – Management Measures Located in the Central ARB....13
Figure F-3 – Management Measures Located in the Upper ARB....14
Figure F-4 – Location of Alternative 15....18
Figure F-5 – Location of Dry Dams along Tributaries....26
Figure F-6 – Close up of Large Scale 0.04 AEP Dam (Darlington Dam)....28

Section 1
Introduction

This appendix supplements the information in Section 4 of the main report and includes tables and maps used in the development, screening, and evaluation of management measures and alternative plans. The ART goals, objectives, and constraints are identified in Section 2 of the main report. They are included here as a point of reference for screening purposes (Table F-1).

Table F-1 – Objectives and Constraints

OBJECTIVES	CONSTRAINTS
Reduce risk to human life from flooding.	Avoid promoting development within the floodplain (in accordance with E.O. 11988) to the maximum extent practicable, which contributes to increased life safety risk.
Reduce rainfall flood damages in the ARB to industrial, commercial, agricultural facilities, and residential and nonresidential structures.	None
Reduce interruption to the nation's transportation corridors in particularly the I-10/I-12 infrastructure.	None
Reduce risks to critical infrastructure (e.g. medical centers, schools, transportation etc.).	None

Additionally, several planning considerations were identified for plan formulation that would not require the removal of an alternative plan, but were assessed as part of the plan formulation process:

- Avoid or minimize negative impacts to:
  - threatened and endangered species and protected species;
  - critical habitat, e.g., threatened and endangered species (T&E);
  - water quality;
  - cultural, historic, and Tribal resources;
  - recreation use in the basin.
- Recognition/awareness that reaches of the Amite and Comite Rivers are Scenic Rivers, which may require legislative changes in order to implement alternatives.
- Consistency with local floodplain management plans by not inducing flooding in other area.

Section 2
Management Measures

Measures considered for this study are discussed in Section 4, Sub-section 4.1. This section provides additional information about those measures that were evaluated and removed from further consideration during the planning process. Due to the large size of the study area, for presentation and discussion purposes, the ARB was divided into three areas that have distinct geomorphology: the Upper Basin, Central Basin, and Lower Basin (Figures F-1 through F-3).

The ARB primarily has flooding from two different sources. The upper basin flooding is caused from headwater flooding from rainfall events. The lower basin flooding is caused by a combination of drainage from headwaters and backwater flooding from tides, wind setup, and flooding from tropical storm events. Thirty-four nonstructural and structural management measures of a variety of scales were identified for evaluation to reduce the risk of flood damages within the ARB (Table F-2).

The management measures use one or more combinations of Concept/Formulation Strategy for Flood Risk Management (FRM) as follows:

- Remove Water (RW) = Removing water more quickly out of the basin
- Hold Water (HW) = During heavy rainfall events water would be held back from flowing down the basin until water levels drop to reduce the flood risk.
- Nonstructural (NS) = does not modify or restrict the natural flood
- Upper and Lower Basin (UL) = Alternative that likely results in reduced flood risk for the entire basin.
- Focused Structural (FS) = Focused Structural measures to protect critical Facilities

2.1 NONSTRUCTURAL MEASURES

Nonstructural measures (NS) reduce the human exposure or vulnerability to a flood hazard without altering the nature or extent of the flood hazard. Nonstructural alternatives could be used in conjunction with any of the structural flood mitigation alternatives to optimize the cost/benefit ratio.

- Nonphysical (NS-1): Consists of flood warning system/evacuation plans. While adequate land use and floodplain management development regulations already exist, it warranted further evaluation.
- Physical NS (NS-2): Consists of property acquisition and relocation assistance, elevation, and/or flood proofing of structures.

2.2 STRUCTURAL MEASURES

Structural measures are those that are physical modifications designed to reduce the frequency of damaging levels of flood inundation. Retention structures are large, regional, below grade structures, designed to attenuate flood peaks and release downstream at non-damaging flow rates. The following features are being considered:

- .01 Annual Exceedance Probability (AEP) dry dams along smaller Amite River Tributaries north of I-12 and/or below I-12 (HW-1).
- Large and small scale dams in the upper portion of the ARB (HW-2 and UL-1).
- Storage Area at Spanish Lake Basin (RW-7)
- Reservoirs along Bayou Manchac (HW-3)
- Diversion Structures: Diversion structure(s) located in the lower portions of the ARB that can divert flow to the Mississippi River. Gravity Fed and Pump diversions were considered as well as modifications to the Comite and Amite Rivers diversions that are presently in place RW-10 through RW-16)
- Channelization: There are numerous possible variations of this measure, including dredging channelization segments in specific downstream reaches of the river combined with upstream detention (RW-1 through RW-4, RW-18 through RW-20, and UL-2)
- Ring Levees: Ring levees, or similar, could be constructed to protect communities and other significant structures and/or lands (FS-1).
- Drainage Improvements: Numerous possibilities such as a combination of contoured swales or road cuts with traditional drainage infrastructure (culverts, catch basins, flow control structures and slotted pipe) to regulate the flow and discharge of storm water south of French Settlement (RW-17 and HW-5).
- Bridge improvements: Change in design to bridges where applicable to reduce the restriction of the flow of the Amite River and tributaries (RW-5, RW-8, RW-9).
- Dredging of Lakes: Increase the depth of the Lake Maurepas and University Lakes to increase the hold capacity of the lakes during extreme rainfall events and tide/wind backwater flooding for Lake Maurepas (RW-22 and HW-7).
- Channel Bank Gapping: Select cuts into the banks of the Amite River and Tributaries (RW-6 and RW-21).
- Levee System: A system of multiple earthen embankment, floodwall, or similar structures along a water course (RW-23).
- Floodgate: Closure of tidal pass at Lake Maurepas/Lake Pontchartrain or Hwy 61 at Blind River to reduce backwater flooding caused by tides and wind driven flooding (HW-4 and HW-6).

2.3 SCREENING CRITERIA

The screening criteria were derived for the specific planning study using planning objectives, constraints, and considerations and opportunities of the project area.

Due to the limited ability to generate new data prior to the Alternatives Milestone, metrics relied principally upon existing data and professional judgment.

2.4 SCREENING OF MEASURES

Each measure was qualitatively assessed using a 4-point scale on whether it met the objective(s) or avoids constraints and considerations as discussed in Section 1 by using the following criteria: Exceeds (++), Meets (+), No Change (n), or Decreases (-) (Table F-2). After evaluating, the USACE formed Project Delivery Team (PDT) consisting of USACE members, the non-Federal sponsor and other interested state and Federal agencies, reviewed the results to reevaluate the highest scoring alternatives should be retained. In some cases, some of the higher scoring management measures were screened out.

The scoring results were compiled and averaged and 19 measures were carried forward for alternative development. Below is a general discussion of those measures that were screened, which were limited to structural.

2.4.1 Diversion Structures (RW-10, RW-11 and RW-13 thru RW-16)

The Mississippi River at the proposed locations (RW-11, RW-13, and RW-15) has a much higher elevation in comparison to the adjacent Amite River and tributaries. A negative flow would not be achievable by gravity fed means; therefore, the gravity fed diversions to the Mississippi River were screened out. The Bayou Conway (RW-10), Romeville (RW-14), and Union (RW-16) locations, proposed for a pump at the Mississippi River with a diversion, were screened, but Bayou Manchac (RW-12) was carried forward due to the complexity of the area and potential benefits. The pump stations would have a limited radius of influence, the cost would be very significant due to the head losses associated with the pump distances needed, and there would be limited opportunities to place a diversion due to large, developed areas under forced drainage systems.

2.4.2 Channelization (RW-18 thru RW-20)

Dredging the outfall at Blind River (RW-18), the Lower Blind River (RW-19), and Colyell Creek (RW-20) were screened out in part due to limited benefits. Based on the LADOTD 2018 Report on Investigation into the Potential Hydraulic Impacts of Dredging the Lower Amite River, dredging near the mouth of Lake Maurepas would result in negligible amounts of water surface elevation reduction due to the flood elevations being controlled by the Lake and influenced by tides. Colyell Creek has also limited benefits due to the low density of structures along the creek.

2.4.3 Drainage Improvements (RW-17 and HW-5)

Modifications to Comite Diversion (RW-17) was screened out. The Comite Diversion project is currently in construction under the Bipartisan Budget Act of 2018. Dry Retention Ponds along the Lower Amite River (HW-5) was screened in part because the geomorphology of the Lower Amite is extremely flat, which prevents the use of dry retention ponds to be feasible in the area below I-12.

2.4.4 Channel Bank Gapping (RW-21)

Select cuts of the bank of the Amite River at the Amite River Diversion (RW-21) was screened out in part because it would have very limited FRM benefits and would only likely affect stages directly on the Amite River diversion channel. It would also potentially impact backwater areas. Channel bank gaping along the Amite River was carried forward as an alternative for further evaluation (RW-6).

2.4.5 Dredging of Lakes (RW-22)

Increasing the depth of the Lake Maurepas (RW-22) by dredging was screened for several reasons including limited benefits and significant impacts to the Lake Maurepas ecosystem. Additionally, overtime the measure could be ineffective with relative sea level rise since it is hydrologically connected to Lake Pontchartrain. Dredging of University Lakes was carried forward as an alternative for further evaluation (HW-7).

2.4.6 Levee System (RW-23)

A system of multiple earthen embankment, floodwall, or similar structures along a water course whose purpose is flood risk reduction or water conveyance constructed to reduce flooding risk to communities and other significant structures and/or lands. A levee system was screened due to geotechnical constraints and flood inducement. A large levee system would have a larger footprint and a greater potential to encounter local geotechnical constraints. (i.e. subsidence, fissures). There are also few locations along the ART that have high ground points to tie in levees which would result in most communities requiring ring levees, which would increase the life safety risk since there would be no direct access to higher ground if the levee failed. Also, levees along the Amite River in highly density population areas would cause a larger peak discharge in downstream portions which would result in induced flooding.

2.4.7 Floodgates (HW-4 and HW-6)

Floodgates at Hwy 61 at Blind River (HW-4) were screened out in part because the measure would require significant improvements to other infrastructure to make it work and there would be limited benefits. Lake Maurepas/Lake Pontchartrain (HW-6) was screened in part due to limited benefits, significant impacts to the Lake Maurepas ecosystem, and historically, there has been significant public opposition to closing off the passes.

Table F-2 – Management Measures

		Exceeds (++), Meets (+), No Change (n), or Decreases (-) the Objective NA were used for Measures that were strictly NER Measures				Avoids Constraint/Considerations High (++), Medium (+), Low to no issue or not applicable (n), or Conflicts (-) with the Constraint/Consideration							
		Obj1	Obj2	Obj3	Obj4	Con1	Con2	Con3	Con4	Con5	Con6	Con7	Con8
Measure ID	Description	Reduce flood damages from rainfall	Reduce risk to human life from flooding events	Reduce interruption to the nation's transportation corridors	Reduce risks to critical infrastructure (e.g. medical centers, schools, transportation etc.);	T&E	Critical Habitat	Cultural	Water Quality	Scenic Rivers	Local Flood Manag-ement Plans	BBA Author-ization limits	Not to induce develop-ment within flood plain
RW-1	Dredging of Outfall @ Amite River	+	n	n	n	n	n	-	+	-	n	+	n
RW-2	Dredging of Lower Amite River	+	n	n	n	n	n	-	+	-	n	+	n
RW-3	Dredging of Upper Amite River	+	n	-	n	n	n	-	n	-	n	+	n
RW-4	Dredging of Bayou Manchac	+	n	++	+	n	n	-	n	-	n	+	n
RW-5	Bridge Restrictions/ Improvements for I-12	+	n	+	+	n	n	-	+	-	n	+	n
RW-6	Amite River Channel Bank Gapping	+	n	n	+	n	n	-	+	+	+	+	n

		Exceeds (++), Meets (+), No Change (n), or Decreases (-) the Objective NA were used for Measures that were strictly NER Measures				Avoids Constraint/Considerations High (++), Medium (+), Low to no issue or not applicable (n), or Conflicts (-) with the Constraint/Consideration							
		Obj1	Obj2	Obj3	Obj4	Con1	Con2	Con3	Con4	Con5	Con6	Con7	Con8
Measure ID	Description	Reduce flood damages from rainfall	Reduce risk to human life from flooding events	Reduce interruption to the nation's transportation corridors	Reduce risks to critical infrastructure (e.g. medical centers, schools, transportation etc.);	T&E	Critical Habitat	Cultural	Water Quality	Scenic Rivers	Local Flood Manag-ement Plans	BBA Author-ization limits	Not to induce develop-ment within flood plain
RW-7	Storage Area at Spanish Lake, Ascension/Iberville Parish	+	n	+	+	-	-	-	-	+	-	+	+
RW-8	Hwy 22 and Port Vincent Bridge Drainage Improvements	+	n	n	n	-	-	n	+	+	+	-	+
RW-9	Upper Amite Bridge Restrictions/ Improvements	+	n	+	+	n	n	-	+	-	n	+	n
RW-10	Bayou Conway Pump to Mississippi River	+	n	+	+	n	-	-	n	+	n	n	+
RW-11	Diversion Gravity Fed (Manchac)	+	n	+	+	n	-	-	n	-	n	+	+
RW-12	Diversion Pump Station (Manchac)	+	n	+	+	n	-	-	n	-	n	+	+

		Exceeds (++), Meets (+), No Change (n), or Decreases (-) the Objective NA were used for Measures that were strictly NER Measures				Avoids Constraint/Considerations High (++), Medium (+), Low to no issue or not applicable (n), or Conflicts (-) with the Constraint/Consideration							
		Obj1	Obj2	Obj3	Obj4	Con1	Con2	Con3	Con4	Con5	Con6	Con7	Con8
Measure ID	**Description**	**Reduce flood damages from rainfall**	**Reduce risk to human life from flooding events**	**Reduce interruption to the nation's transportation corridors**	**Reduce risks to critical infrastructure (e.g. medical centers, schools, transportation etc.);**	**T&E**	**Critical Habitat**	**Cultural**	**Water Quality**	**Scenic Rivers**	**Local Flood Manag-ement Plans**	**BBA Author-ization limits**	**Not to induce develop-ment within flood plain**
RW-13	Diversion Gravity Fed (Union)	+	n	n	n	n	-	n	n	+	n	n	+
RW-14	Diversion Pump Station (Union) with conveyance channel	+	n	n	n	n	-	n	n	+	n	n	+
RW-15	Diversion Gravity Fed (Romeville)	+	n	n	n	n	-	n	n	+	n	n	+
RW-16	Diversion Pump Station (Romeville) with conveyance channel	+	n	n	n	n	-	n	n	+	n	n	+
RW-17	Modifications to Comite Diversion	+	n	n	n	n	n	-	n	-	n	-	n
RW-18	Dredging of Outfall @ Blind River	+	n	n	n	n	n	-	+	-	n	+	n

		Exceeds (++), Meets (+), No Change (n), or Decreases (-) the Objective NA were used for Measures that were strictly NER Measures				Avoids Constraint/Considerations High (++), Medium (+), Low to no issue or not applicable (n), or Conflicts (-) with the Constraint/Consideration							
		Obj1	Obj2	Obj3	Obj4	Con1	Con2	Con3	Con4	Con5	Con6	Con7	Con8
Measure ID	Description	Reduce flood damages from rainfall	Reduce risk to human life from flooding events	Reduce interruption to the nation's transportation corridors	Reduce risks to critical infrastructure (e.g. medical centers, schools, transportation etc.);	T&E	Critical Habitat	Cultural	Water Quality	Scenic Rivers	Local Flood Management Plans	BBA Authorization limits	Not to induce development within flood plain
RW-19	Dredging of Lower Blind River	+	n	n	n	n	n	-	+	-	n	+	n
RW-20	Dredging of Colyell Creek	n	n	n	n	-	-	-	-	-	n	+	n
RW-21	Amite River Diversion Channel Bank Gapping	n	n	n	n	n	n	n	+	+	+	n	n
RW-22	Dredging of Lake Maurepas	n	n	n	n	-	-	-	-	-	n	+	n
RW-23	Levees System	n	-	+	+	n	n	-	-	-	n	+	-
HW-1	.01 AEP Dry Dams-Upper Amite Tributaries	+	n	+	+	n	n	n	+	n	n	+	n
HW-2	Small Dry Dams on Amite River - Upper Amite	++	+	+	+	n	n	-	+	-	+	+	n
HW-3	Reservoirs along Bayou Manchac	+	n	+	+	n	n	-	n	-	n	n	n

		Exceeds (++), Meets (+), No Change (n), or Decreases (-) the Objective NA were used for Measures that were strictly NER Measures				Avoids Constraint/Considerations High (++), Medium (+), Low to no issue or not applicable (n), or Conflicts (-) with the Constraint/Consideration							
		Obj1	Obj2	Obj3	Obj4	Con1	Con2	Con3	Con4	Con5	Con6	Con7	Con8
Measure ID	Description	Reduce flood damages from rainfall	Reduce risk to human life from flooding events	Reduce interruption to the nation's transportation corridors	Reduce risks to critical infrastructure (e.g. medical centers, schools, transportation etc.);	T&E	Critical Habitat	Cultural	Water Quality	Scenic Rivers	Local Flood Management Plans	BBA Authorization limits	Not to induce development within flood plain
HW-4	Flood Gate at Blind River Hwy 61	+	n	n	+	-	n	n	n	-	n	n	n
HW-5	Dry Retention Ponds- Lower Amite	+	n	n	n	-	n	-	n	n	n	n	n
HW-6	Closures at Tidal Passes	+	n	n	+	-	-	n	-	n	n	-	n
HW-7	University Lakes as Reservoir	+	n	n	n	n	n	n	n	n	++	+	n
UL-1	Large Scale .04 AEP Dam -Upper Amite (i.e. Darlington)	++	n	++	++	-	-	-	n	-	+	++	n
NS-1	Flood warning/Monitoring systems	n	++	+	n	n	n	n	n	n	n	n	n
UL-2	Dredging of Amite River Tributaries	+	+	+	+	n	n	-	n	-	n	+	n

		Exceeds (++), Meets (+), No Change (n), or Decreases (-) the Objective NA were used for Measures that were strictly NER Measures				Avoids Constraint/Considerations High (++), Medium (+), Low to no issue or not applicable (n), or Conflicts (-) with the Constraint/Consideration							
		Obj1	Obj2	Obj3	Obj4	Con1	Con2	Con3	Con4	Con5	Con6	Con7	Con8
Measure ID	Description	Reduce flood damages from rainfall	Reduce risk to human life from flooding events	Reduce interruption to the nation's transportation corridors	Reduce risks to critical infrastructure (e.g. medical centers, schools, transportation etc.);	T&E	Critical Habitat	Cultural	Water Quality	Scenic Rivers	Local Flood Manag-ement Plans	BBA Author-ization limits	Not to induce develop-ment within flood plain
NS-2	Nonstructural Improvements for high frequency events	+	+	n	n	n	n	n	n	n	n	+	n
FS-1	Ring Levees around Critical Facilities	+	+	n	+	n	n	-	n	n	n	+	n

Note: Shaded cells are measures that were not carried forward during the screening process.
NA = Not Applicable

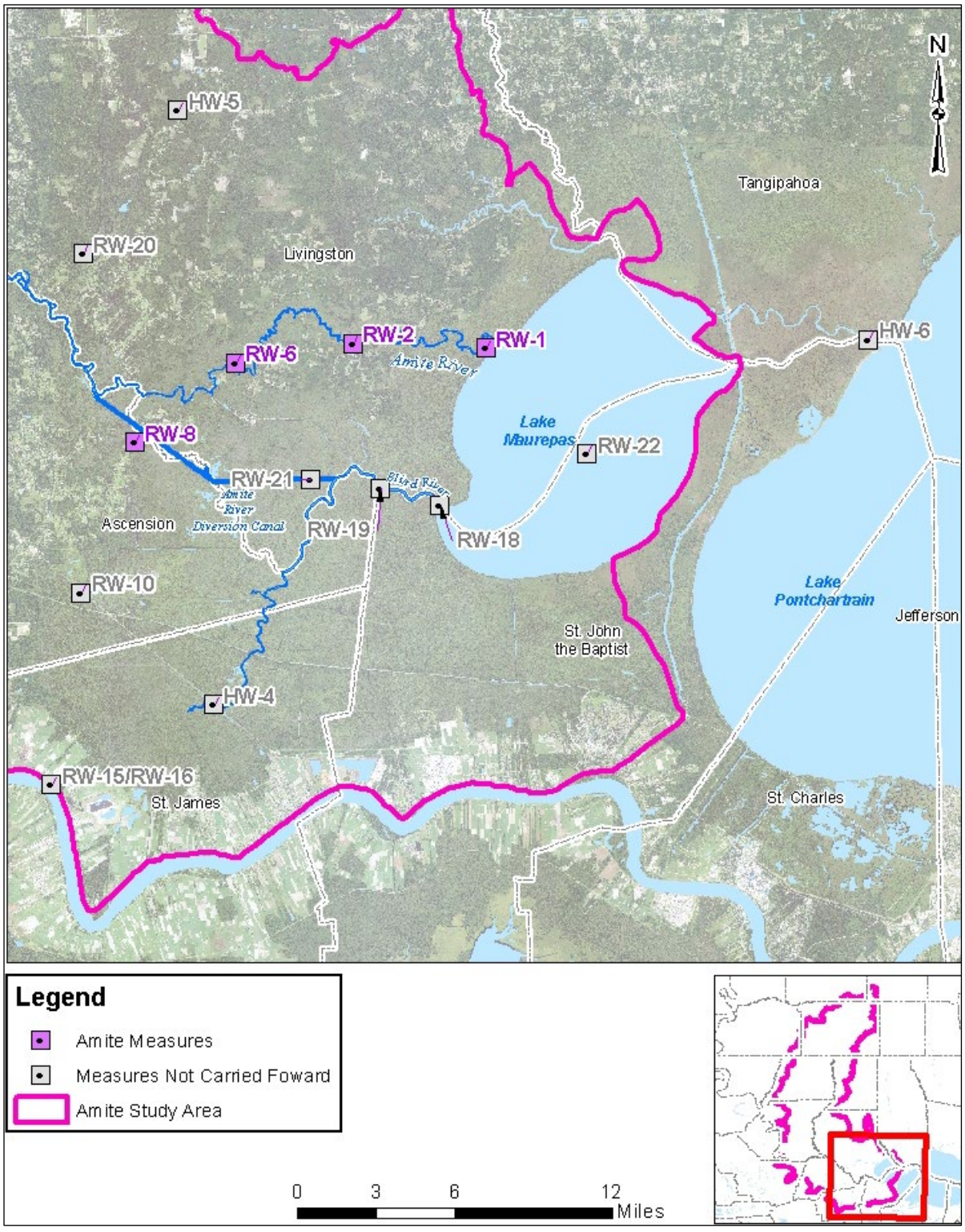

Figure F-1 – Management Measures Located in the Lower ARB

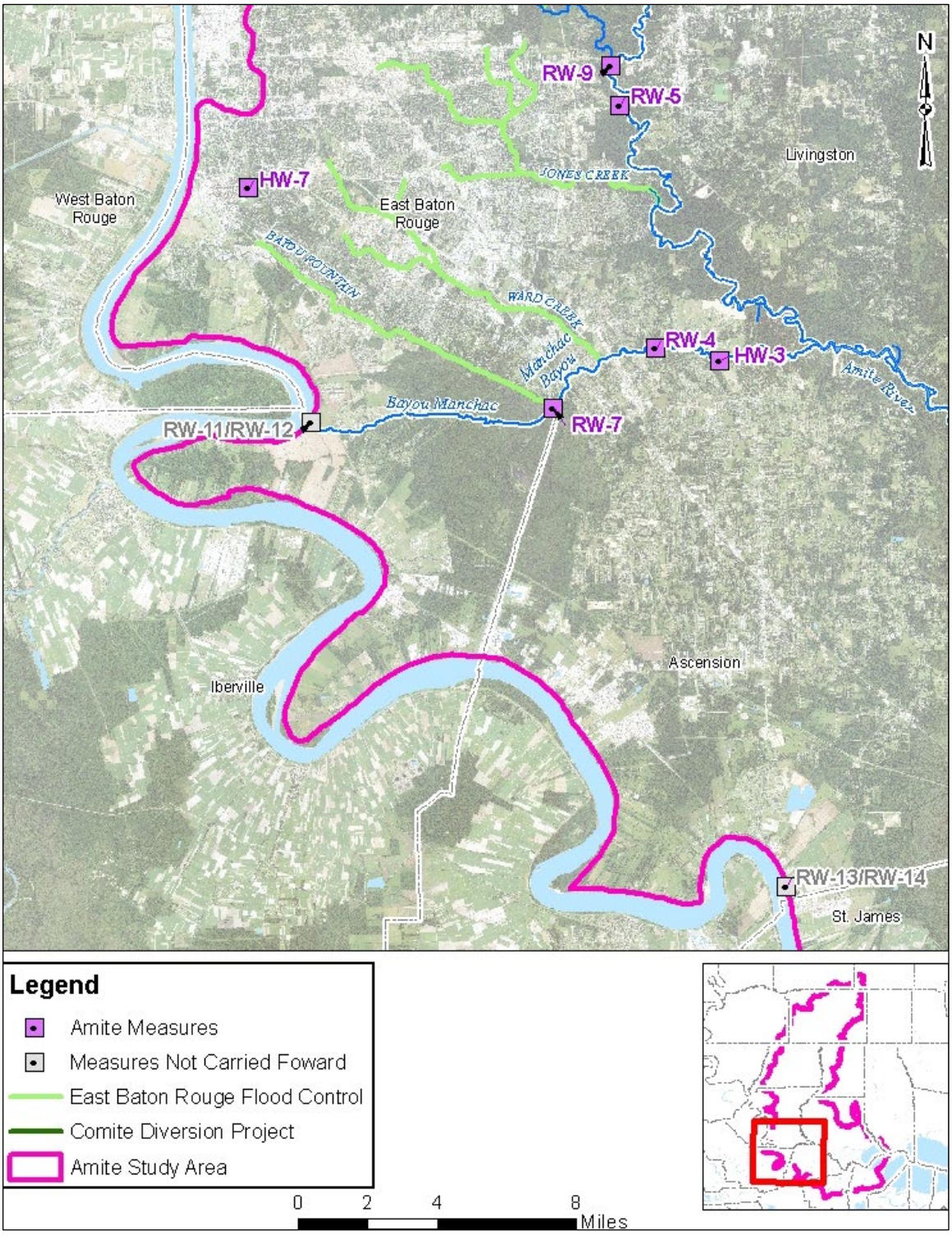

Figure F-2 – Management Measures Located in the Central ARB

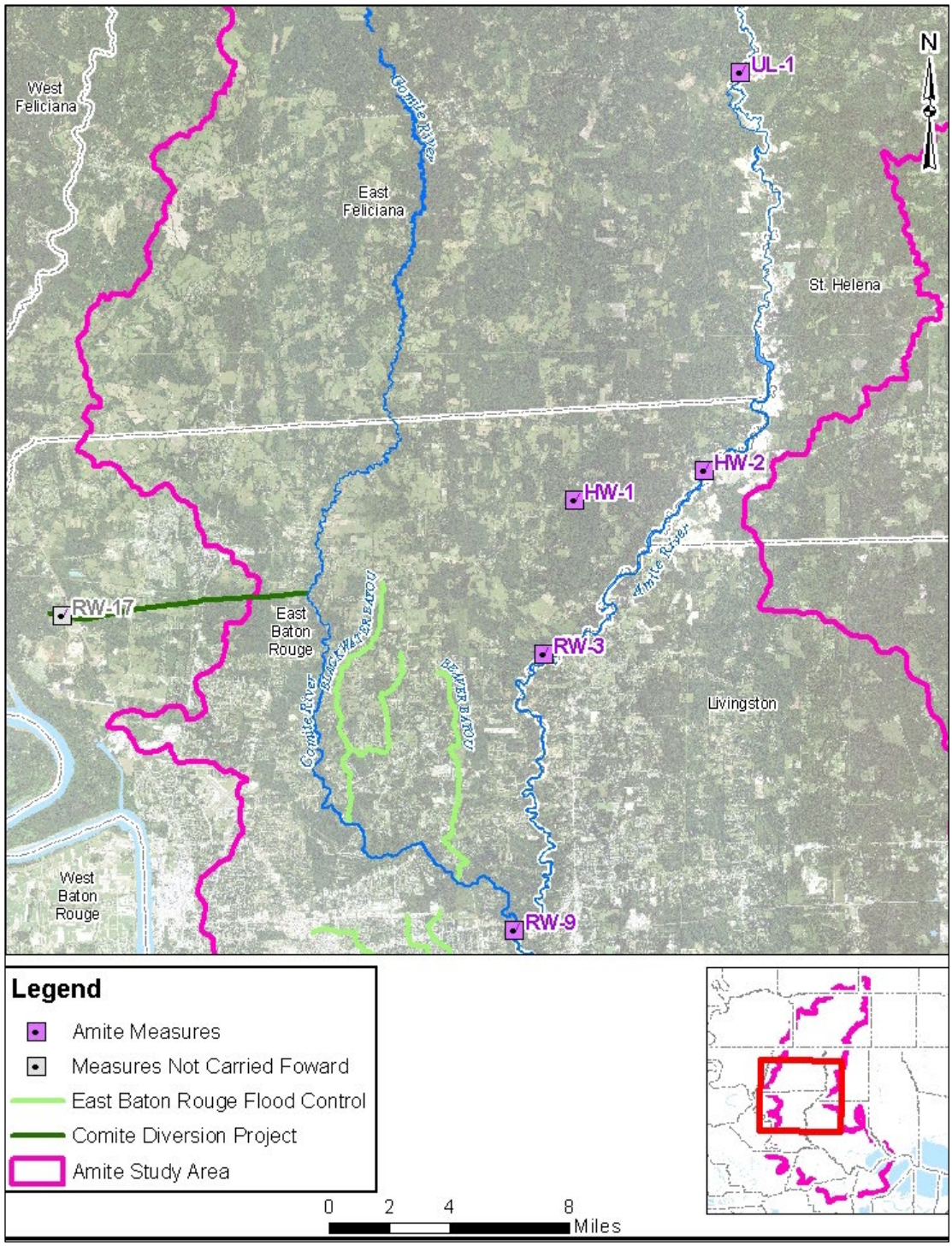

Figure F-3 – Management Measures Located in the Upper ARB

Section 3
Initial Array of Alternatives

3.1 DEVELOPMENT OF INITIAL ARRAY OF ALTERNATIVE

Fifteen alternatives were assembled through the plan formulation process. Thirteen alternative plans were initially identified using one or more of the 19 management measures that were carried forward after the screening process. Two additional alternatives (Alternatives 14 and 15) were identified through public scoping, as discussed in Section 2.4 of the main report. Similarly, to the development of management measures, for presentation and discussion purposes, the ARB was divided into areas of hydraulic influence as follows:

- Lower Basin
- Central Basin
- Upper Basin
- Upper and Lower Basin

NEPA regulations (40 CFR 1502.14(d)) requires that a No Action plan be considered as a viable alternative in the final array of plans. It represents future conditions that will likely occur if USACE takes no action. The No Action plan is included as Alternative 1. In accordance with Section 73 of the Water Resources Development Act of 1974, a minimum of one primarily nonstructural plan must be considered; therefore, Alternative 13 for nonstructural is included.

3.1.1 Influence Area Lower Basin

Three alternatives were identified with an influence area of the lower ARB near Lake Maurepas that use the strategy of removing water out of the basin more quickly than baseline conditions (Figure F-1). The alternatives could be combined into several different combinations, but they focus on dredging (i.e. clearing/snagging of banks) of the Amite River in the lower reaches and outfall, channel bank gapping, and Hwy 22 drainage improvements.

Alternative 2: Dredging of the Amite River outfall (RW-1) and in the lower reaches of the Amite River (RW-2). The dredging would include scraping, clearing, and snagging of the banks. This potentially had an influence area from Colyell Creek to Lake Maurepas and some backwater areas.

Alternative 3: Lower Amite River Channel Bank Gapping (RW-6). This potentially had an influence area from French Settlement to Lake Maurepas.

Alternative 4: Hwy 22 and Port Vincent Bridge drainage improvements (RW-8). This potentially had an influence area from French Settlement to the River Outlet. This alternative included the assessment of the local hydrology to identify restrictions from the Port Vincent and Highway 22 bridges. Placing culverts in the area as well as the Ascension Parish

proposed plan of placing a Causeway for a portion of Hwy 22 instead of the roadway and small bridge currently in place were assessed as part of this alternative.

3.1.2 Influence Area Central Basin

Five alternatives (Alternatives 5-9) were identified that focus on addressing flood risk in the central portion of the ARB including the area of Bayou Manchac (Figure F-2). Alternatives 5 and 6 focus on the Bayou Manchac Area and include dredging (i.e. clearing/snagging of banks), small dry reservoirs, and operation of flood gates and pumps.

Alternatives 7 and 8 focus on the central portion of the Amite River and Alternative 9 focuses on a tributary to Bayou Manchac that flows into the Amite River.

Alternative 5: Dredging (RW-4) and storage along Bayou Manchac in multiple small reservoirs (HW-3). The dredging would include scraping, clearing, and snagging of the banks. This potentially had an influence area for the entire Bayou Manchac area.

Alternative 6: Flood gate with Pump to Mississippi River along with open flood gates at Turtle/Alligator Bayous (RW-7), nonstructural (NS-2), and focused structural (FS-1). This alternative includes placing a flood gate on Bayou Manchac at Airline Hwy in order to address flooding from the Amite River. Pumping to Mississippi River with a conveyance channel along Bluebonnet was included in order to address the water in Bayou Manchac between the floodgate and the Mississippi River, along with the flood gates at Turtle and Alligator Bayous to remain open so the water would flow into the natural retention area, Spanish Lake. Additionally, the alternative included nonstructural measures to address potential impacts as well and focused nonstructural such as ring levees for residential communities and critical infrastructure in the area.

Alternative 7: Reduction of flow restrictions from bridges at I-12 (RW-5) and above I-12 (RW-9). Public feedback has expressed concern over the I-12 and Hwy 190 Bridges contributing to flooding.

Alternative 8: Dredging of the Upper and Central Amite Basin, above I-12 (RW-3). The dredging would include scraping, clearing and snagging of the banks. This potentially had an influence area for the Upper and Central portions of the Amite River.

Alternative 9: University Lakes as reservoirs (HW-7). This alternative is part of the Baton Rouge Area Foundation's Baton Rouge Lakes Master Plan with a potential influence of the Bayou Duplanier area. The plan includes changing the local hydrology including the use of weirs.

3.1.3 Influence Area Upper Amite River Basin

Two alternatives (Alternatives 10 and 11) were identified with an influence area of the upper ARB that use the strategy of holding water to address extreme frequency flood events (Figure F-3).

Alternative 10: Dry Dams along tributaries (HW-1). The .01 AEP dry dams would be placed on the larger tributaries that flow into the Amite River to provide flood risk reduction to the immediate areas and to delay the release of water being conveyed into the Amite River.

Alternative 11: Small dry dams on the Amite River (HW-2). This alternative is from the recommendations in the 1995 ARBC commissioned study which recommended three locations: Grangeville Bridge, just North of Greenwell Springs, and the St. Helena/Livingston Parish Boundary.

3.1.4 Influence Area of Upper and Lower Amite River Basin

Four alternatives (Alternatives 12 through 15) were identified as having an influence area of the upper and lower ARB. These alternatives include holding water back by a large scale dam, nonstructural, and natural river restoration.

Alternative 12: Large scale .04 AEP dam (UL-1). This alternative is from the recommendations in the 1997 Darlington Reservoir RF-evaluation Study by USACE. The alternative includes an earthen dam that could be dry or wet, located on the Amite River in East Feliciana and St. Helena Parishes (Figure F-3).

Alternative 13: Nonstructural (NS-1 and NS-2). Nonstructural allows for people and structures that are exposed and vulnerable to flood risk to adapt to flooding and to risks associated with flooding. NS-1 measure improves the Flood warning/Monitoring systems by installing rain gauges in the state of Mississippi and real time water level gauges in the backwater areas so predictive flooding could be identified more easily as requested by the Natural Weather Service. NS-2 measure consist of improving elevation and/or flood proofing of residential and nonresidential structures or acquisitions/relocation assistance of floodplain properties. The alternative is located throughout the ARB.

Alternative 14: Conversion of sand and gravel mines in the Amite Riverine to bottomland hardwood forest and swamp forest. Per request of the Healthy Gulf Coalition letter submitted on 23 April 2019, the alternative was added and includes the conversion of 14,000 acres of fallow mines. This alternative is considered a natural and nature-based measure.

Alternative 15: *Restoration of River Meanders.* Per request of the USFWS letter submitted on 25 June 2019, the alternative was added. It includes restoring meanders to critical sections of the river where straightening has occurred due to sand and gravel mining operations. No specific locations were suggested; however, based on the recommendations in the 2011 USACE Amite River Field Investigation and Geomorphic Assessment Report, the reach of the river from approximately river mile 114 to 73 had 21 preliminary restoration sites (Figure F-4). This alternative is considered a natural and nature-based measure.

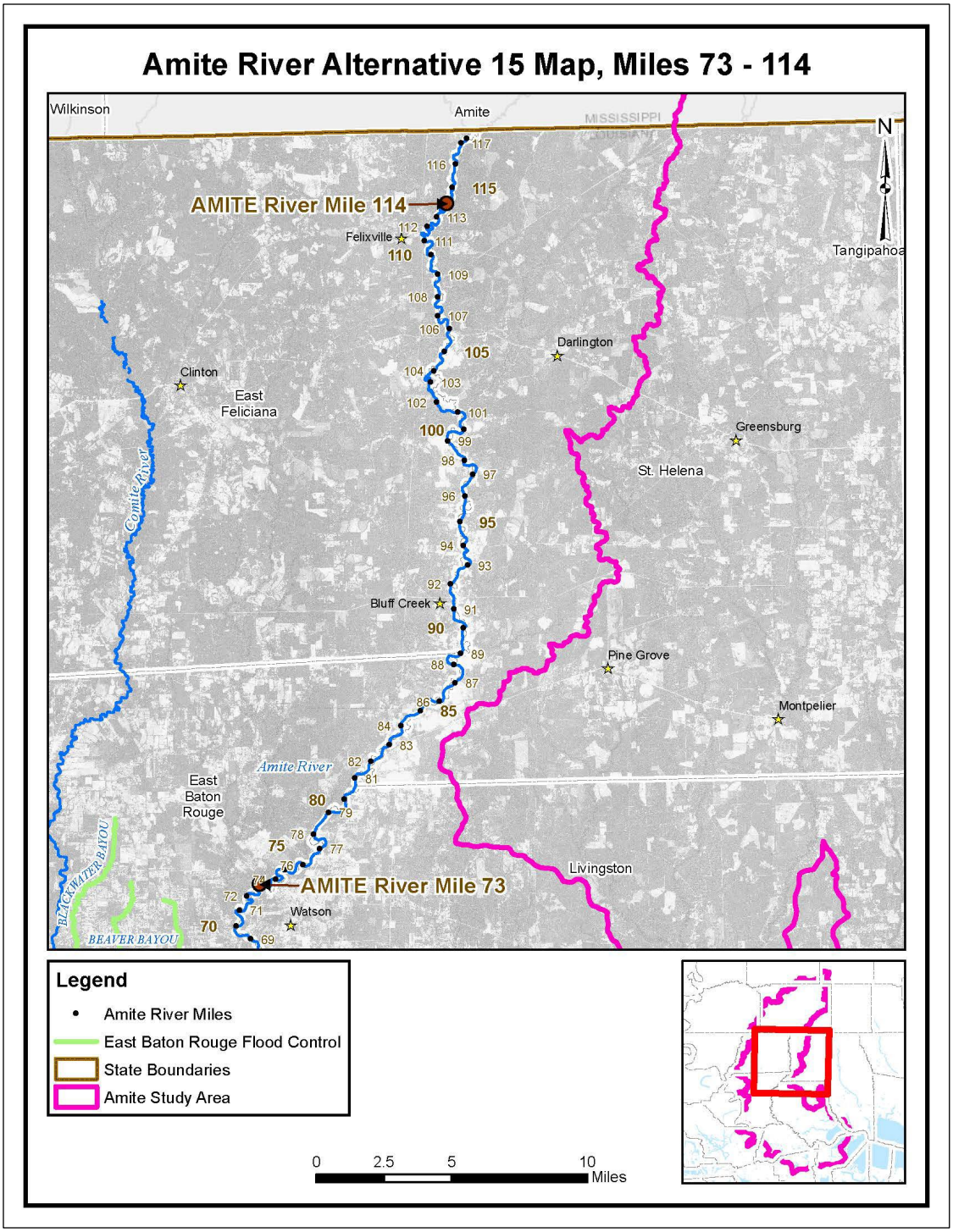

Figure F-4 – Location of Alternative 15

3.2 SCREENING CRITERIA

After the alternatives were assembled, a qualitative screening process was employed to carry forward the alternatives that showed the most promise (Table F-3). Alternatives were assessed using the same specific planning study criteria used to assess individual mitigation measures as described in Section 2.2.

3.3 SCREENING OF ALTERNATIVES

The scoring results were compiled and averaged. After scoring, the PDT reviewed the results and confirmed that the highest scoring alternatives should be retained in addition to No Action and nonstructural. Alternatives 1, 10, 12, and 13 were carried forward to the final array of alternatives for further assessment and are discussed in the text of the main report. The lower scoring alternatives were reviewed further and were screened. Below is a general discussion regarding why each of the alternatives were screened. Appendix G of the main report provides an in-depth discussion of the hydrology of the ARB and of the areas that would be influenced by the alternatives.

3.3.1 Alternative 2: Dredging of the Amite River Outfall and in the Lower Reaches of the Amite River

Per the LADOTD's 24 January 2019 report by Dewberry Engineers Inc., the alternative ranged from a water surface elevation reduction of a maximum of 4-5 inches and would require dredging of 2-8 million cubic yards to begin seeing the lowerings. With a cost estimate minimum of $20-80 million for dredging and without a high density of structures that would be impacted, this alternative would have limited benefits.

3.3.2 Alternative 3: Lower Amite River Channel Bank Gapping

The Lower Amite River has very low banks and quickly overflows; therefore, the alternative has limited benefits. Also, implementing bank gapping could cause shoaling of the river; thus resulting in reduced capacity of the river to carry flood water.

3.3.3 Alternative 4: Hwy 22 and Port Vincent Bridge Drainage Improvement

Appendix G of the main report provides an H&H discussion of the modeling results for this area including a discussion regarding Hwy 16 for Colyell Creek and the need for additional surveys to assess this area, which is outside of this feasibility study. While lowerings could be achieved at each of these areas, the drainage would provide limited benefits due to the low density of structures in the area.

3.3.4 Alternative 5: Dredging and Storage along Bayou Manchac in Multiple Small Reservoirs

Along Bayou Manchac there are limited areas that are largely undeveloped that would be available to build small reservoirs. Additionally, as stated in the USACE 1995 Feasibility Study for the East Baton Rouge Parish Watershed Flood Control Projects, due to the lack of topographical relief of the watershed detention/retention storage, basins were determined to

be impractical. Required containment structures, in conjunction with land requirements would be excessive in order to achieve significant flow retention. Detention/retention storage basins would also only reduce flood risk during localized rainfall events.

Clearing and snagging was determined to increase the flood risk as water would move more quickly into the area since the flooding along Bayou Manchac is in part due to backwater flooding from the Amite River.

3.3.5 Alternative 6: Flood Gate with Pump to Mississippi River along with Open Flood Gates at Turtle/Alligator Bayous, Nonstructural and Focused Structural

This alternative was screened out due to limited benefits and in large part due to the size and costs of the pumps required to implement the alternative. It was estimated that ten 1,000 cfs pumps each with 10' diameter discharge would be needed to pump into the Mississippi River over the levee.

3.3.6 Alternative 7: Reduction of Flow Restrictions from Bridges

Based on the hydraulic model for baseline conditions, minimal flow restrictions from bridges along the Amite River were identified; therefore, it was screened out due to limited benefits. Many of the bridge restrictions presented by the public during the scoping of the study are likely from debris carried by the water during a flood event such as vegetation and general trash that become trapped within the bridge support system located in the river channel resulting in a reduction of flow.

3.3.7 Alternative 8: Dredging of the Upper and Central Amite Basin above I-12

The hydraulic model for baseline conditions did not show any areas of significance where clearing/snagging would reduce flood risk reduction benefits due to the size of the channel and the floodplain.

3.3.8 Alternative 9: University Lakes as Reservoirs

The Baton Rouge Area Foundation provided their modeling and costs for the suggested plan. While the plan does have flood risk reduction benefits, they were not enough to justify the project based on FRM alone; therefore, the alternative was screened.

3.3.9 Alternative 11: Small Dry Dams on the Amite River (HW-2)

The potential benefits from this alternative, as well as in channel weirs, would be limited to very few higher frequency events, since the river very quickly flows out of the channel. The limited benefits would also have to be adjusted for inducements of flooding upstream including along small tributaries. Additionally, in the upper basin where the small dry dams were proposed, the channel is up to 2 miles wide at flooding stages and the dam and/or weir would have to be fairly large with significant bank armoring. Without significant bank armoring and tie in points, these measures would have the potential to change the geomorphology and course of the river. This alternative was screened based on limited benefits.

3.3.10 Alternative 14: Conversion of Sand and Gravel Mines in the Amite Riverine to Bottomland Hardwood Forest

The baseline conditions of the H&H model shows that the area of the sand and gravel mines is already providing a higher storage/retention than what the conversion of floodplain forest would provide so the alternative was screened. Additionally, the location of the gravel pits are primarily not immediately adjacent to the main channel of the Amite River, so the velocity reductions from the conversion of the area to Bottomland Hardwood forest would be very limited.

3.3.11 Alternative 15: Restoration of River Meanders

Adding river meanders to the Amite River would increase the length of the river and thus additional storage capacity, and floodwaters would be slowed down on their journey to inundate populated areas downstream. There are potential benefits from this alternative at higher frequency events, but very unlikely at lower frequency events; therefore, the alternative was screened due to limited benefits. Appendix H of the main report provides further H&H discussion of the alternative assessment.

3.4 THE FOCUSED AND FINAL ARRAY OF ALTERNATIVES

Most alternatives assessed had very little reduction in flood risk and limited benefits. The less frequent AEP events (25 yr and up) cause the majority of flooding issues in the Amite River Basin. The rainfall events, combined with a steep hydraulic gradient from the headlands of the basin to the flat middle and lower basins, provide for a significant backwater effect at the lower end of the system at Lake Maurepas. Once the water accumulates and backs up, it can no longer exit the basin and the basin begins to fill. This unique hydrology was evaluated with numerous measures and alternatives that resulted in primarily shifting water from one place to another within the damage areas while not reducing the backwater effect and thus not allowing water to drain from the basin. In essence, other alternatives could not get to the core of the issues because they were not removing water from hydraulic budget. Because water backs up into the watershed, water surface elevations did not lower in specific areas or overall. This in turn did not allow for significant lowering of water surface elevation in damage areas. The parishes in the study area have a combined population of about 900,000 with more than half of the population living in East Baton Rouge Parish. The study area has over 260,000 structures and of those, about 80 percent are in the central portion of the ARB, north of Bayou Manchac. The remaining alternatives that were not screened, were those that provided storage of water to attenuate flooding downstream in heavily developed areas. Those alternatives are the focused array of alternatives.

The focused and final array of alternatives carried forward for consideration and evaluated are presented in Sections 4 through 7 of the Main Report.

Table F-3 – Alternatives

			Exceeds (++), Meets (+), No Change (n), or Decreases (-) the Objective				Avoids Constraint/Considerations High (++), Medium (+), Low to no issue or not applicable (n), or Conflicts (-) with the Constraint/Consideration							
Alt ID	**Measures**	**Alternative Description**	**Reduce flood damages from rainfall**	**Reduce risk to human life from flooding events**	**Reduce interruption to the nation's transportation corridors**	**Reduce risks to critical infrastructure (e.g. medical centers, schools, transportation etc.);**	**T&E**	**Critical Habitat**	**Cultural**	**Water Quality**	**Scenic Rivers**	**Local Flood Management Plans**	**BBA Authorization limits**	**Not to induce development within flood plain**
Alt 1	No Action	No action would be taken under this plan. Damages would continue into the future.	n	n	n	n	n	n	n	n	n	n	n	n
Alt 2	RW-1+RW-2	Dredging of the Amite River outfall (RW-1) and in the lower reaches of the Amite River (RW-2)	+	n	n	n	n	n	-	+	-	n	+	n
Alt 3	RW-6	Lower Amite River Channel Bank Gapping (RW-6)	+	n	n	n	n	n	-	+	-	n	+	n
Alt 4	RW-8	Hwy 22 and Port Vincent Bridge drainage improvements (RW-8)	+	n	n	n	n	n	-	+	-	n	+	n
Alt 5	HW-3+ RW-4	Dredging (RW-4) and storage along Bayou Manchac in multiple	+	n	+	+	n	n	-	n	-	n	n	n

			Exceeds (++), Meets (+), No Change (n), or Decreases (-) the Objective				Avoids Constraint/Considerations High (++), Medium (+), Low to no issue or not applicable (n), or Conflicts (-) with the Constraint/Consideration							
		small reservoirs (HW-3)												
Alt 6	RW-7+NS-2+FS-1	Flood gate at Airline Hwy, Pump to MS River, open flood gates at Turtle and Alligator Bayous (RW-7) with the addition of nonstructural measures (NS-2) and ring levees for residential communities and critical infrastructure (FS-1)	+	n	++	++	n	n	-	n	-	n	+	n
Alt 7	RW-5+RW-9	Reduction of flow restrictions from bridges at I-12 (RW-5) and above I-12 (RW-9)	+	n	++	++	-	n	-	n	-	n	+	n
Alt 8	RW-3	Dredging of the Upper and Central Amite Basin, above I-12 (RW-3)	+	n	++	++	-	n	-	n	-	n	+	n
Alt 9	HW-7	University Lakes as reservoirs (HW-7)	+	n	n	n	n	n	n	n	n	++	+	n
Alt 10	HW-1	.01 AEP Dry Dams along tributaries (HW-1)	+	n	+	+	n	n	n	+	n	n	+	n
Alt 11	HW-2	Small dry dams on the Amite River (HW-2)	++	+	+	+	-	-	-	+	-	+	+	n
Alt 12	UL-1	Large scale .04 AEP dam (UL-1)	++	n	++	++	+	n	-	n	-	+	++	n
Alt 13	NS-1+ NS-2	Nonstructural (NS-1 and NS-2)	++	+	n	++	n	n	-	n	n	+	++	n
Alt 14	None	Conversion of sand and gravel mines in the	n	n	n	n	++	n	-	++	++	n	n	n

			Exceeds (++), Meets (+), No Change (n), or Decreases (-) the Objective				Avoids Constraint/Considerations High (++), Medium (+), Low to no issue or not applicable (n), or Conflicts (-) with the Constraint/Consideration							
		Amite Riverine to bottomland hardwood forest and swamp forest												
Alt 15	None	Restoration of River Meanders	n	n	n	n	+	++	-	n	n	n	-	n

Section 4
Focused Array of Alternatives

The focused array of alternatives, is the same alternatives as previously identified in the final array in the publicly released 2019 DIFR/EIS, are presented in Table F-3 and the locations of the structural alternatives are presented on Figure F-5 and Figure F-6.

Table F-3 – Focused Array of Alternatives

Alt ID	Management Measures	Alternative Description
Alt 1	No Action	No action would be taken under this plan. Damages would continue into the future.
Alt 10	HW-1	0.01 AEP Dry Dams along tributaries (HW-1)
Alt 12	UL-1	Large scale 0.04 AEP dam (UL-1)
Alt 13	NS-1+ NS-2	Nonstructural (NS-1 and NS-2)

4.1 NO ACTION

Under the no action alternative, no risk reduction would occur. The area would continue to experience damages from rainfall and wind/tide-induced flooding. This would be exacerbated in the lower ARB due to relative sea level rise.

4.2 DRY DAMS ALONG TRIBUTARIES

A 0.01 AEP dam design and locations were chosen to try to capture the most benefits by lowering the peak stage height along the Amite River by holding water back along larger tributaries in the upper basin. The alternative for dry dams along tributaries was divided further into two different alternatives after the initial assessment to ensure incremental justification of the dry dams. The alternative was broken into H&H analysis runs for one dam along Sandy Creek and the other run, which combined the smaller dams along Darling, Lilley, and Bluff Creeks. Limited data was available; therefore, many assumptions were made, such as the geology of the area, the dam theoretical section, the outlet and spillway structure design, borrow material, and quantities, as discussed in Appendix B.

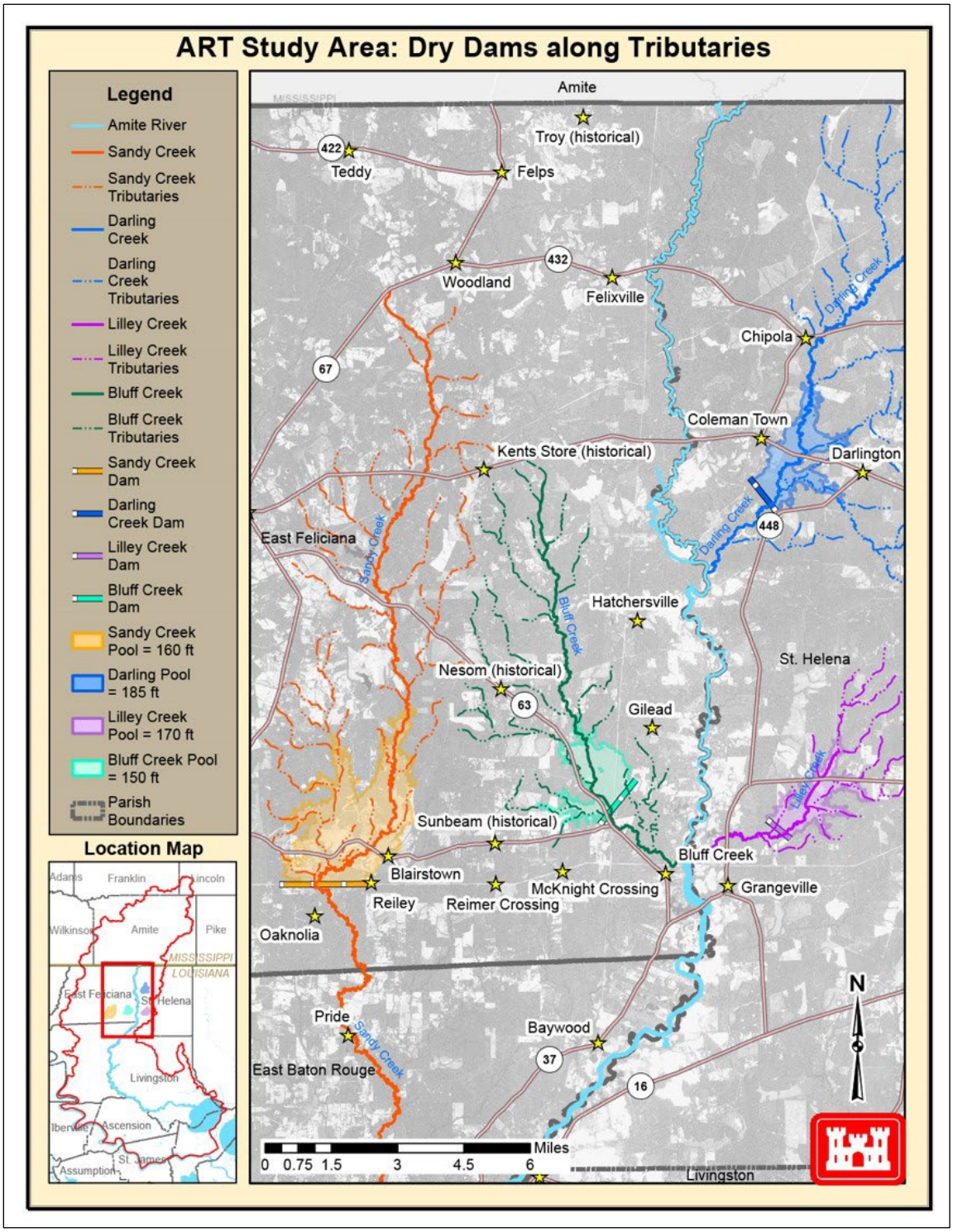

Figure F-5 – Location of Dry Dams along Tributaries

4.3 LARGE SCALE 0.04 AEP DAM (DARLINGTON DAM)

The large scale 0.04 AEP Darlington Dam alternative consists of an earthen dam on the Amite River with the option of being a wet or dry dam. Because this alternative was previously studied, data for analyzing it was available in the “Amite River and Tributaries, Darlington Reservoir Re-evaluation Study (Reconnaissance Scope),” dated September 1997. The location of the dam was selected because of the short width of the floodplain, resulting in a shorter length of dam. The shorter width floodplain results in a smaller area of potential inundation, which reduces the required land and flow easement purchases. The upper reach of the Amite River floodplain, where it converges with the East and West Fork Rivers, is broader (ERDC/GSL TR-07-26, 2007) and would require significantly more costs and land acquisition for siting of the dam. The current location also avoids inundation to more densely populated areas such as Liberty, Mississippi.

The 1997 report used the same design section for a wet or a dry dam (Figure F–6 and Appendix B of this report). A wet dam would consist of a permanently flooded reservoir/conservation pool, while the reservoir for a dry dam would be used only during flood events to accommodate outflow and thus minimize inundation to the surrounding area. The dry dam would have a crown elevation 1.8 feet lower than the reduced-wet.

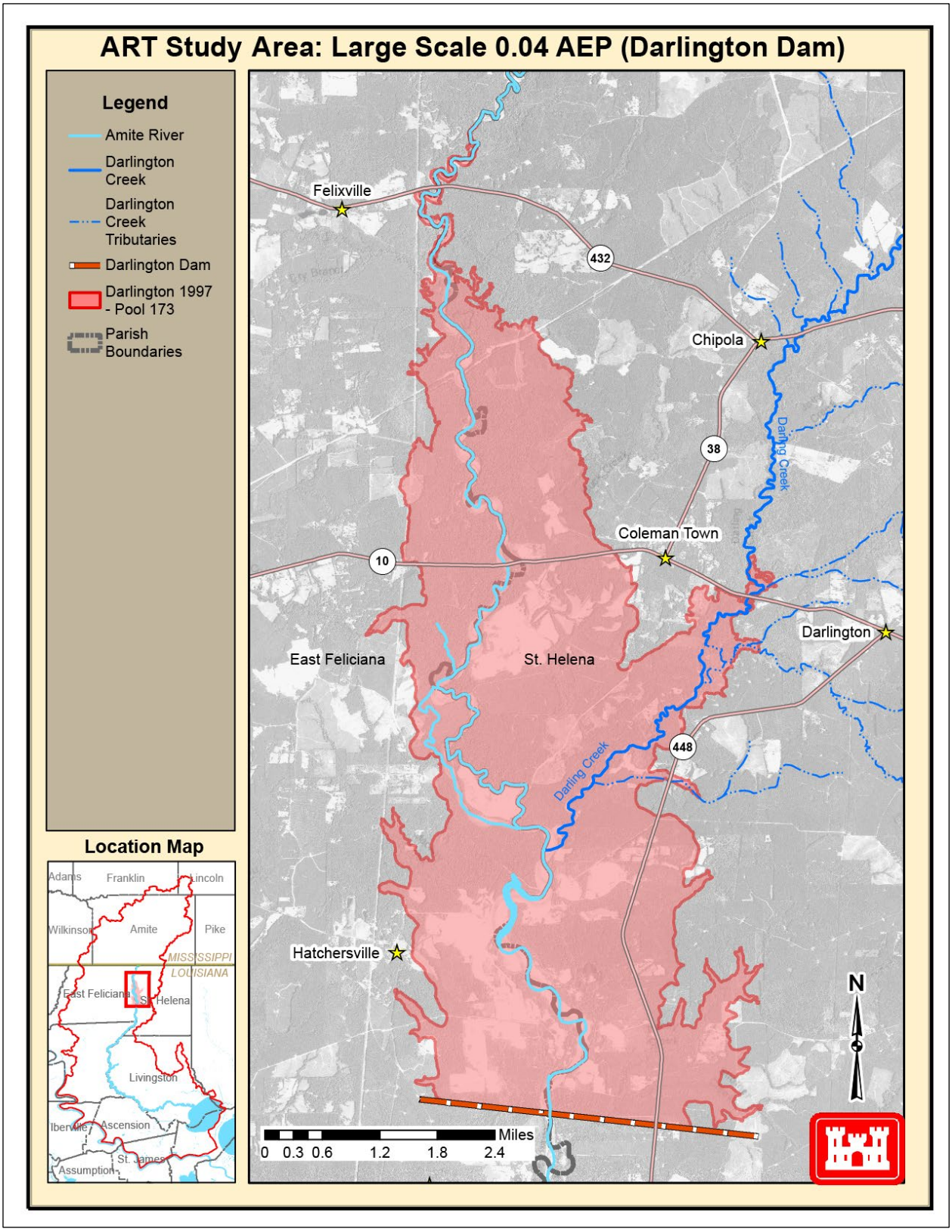

Figure F-6 – Close up of Large Scale 0.04 AEP Dam (Darlington Dam)

4.4 NONSTRUCTURAL

A nonstructural assessment was completed that looked at the effectiveness of implementing physical nonstructural measures (NS-2) such as structure elevations, and floodproofing. For evaluation purposes, the nonphysical measures (NS-1) which consists of flood warning system/evacuation plans were not included in the evaluation since there are no economic benefits that can be derived, but these measures are intended to reduce incremental risk at low cost. Regardless of the recommended plan chosen, the residual risk with the plan in place, along with the potential consequences, will be communicated to the NFS to become a requirement of any communication and evacuation plan.

An inventory of residential and nonresidential structures was developed using the National Structure Inventory (NSI) version 2.0 for the portions of the study area impacted by flooding from rainfall and sea-level rise associated with the future without project condition. An assessment of all structures located in the 0.04 and 0.02 AEP floodplains was performed.

The second nonstructural alternative that was evaluated included acquisition and relocation for all structures located in the 0.04 aggregated floodplain. In this alternative, the costs of acquisitions, with relocation assistance to displaced persons, were compared with the expected annual damages reduced by the demolition of structures from the floodplain. For the analysis of the nonstructural alternative as a standalone alternative, acquisitions were not carried forward because the cost of the alternative exceeded the damages reduced (benefits).

4.5 2019 ECONOMIC ANALYSIS

An economic analysis of the focused array of alternatives was performed based on the Hydraulics and Hydrology (H&H) model outputs and the economics functions. Water surface profiles were provided for eight annual exceedance probability (AEP) events: 0.50 (2-year), 0.20 (5-year), 0.10 (10-year), 0.04 (25-year), 0.02 (50-year), 0.01 (100-year), 0.005 (200-year), and 0.002 (500-year). Annualized costs and benefits were calculated, and the Benefit Cost Ratio (BCR) was estimated for each alternative. Each of the alternatives should have benefits long into the future but guidance limits it to the 50-year period of analysis from 2028 to 2078. The economic analysis yielded several alternatives that are in the Federal interest and from which a TSP can be identified. Three alternatives were screened due to negative net benefits: the nonstructural plan for a 0.02 AEP floodplain, large scale 0.04 AEP wet Darlington Dam and the three 0.01 AEP dry dams on the Darlington, Lilley, and Bluff Creeks (Table F-4).

Table F-4 – Summary of Costs and Benefits for Focused Array of Alternatives based on 2019 Evaluation

Alternative	Non-structural 0.04 AEP	Non-structural 0.02 AEP	Darlington Wet Dam 0.04 AEP	Darlington Dry Dam 0.04 AEP	Sandy Creek Dry Dam 0.01 AEP	3 Tributary Dry Dams 0.01 AEP
Total Project Costs						
First Cost	$1,335,282	$2,160,836	$1,788,531	$1,278,523	$270,977	$349,981
Interest During Construction	$4,536	$7,34	$100,590	$71,907	$7,477	$9,658
Total Investment Cost	$1,339,818	$2,168,176	$1,889,121	$1,350,430	$278,455	$359,638
Estimated Annual Costs						
Annualized Project Costs	$49,628	$80,311	$69,975	$50,021	$10,314	$13,321
Annual OMRR&R	$0	$0	$658	$439	$220	$659
Total Annual Costs	$49,628	$80,311	$70,633	$50,461	$10,534	$13,980
Average Annual Benefits						
Total Annual Benefits	$53,547	$63,542	$65,066	$65,066	$13,649	$6,131
Net Annual Benefits	$3,919	-$16,769	-$5,567	$14,605	$3,115	-$7,849
Benefit to Cost Ratio	1.08	0.79	0.92	1.29	1.3	0.44