Mississippi Valley Division,
Regional Planning and Environment Division South

Tangipahoa Parish, Louisiana Feasibility Study

Appendix J – Tangipahoa Parish Feasibility Study General Engineering Appendix

August 2024

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SECTION 1
General

This Engineering Appendix documents the feasibility levee engineering and design process for the structural alternatives that were considered and screened out prior to the final array of alternatives. Non-structural alternatives are discussed in Appendix E. Development of this appendix was in accordance with Engineering Regulation (ER) 1110-2-1150, “Engineering and Design for Civil Works Projects,” dated 31 August 1999.

The study area is Tangipahoa Parish, Louisiana. Tangipahoa parish is bordered by the state of Mississippi to the north, Washington and St. Tammany parishes to the east, Lakes Maurepas and Pontchartrain to the south, and Livingston and St. Helena parishes to the west. The parish includes rivers, like the Tangipahoa and Natalbany rivers, and larger creek tributaries to them, such as the Beaver, Bedico, Chappepeela, Ponchatoula, and Washley creeks. The watersheds in the parish are discussed in Appendix B.

The alternatives discussed in the sections that follow were analyzed by the Design and Geotechnical Branches of USACE, Mississippi Valley Division, St. Louis District (MVS), Engineering & Construction Division.

SECTION 2
Structural Alternatives

Tangipahoa Parish has two primary flooding sources: riverine due to headwater and rainfall, and coastal flooding from the Gulf of Mexico via Lakes Maurepas and Pontchartrain. The upper portion of the Parish has flood risk from headwater flooding due to rainfall events, whereas the lower portion of the Parish experiences compound flooding from rainfall events and backwater flooding from coastal sources such as tides, wind direction, and seasonal tropical storm events.

16 alternatives were considered and developed for the initial array using these structural measures:

- Channel Improvements/Dredging
- Detention Basins
- Diversion Channels
- Drainage Improvements
- Elevation of Roadways
- Levees and Floodwalls
- Reservoirs
- Slope/Channel Revetment
- Snagging & Clearing
- Water Control Structures

The following Natural and Nature-Based Features (NNBF) were considered for all the above measures and incorporated where possible:

- Reclamation of Abandoned Quarries for Flood Storage
- Detention Ponds with Wetland Restoration Benefits
- Beneficial Use of Dredged/Snagged Material
- Application of the Louisiana Watershed Initiative

The focused array of structural alternatives included measures where hydraulic analysis was performed to capture their flood risk reduction effectiveness. The focused array of structural measures examined are:

Alternative 3: Washley Creek

- 3a: Robert Levee (WASH-1)
- 3b: Robert Levee Short (WASH-2)
- 3c: Robert Levee with Combined Detention Basin (WASH-3)

Alternative 4: Beaver Creek/Tangipahoa River

- 4a: Tangipahoa Levee (SPTR-1a and SPTR 1-b)

Alternative 5: Bedico Creek

- 5a: Roadway Elevation of Firetower Road near Highway LA-22 (BED-1)
- 5b: Roadway Elevation of Highway LA-22 near Firetower Road (BED-4)
- 5c: Combination of BED-1 and BED-4 (BED-5)

Alternative 6: Little Chappepeela Creek/Cooper Creek

- 6a: Roadway Elevation and Bridge Replacement Along Briar Patch Cemetery Road (LCC-1)

Alternative 7: Tangipahoa River and Chappepeela Creek

- 7a: Tangipahoa River Snagging and Clearing from US Highway 190 to Independence (SNG-1)
- 7b: Tangipahoa River, SNG-1, and Chappepeela Creek from the Tangipahoa River to Little Chappepeela Creek (SNG-3)

The focused array of alternatives included measures that were shown to be hydraulically effective in flood risk reduction. Construction quantities and associated costs of construction were determined for the economic analysis of the benefit costs.

2.1 ALTERNATIVE 3: WASHLEY CREEK

Robert, LA is an unincorporated community in Tangipahoa Parish, east of Hammond, LA along US Highway 190 at its intersection Louisiana Highway 445. The community is small but receives regular and reoccurring flood damage. The community sits near the confluence of the Tangipahoa River and Washley Creek causing the flooding to cover much of the community, resulting in property damage and cutting off access to other parts of the parish. Levee measures were examined for the area with two alignments being proposed.

2.1.1 Robert, LA Levee (WASH-1)

The WASH-1 levee alignment around Robert, LA has two sections. The first starts at the road to Robertson Cemetery extending south adjacent to Chemekette Road and the Tangipahoa River. The alignment continues south crossing US Highway 190 eventually turning northeast south of the Bennett Lane neighborhood. Adjacent to Washley Creek the levee crosses Pole Bridge Branch and Holden Branch. The levee alignment continues across Doc Hyde Road and US Highway 190 where it terminates 2,200 feet north of US Highway 190. The second alignment, used to restrict flow crossover from Washley Creek into Holden Branch, is adjacent to Washley Creek 3,700 feet east of Riverdale Heights Road. The levee alignment is shown in Figure J: 2-1.

This levee alignment requires gate closure structures at LA 445, Doc Hyde Road, and US Highway 190 (two separate closures sections, one on the west side of the alignment and one on the east). Two pump stations are also required pass Holden Branch and Pole Bridge

Branch drainage during high Washley Creek stages. Gravity drainage will be allowed during normal Washley Creek conditions. The modeled capacity of the Pole Bridge Branch pump station was 450 cubic feet per second and the capacity of the Holden Branch pump station was 350 cubic feet per second.

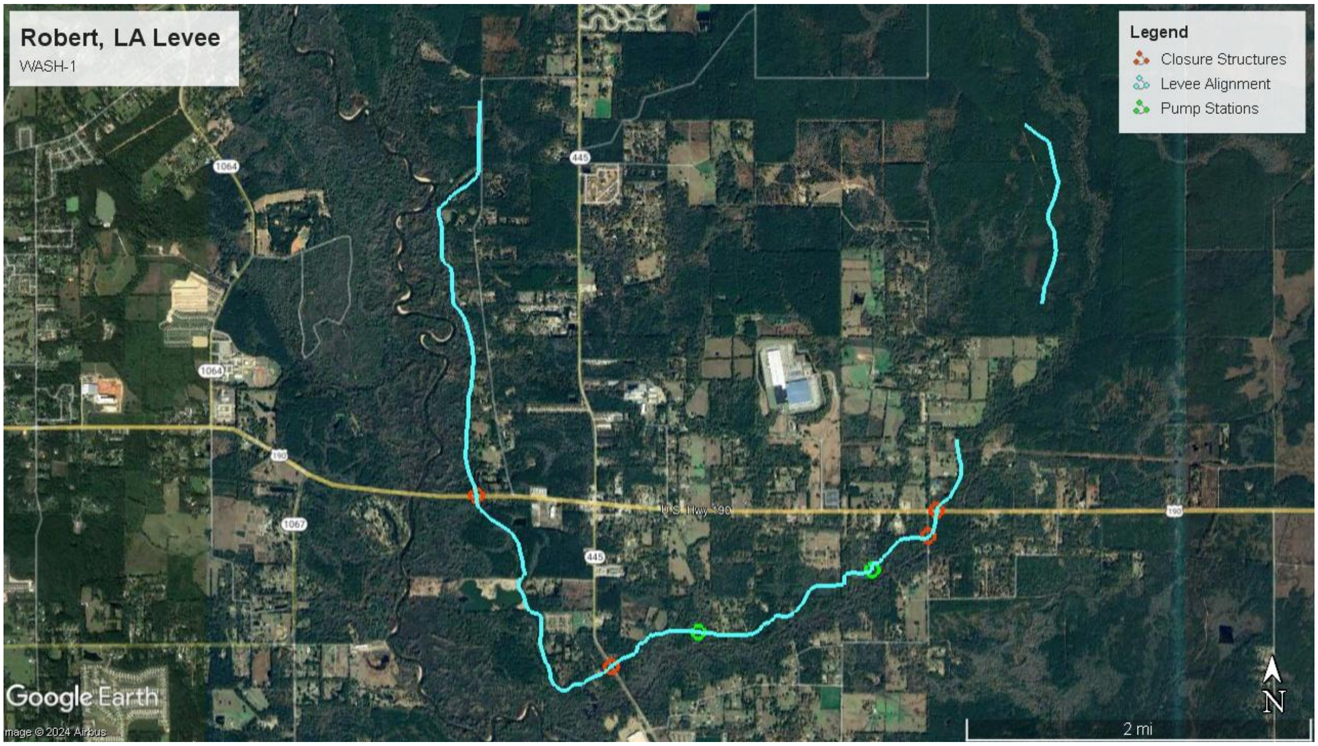


Figure J: 2-1 - WASH-1 Levee Alignment

2.1.2 Robert, LA Levee Short (WASH-2)

The WASH-2 levee alignment around Robert, LA is a single segment. It starts at the road to Robertson Cemetery extending south adjacent to Chemekette Road and the Tangipahoa River. The alignment continues south crossing US Highway 190 eventually turning northeast south of the Bennett Lane neighborhood. Adjacent to Washley Creek the levee crosses Pole Bridge Branch. The levee alignment continues till it turns north between Holden Branch and Dixie Farm Road. Adjacent to Holden Branch, it crosses US Highway 190 and continues north until it reaches Needham Road where it terminates. The levee alignment is shown in Figure J: 2-2.

This levee alignment requires gate closure structures at LA 445 and US Highway 190 (two separate closures sections). One pump station is also required to pass Pole Bridge Branch drainage during high Washley Creek stages. Gravity drainage will be allowed during normal Washley Creek conditions. The modeled capacity of the Pole Bridge Branch pump station was 350 cubic feet per second.

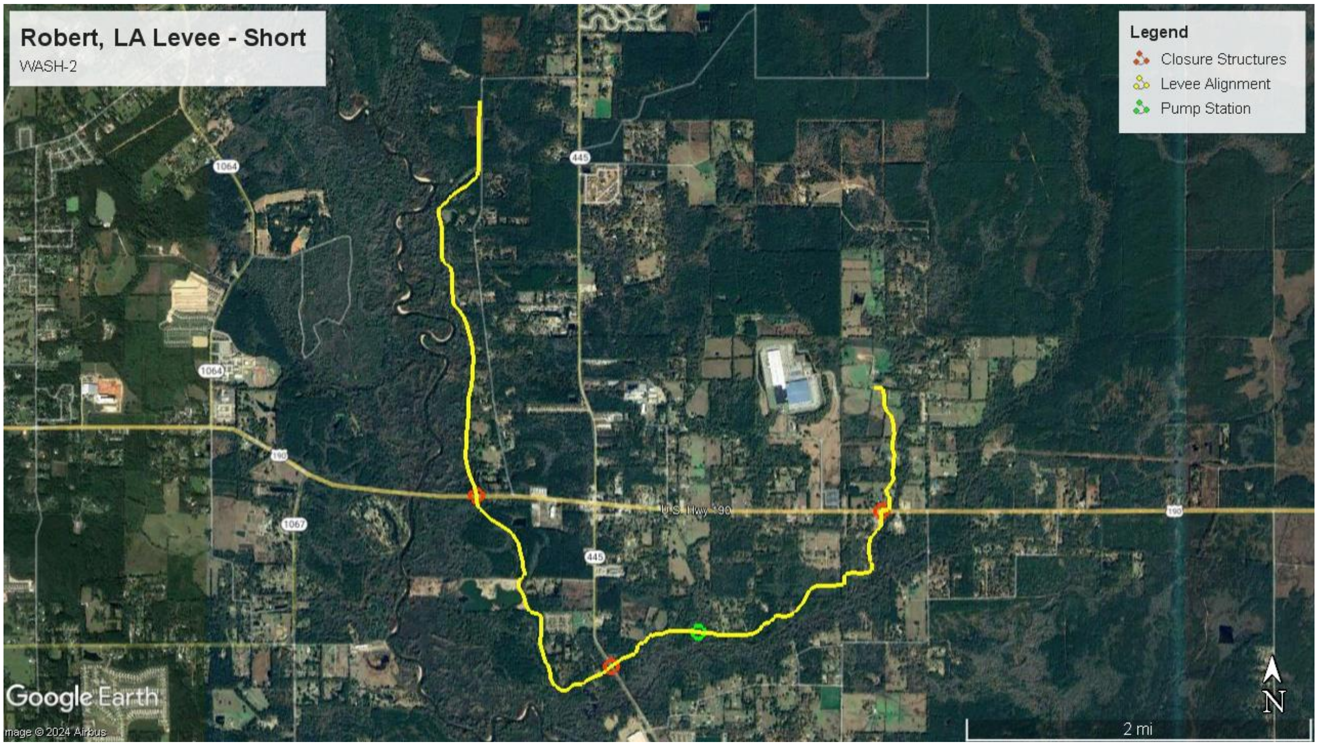


Figure J: 2-2 – WASH-2 Levee Alignment

2.1.3 Robert, LA Levee with Detention Basin (WASH-3)

As is discussed in Appendix G – Economics, WASH-1 and WASH-2 are not NED justifiable projects. The alternative benefit cost ratios are less than one and the net annual benefits are negative. Since WASH-3 is only effective if the Robert, LA levee alternatives are implemented, the detention basin would not be feasible. A hydraulic analysis was not performed on the WASH-3 alternative, and no additional design quantities were gathered.

2.2 ALTERNATIVE 4: BEAVER CREEK/TANGIPAHOA RIVER

The village of Tangipahoa is in the northern portion of the parish, sitting between Interstate 55 on the west and the Tangipahoa River on the East. Tangipahoa, LA receives a lot of regular and reoccurring flooding from both Beaver Creek and the Tangipahoa River. Because of its proximity to the Tangipahoa River at the confluence of Beaver Creek, the flooding is extensive. A levee protecting the town of Tangipahoa, LA was examined with two separate levee sections.

2.2.1 Village of Tangipahoa, LA Levee (SPTR-1A and SPTR-1B)

The SPTR-1A and 1B levee alignment around Tangipahoa, LA has two segments. The 1A segment starts just west of the west end of the unnamed road just north of the Browns Chapel Missionary Baptist Church. It goes north to than east adjacent to Beaver Creek. It passes over Highway 1050 north of Cook Lane. It continues east between Cook Lane and

Beaver Creek. It passes north of Morris Lane transversing to the southeast eventually tying into Highway 51. Part of this segment also includes closing off the area between Highway 51 and the railroad. Segment 1B starts 570 feet south of the termination of the 1A section branching off to the west from the railroad. The segment primarily runs southeast adjacent to Beaver Creek north of Franklin Street, Jackson Street, and an unnamed neighborhood. Segment 1B terminates at Center Street. The levee alignment is shown in Figure J: 2-3.

Because there are no large tributaries into Beaver Creek and since drainage is primarily to the south through the village of Tangipahoa, a pump station is not necessary. Sluice gates can be used to allow for storage of the interior drainage during high Beaver Creek stages.

Figure J: 2-3 – SP-TR-1 Levee Alignment

2.3 ALTERNATIVE 5: BEDICO CREEK

These roadway elevation alternatives focus on roadways effected by flooding from Bedico Creek from both riverine and lake surge event flooding. The roadways examined are Fire Tower Road at the Cedar Branch crossing, Highway 22 near the crossing of Bedico Creek, and Fire Tower Road near Highway 22. See 4.3 for assumptions and details.

2.3.1 Roadway Elevation of Firetower Road near Highway LA-22 (BED-1)

The segment of Fire Tower Road proposed to be raised is the road and bridge section that crosses Cedar Branch. This section is between April Lane and Crown Drive on Fire Tower Road. Figure J: 2-4 shows the road raise section.

Figure J: 2-4 – BED-1 Roadway Elevation Alignment

2.3.2 Roadway Elevation of Highway LA-22 near Firetower Road (BED-4)

The segment of Highway 22 proposed to be raised is the west road approaching the bridge that crosses the Tangipahoa River. The raise on Highway 22 would start at the intersection of Fire Tower Road. The lower Fire Tower Road section is near the intersection with Highway 22. It would start 640 feet north on Fire Tower Road. The reason for the raise on the lower portion of Fire Tower Road is because of the impacts induced from the raise of Highway 22. Figure J: 2-5 shows the road raise section.

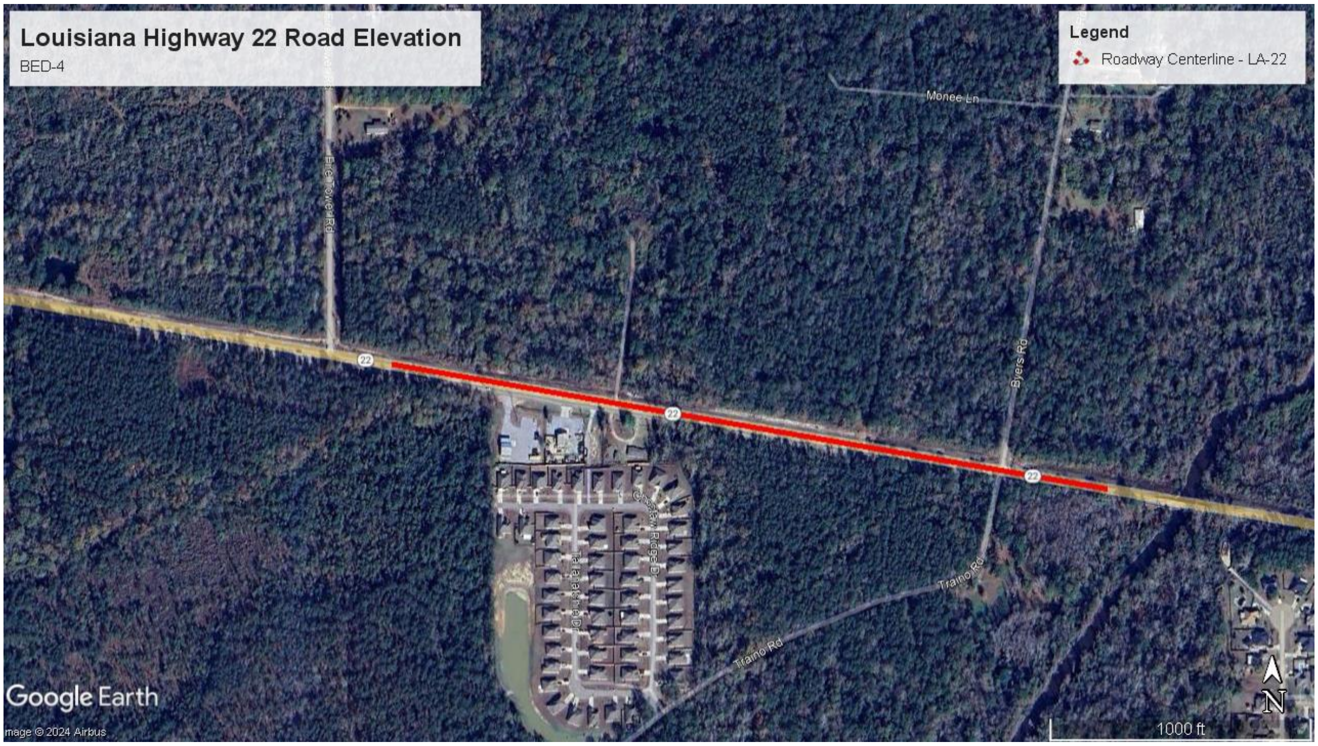


Figure J: 2-5 – BED-4 Roadway Elevation Alignment

2.4 ALTERNATIVE 6: LITTLE CHAPPEPEELA CREEK/COOPER CREEK

Briar Patch Cemetery Road connects the rural Fifth Ward to the town of Independence, LA across Little Chappepeela Creek and Cooper Creek, providing emergency access across the waterways.

2.4.1 Roadway Elevation and Bridge Replacement Along Briar Patch Cemetery Road (LCC-1)

The segment of Briar Patch Cemetery Road proposed to be raised is the approaching road and bridge that crosses the Cooper Creek. The raise on Briar Patch Cemetery Road would start near the intersection of Loranger Road and end near the point where Briar Patch Cemetery Road turns to the north. Figure J: 2-6 shows the road raise section.

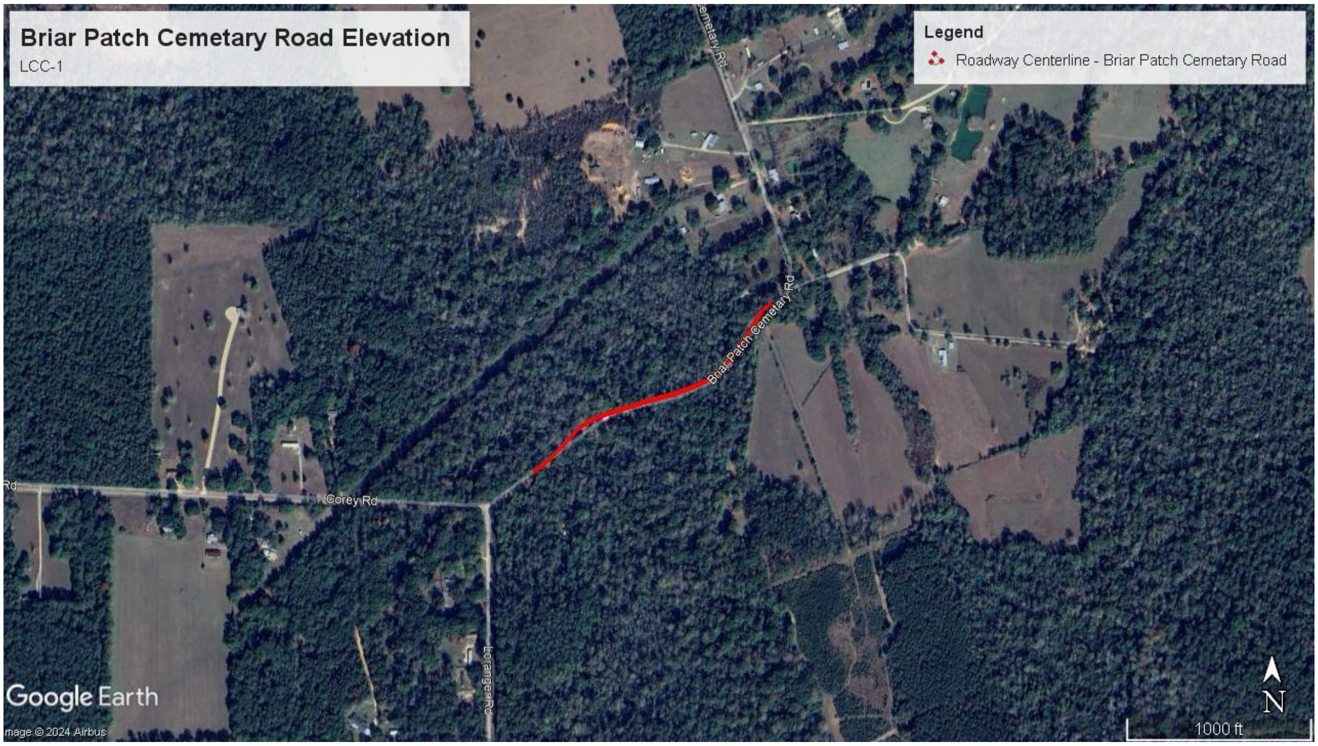


Figure J: 2-6 – LCC-1 Roadway Elevation Alignment

2.5 ALTERNATIVE 7: TANGIPAHOA RIVER AND CHAPPEPEELA CREEK

Clearing and snagging was considered on portions of the Tangipahoa River and Chappepeela Creek. The Tangipahoa River scenic waterway in Louisiana, state law restricts that only 50% of material can be removed during the clearing and snagging efforts. The clearing and snagging measures saw water surface levels reduced for the communities near the Tangipahoa River in the lower portion of the parish, such as Hammond, Ponchatoula, and Robert.

2.5.1 Tangipahoa River Snagging and Clearing from US Highway 190 to Independence (SNG-1)

Snagging and clearing the Tangipahoa River upstream of the coastal surge influence was analyzed as an option for improving flow of the river. Snagging and clearing efforts have negative impacts to the ecosystem, and thus would require mitigation if implemented, which was captured in the cost for these alternatives. See Appendix D for more details on impacts and mitigation assumptions. The extent of snagging and clearing starts upstream at the Highway LA-40 overpass near Independence, LA and continues downstream until reaching the US Highway 190 overpass. Downstream of US Highway 190, was previously cleared within the last few years. Figure J: 2-7 shows the extents of snagging and clearing proposed on the Tangipahoa River.

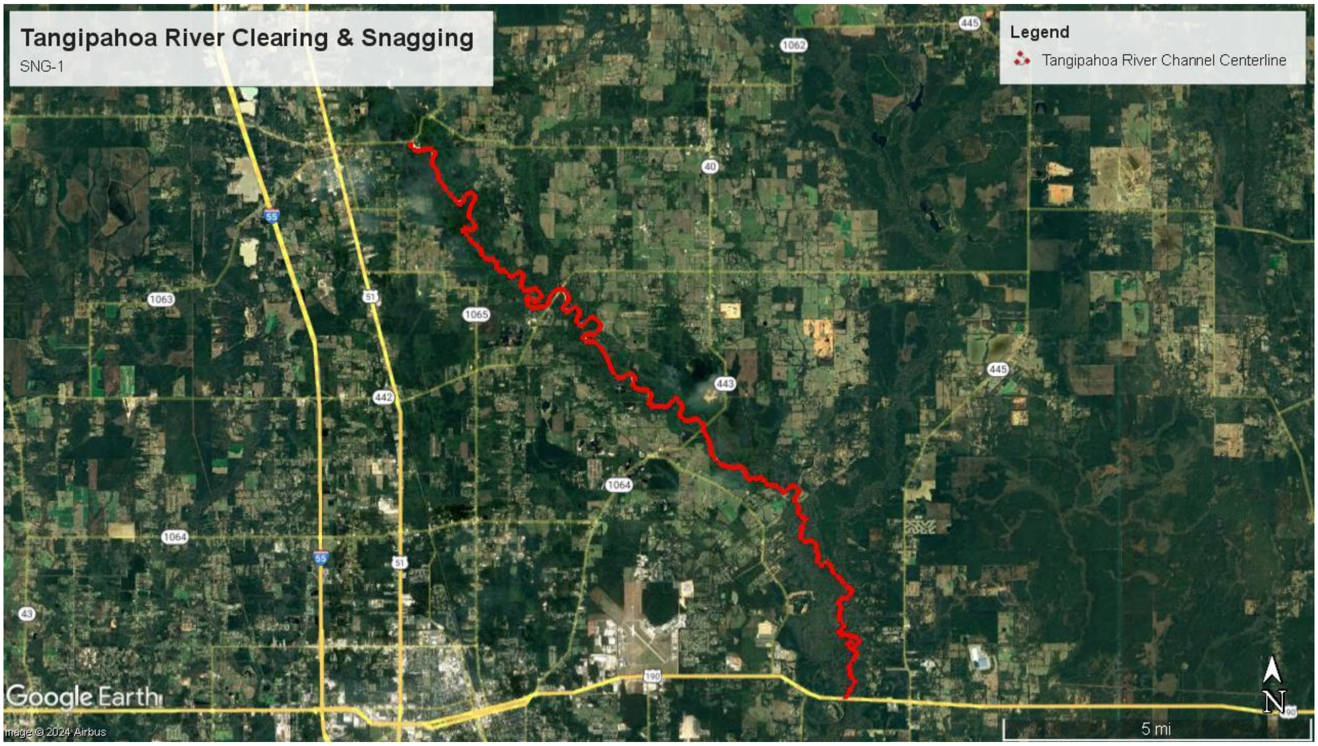


Figure J: 2-7 – SNG-1 Snagging and Clearing Extents

2.5.2 Tangipahoa River, SNG-1, and Chappepeela Creek from the Tangipahoa River to Little Chappepeela Creek (SNG-3)

Snagging and clearing the Tangipahoa River and Chappepeela Creek upstream of the coastal surge influence was analyzed. The Tangipahoa River extent of clearing and snagging starts upstream at the Highway 40 overpass near Independence, LA and continues downstream until reaching the Highway 190 overpass. The Chappepeela Creek extent of snagging and clearing starts upstream at the confluence with Little Chappepeela Creek and continues downstream until reaching the Tangipahoa River confluence. Figure J: 2-8 shows the extents of snagging and clearing proposed on the Tangipahoa River.

Figure J: 2-8 – SNG-3 Snagging and Clearing Extents

SECTION 3
Geotechnical Engineering

The geotechnical data available for this study was limited and the data that was obtained did not apply directly to the project sites for the proposed structural measures. Geotechnical data for the study was provided by the Louisiana Department of Transportation and Development (LADOTD) and covered bridge projects on roads and highways maintained by the state of Louisiana.

3.1 GEOLOGY

3.1.1 Regional Geology

Tangipahoa Parish is in southeastern Louisiana and extends south from the Mississippi-Louisiana border to the southern parish boundary near Lakes Maurepas and Pontchartrain, which is approximately 49 miles. The eastern side of the parish is bordered by Washington and St. Tammany parishes, and the western side is bordered by Livingston and St. Helena parishes. The width of the parish is approximately 19 miles, except the southern tip, which is narrowed to 13 miles wide. The parish covers approximately 791 square miles and contains the major communities of Ponchatoula, Hammond, Robert, Tickfaw in the southern section of the parish, and Kentwood, near the northern boundary. The Tangipahoa River is the major waterway through the parish. It is located on the western extent of the parish and runs from north to south, flowing into Lake Pontchartrain. The topography declines from approximately 340 feet above mean sea level (amsl) at the northern boundary to sea level at Lake Pontchartrain.

Louisiana is part of the Coastal Plain physiographic province, which stretches over 3,540 km (2,200 miles) from Cape Cod to the Mexican border, and then another 1609 km (1,000 miles) south to the Yucatan Peninsula (Coastal Plain Province, 2018). The Coastal Plain is characterized by a series of seaward, gently sloping terraces, which eventually form the continental shelf in the Atlantic and Gulf of Mexico (Coastal Plain Province, 2018; Geology of the Pine Grove 7.5-Minute Quadrangle, LA). The Coastal Plain is divided into six sections: 1. East Gulf Coastal Plain, 2. Embayed Section, 3. Floridian Section, 4. Mississippi Alluvial Plain, 5. Sea Island Section, and 6. West Gulf Coast Plain (Coastal Plain Province, 2018). The southern tip of Tangipahoa Parish nearest to Lake Pontchartrain and Lake Maurepas is in the Mississippi Alluvial Plain whereas the rest of the parish is part of the East Gulf Coastal Plain.

Regional geology of the Tangipahoa Parish is split into approximately four general sections. Along the northwest edge of Lake Pontchartrain, extending west to I-55 and east to the parish border near Madisonville, are Holocene delta plain and fresh marsh deposits (Qdf) consisting of gray to black clay with very high organic content, containing some peat, with thick peat beds underlying freshwater marshes and swamps (Snead, 1984). This is an area of abandoned delta lobes of the Mississippi River. The second general section of Tangipahoa Parish is north of the delta and marsh deposits extending from east of Springfield to Madisonville and consists of alluvium (Qal; Snead, 1984). The alluvium is gray to brownish gray clay and silty clay, which is reddish brown with some local sand and gravel in the Red River Valley (Snead, 1984). Deposited alluvium includes all alluvial valley deposits except natural levees of major streams. North of the boundary are prairie terraces (Qtp) of light gray to light brown clay, sandy clay, silt, sand, and some gravel, which make up the third general section of the parish. State highway 22 generally follows the boundary between the alluvium and terrace deposits. This area has a higher topography than the alluvial area, with little surface dissection (Snead, 1984). The prairie terraces have an elevation ranging between approximately 15 to 30 feet amsl. There are three levels of terraces: two along alluvial valleys and the third, which is the lowest, found intermittently towards the Gulf. The last general geologic unit is found in the northern section of the parish. The High Terraces unit (Qth) is composed of tan to orange clay, silt, and sand with a large amount of base gravel. The High Terraces area begins northeast of Independence to the border with Mississippi, and is located east and west of the Tangipahoa River Valley (Snead, 1984). There are three terraces within the High Terraces Province: Williana, Citronelle, and Bentley, which is the highest. Surfaces here are highly dissected and less continuous than the lower terraces (Snead, 1984).

3.1.2 Seismic Hazards

The state of Louisiana resides within the Gulf Coast Basin, a tectonic province known for thick layers of sedimentary rocks, sedimentary strata that thickens and dips to the south, salt domes, and listric growth faults, which are faults where sediment was deposited above a fault scarp and the downthrown block thickened and induced movement while the dip shallowed with depth (Stevenson and McCulloh, 2001; McCulloh, 2001). There are two areas of prominent faulting in Louisiana. Northern Louisiana contains multiple inactive faults and southern Louisiana contains the Baton Rouge fault system, which contains prominent, wide spanning listric grown faults (Stevenson and McCulloh, 2001; McCulloh, 2001). Most movement that occurs due to the listric growth faults is related to a gradual creep process (Stevenson and McCulloh, 2001; McCulloh, 2001). In Tangipahoa Parish the Baton Rouge Fault, a listric growth fault, runs horizontally through the parish between Prairie Terraces and lowlands. Two distinct fault systems are present in Lake Pontchartrain (USGS, 2002). The southern faults are reportedly inactive, and the northern half of the lake contains active faults of the Baton Rouge-Denham Springs fault system.

Another fault zone that could have effects in Louisiana is the New Madrid Seismic Zone (NMSZ) near New Madrid, Missouri, which in 1811-1812 produced earthquakes felt in Louisiana that likely had intensities ranging from V-VI to III-IV (McCulloh, 2001; Stevenson, 2001).

According to Stevenson and McCulloh, 2001 and McCulloh, 2001, other historical earthquakes that may have impacted Tangipahoa Parish include:

1. May 7, 1842 MM Intensity III-IV felt near Catahoula, LA,
2. October 19, 1930 MM Intensity VI near Donaldsonville, LA,
3. November 6, 1958 MM Intensity IV in New Orleans,
4. November 19, 1958 MM Intensity V near Baton Rouge, LA,

5. October 15, 1959 MM Intensity IV in southwestern LA,
6. April 24, 1969 MM Intensity from IV-VI near LA-TX border,
7. October 16, 1963 earthquake near Lake Charles, and
8. March 27, 1964 earthquake of magnitude 8.3 from Prince William Sound Alaska that wasn't felt, but caused water oscillations on bodies of water in the Gulf Coast.

Overall, Louisiana is not seismically active, but many smaller magnitude earthquakes have occurred throughout history. There have been 32 earthquakes from 1843-1994 with magnitudes between 2.2 and 4.4 and 11 earthquakes with an unknown magnitude (Stevenson and McCulloh, 2001; McCulloh, 2001). Recent earthquakes from 1995 to 2023 near Tangipahoa Parish include one magnitude 3.0 earthquake in 2005 and one magnitude 3.0 earthquake in 2010 (Latest Earthquakes USGS).

3.2 GEOTECHNICAL DATA AVAILABLE FOR ASSESSMENT

No soil borings were collected, and no soil testing was performed for this study. The assessment was based on borings provided by the Louisiana Department of Transportation and Development (LADOTD) and covered bridge projects on roads and highways maintained by the state of Louisiana. Bridges near the Robert, LA levees (WASH-1 and WASH-2) and the Village of Tangipahoa, LA levee (SP-TR-1) were analyzed to help inform quantities and assumptions during feasibility. Fourteen (14) of the borings provided were near the Village of Tangipahoa, in the vicinity of structural feature SP-TR-1 Levee alignment, however not along the alignment. These borings were labeled as follows; 276-03-0012, 562-53-0003 1 to 5, 700-29-0043 1 to 5, 853-03-0007 1 to 2 and 853-12-0009. Several borings show an approximately 5-foot-thick weak clay layer within the upper 15 feet. This layer may result in the need of additional material for settlement, a stability berm, and/or use of geotextile fabric to increase strength.

The MVS geotechnical team also consulted with the MVN geotechnical team to inform the decision on the levee design cross section. 5H:1V layers were selected due to the variable layers at the ground surface and borings not being taken within the feature locations. The lesser slope were also chosen due to the unknown borrow source(s) and material(s). This assumption would be sufficient for feasibility-level cost estimating purposes and support determining the technical feasibility of the structural alternatives in the focused array.

3.3 SHEER STRENGTH DATA

Shear strength tests, including unconsolidated undrained, consolidated undrained, direct shear, and consolidation, were not performed and shear strength values were not selected for design.

3.4 STABILITY ANALYSES

Stability analyses were not performed due to the structural measures being screened prior to the final array of alternatives.

3.5 SEEPAGE ANALYSES

Seepage analyses were not performed due to the structural measures being screened prior to the final array of alternatives.

3.6 FOUNDATION SETTLEMENT

Settlement analyses were not performed due to the structural measures being screened prior to the final array of alternatives.

SECTION 4
Civil Engineering

4.1 ALTERNATIVE 3: WASHLEY CREEK

4.1.1 Levee and Floodwall Assumptions

The design section for the earthen levees was developed by the civil design section with the aid of the geotechnical design section and consists of a 12-foot crown at the elevation of the 1% AEP event, which was provided by the Hydraulics & Hydrology (H&H) section, and side slopes of 5 horizontal to 1 vertical (5:1), shown in Figure J: 4-1. The flatter side slopes were chosen as a conservative option to a more typical 3:1 side slope design. The existing geotechnical information that the team was able to find for Tangipahoa Parish led the team to make this choice, but further additions to the levee typical section could have been necessary had the levee alternatives moved forward into the final array of alternative.

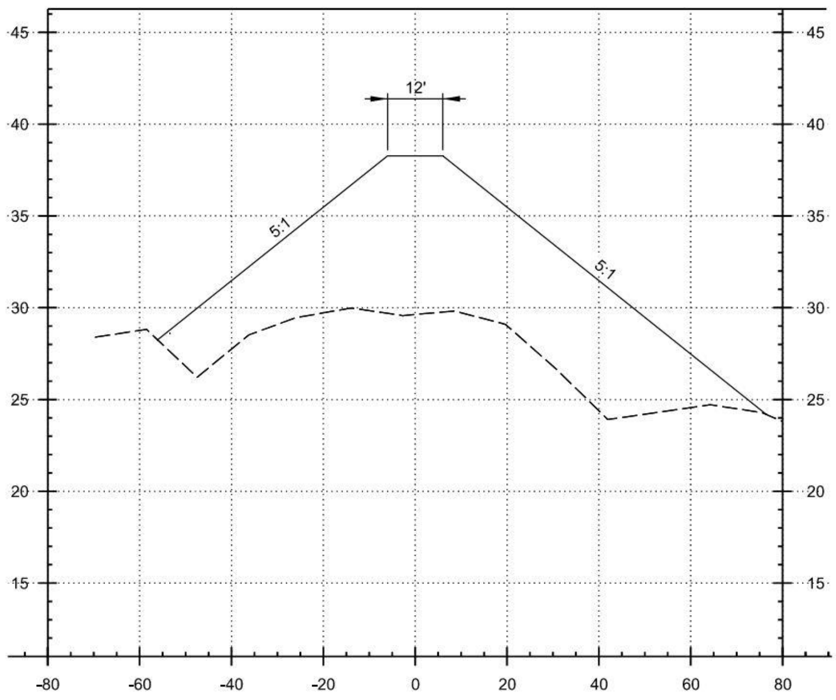
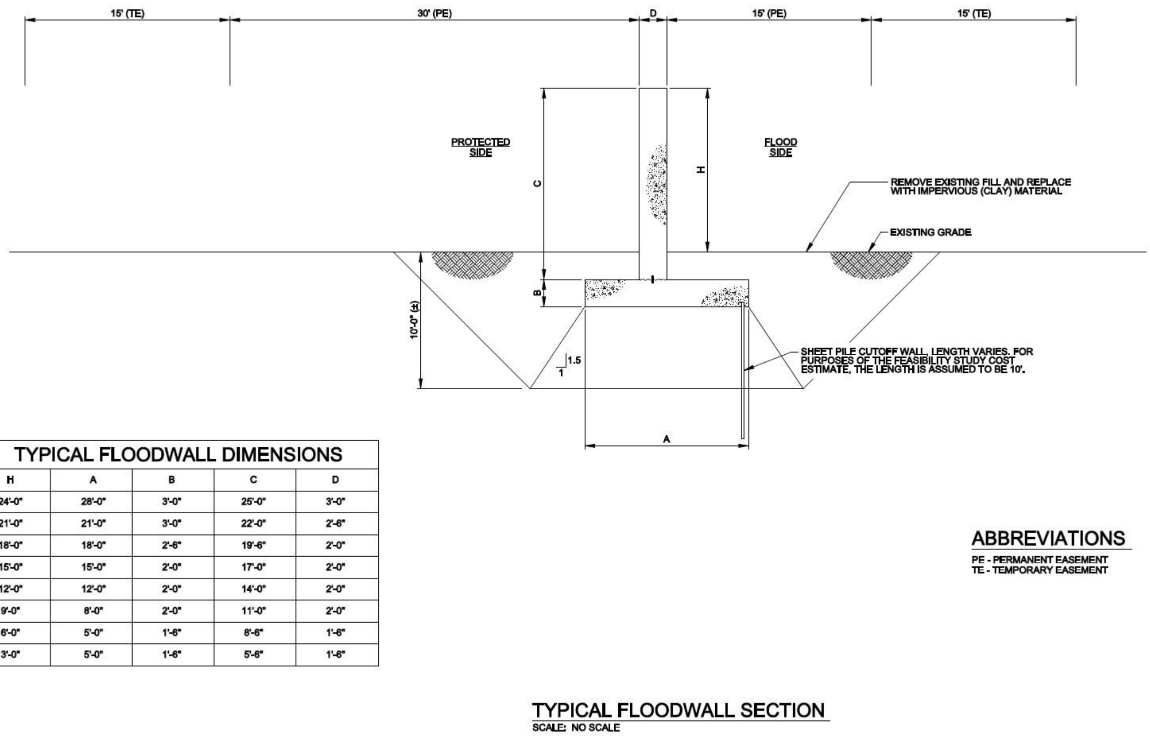


Figure J: 4-1 - Typical Section of Earthen Levee

During the development of these Washley Creek levee system measures, several sections of the alignment were evaluated as both earthen levee and concrete floodwall. The difference in overall structure footprint between the levee and floodwall options allowed some areas to be less impactful to cultural, environmental, and real estate interests. The typical section used for these sections of floodwall can be seen in Figure J: 4-2.



TYPICAL FLOODWALL DIMENSIONS

H	A	B	C	D
24'-0"	28'-0"	3'-0"	25'-0"	3'-0"
21'-0"	21'-0"	3'-0"	22'-0"	2'-6"
18'-0"	18'-0"	2'-6"	19'-6"	2'-0"
15'-0"	15'-0"	2'-0"	17'-0"	2'-0"
12'-0"	12'-0"	2'-0"	14'-0"	2'-0"
9'-0"	8'-0"	2'-0"	11'-0"	2'-0"
6'-0"	5'-0"	1'-6"	8'-6"	1'-6"
3'-0"	5'-0"	1'-6"	5'-6"	1'-6"

Figure J: 4-2 - Typical Section of Concrete Floodwall

4.1.2 Pump Station Assumptions

The capacity of the pump stations required to deal with the interior drainage behind the levees was determined by H&H and this figure was used to find comparable pump stations built for other levee projects in order to get a roughly equivalent cost estimate. This was done for both pump stations required for WASH-1 and the single pump station required for WASH-2.

4.1.3 Closure Structure Assumptions

Closure structures were designed, and the costs were estimated for the closure structures in a similar way to the pump stations. A comparable, recently built closure structure was found to use a baseline cost and the civil design and cost engineers adapted the estimates to match the 4 closure structures needed for WASH-1 and the 3 needed for WASH-2. Details on the widths and heights needed for the closure structures can be found in Table J: 4-1 and Table J: 4-2.

Table J: 4-1 - WASH-1 Closure Structures

Road Name	Width of Opening (FT)	Height (FT)
U.S. Highway 190 (West Side)	80	3
Louisiana Highway 445	80	7
Doc Hyde Road	60	1
U.S. Highway 190 (East Side)	80	1

Table J: 4-2 - WASH-2 Closure Structures

Road Name	Width of Opening (FT)	Height (FT)
U.S. Highway 190 (West Side)	80	3
Louisiana Highway 445	80	7
U.S. Highway 190 (East Side)	80	2

4.1.4 Quantities

Table J: 4-3 provides the earthwork quantities that were used for the development of the cost estimate for WASH-1 and WASH-2. The earthwork quantities were developed using OpenRoads Designer corridors and the assumptions laid out in sections 4.1.2 and 4.1.3 above were used for the development of the cost estimate. The design for these measures was done using an iterative process to ensure unnecessary design efforts were not expended on measures that would prove to be economically or environmentally infeasible.

Table J: 4-3 – Earthwork Quantities for WASH-1 and WASH-2

Alternative Name/ Measure Name	Fill Volume (Cubic Feet)	Fill Volume (Cubic Yards)
WASH-1	16,961,000	628,180
WASH-2	16,941,000	627,420

4.2 ALTERNATIVE 4: BEAVER CREEK/TANGIPAHOA RIVER

4.2.1 Levee and Floodwall Assumptions

The design earthen levee and concrete floodwall sections detailed in section 4.1.1 above were used for the design for the Village of Tangipahoa levee.

4.2.2 Railroad Embankment Cutoff Wall Assumptions

The Village of Tangipahoa levee measure ties into high ground at the US Highway 51 roadway embankment that runs through the east side of town. The Canadian National Railway runs parallel to US-51 and requires a concrete cut-off wall through the railway embankment in order to connect the earthen levee section east of the railroad right-of-way to the high ground on the US-51 roadway embankment. A plan view detail of the concrete cutoff wall can be seen in Figure J: 4-3.

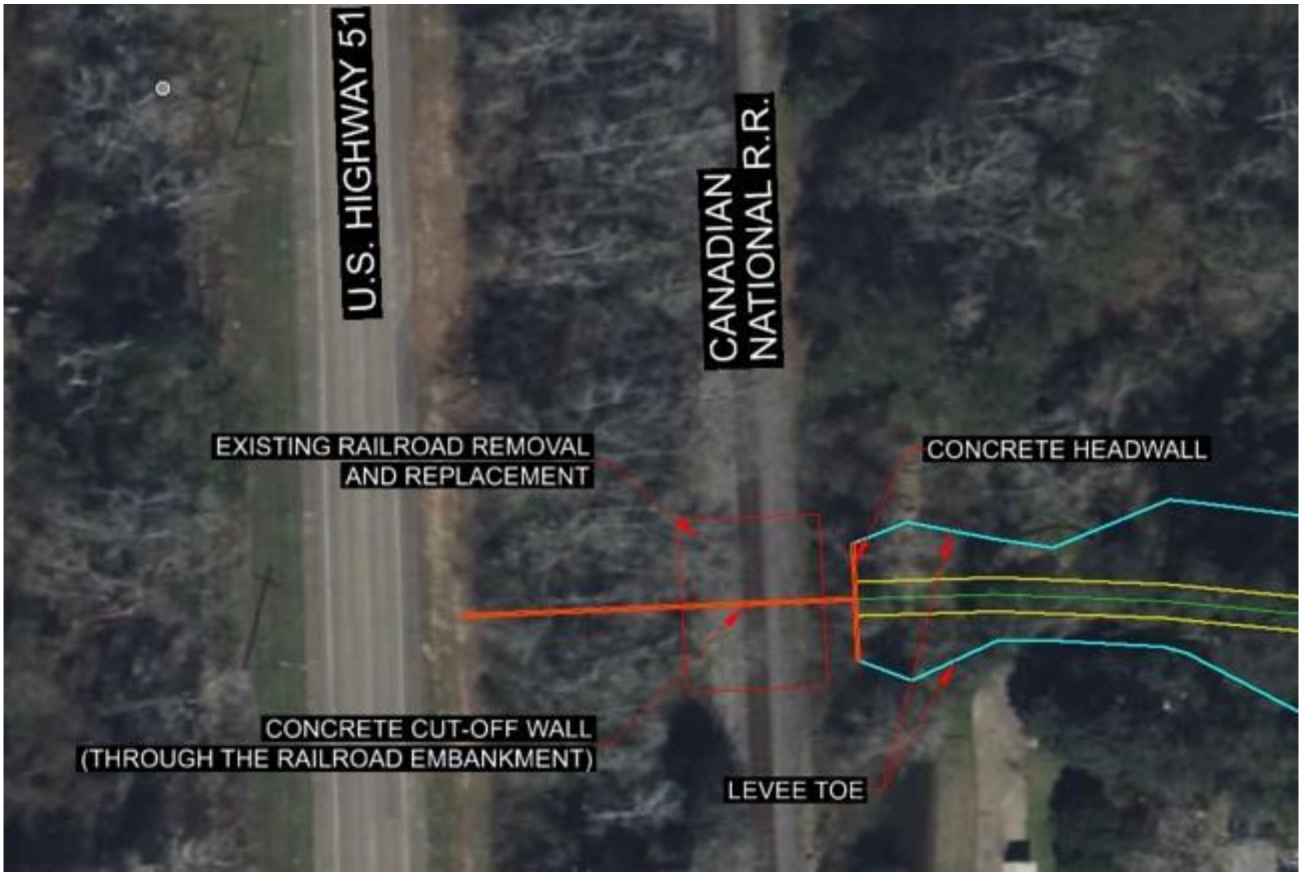


Figure J: 4-3 – Concrete Cutoff Wall Through Canadian National Railway Embankment

The construction of the cut-off wall would require approximately 60 feet of railroad tracks, ballast, sub-ballast, and embankment to be removed and replaced. The replacement quantities were developed using the Canadian National Railway typical railroad track section shown in Figure J: 4-4. The railroad tracks would be closed for construction for 5 to 7 days and extensive coordination with Canadian National Railway would be required to complete the project. This fact, along with the economic benefits calculated for the alternative led to it being screened before the final array of alternatives was developed.

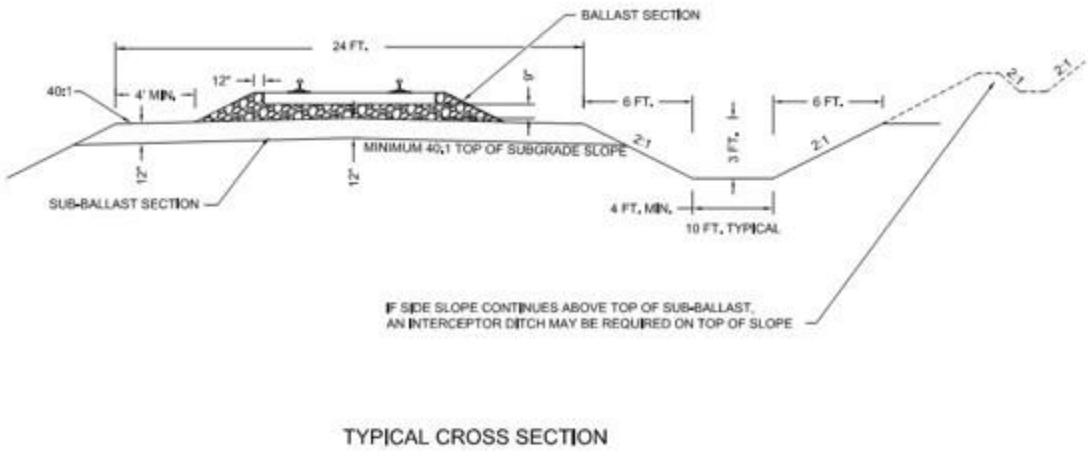


Figure J: 4-4 – Canadian National Railway Typical Section

4.2.3 Quantities

Table J: 4-4 provides the earthwork quantities that were used for the development of the cost estimate for SP-TR-1 and Tables J: 4-5 and J: 4-6 provide the quantities and assumptions needed to develop the cost estimate for the concrete cut-off wall discussed in section 4.2.2. The earthwork quantities were developed using OpenRoads Designer corridor. The design for these measures was done using an iterative process to ensure unnecessary design efforts were not expended on measures that would prove to be economically or environmentally infeasible.

Table J: 4-4 – Earthwork Quantities for SP-TR-1

Alternative Name/Measure Name	Fill Volume (Cubic Feet)	Fill Volume (Cubic Yards)
SP-TR-1	629,300	23,310

Table J: 4-5 – Concrete Cut-Off Wall Quantities

Variable	Value
Length (FT)	140
Width (FT)	1
Depth (FT)	8
Concrete Volume (CY)	41.48
Class 1 Ballast Removed & Replaced (CY)	720
Sub-Ballast Removed & Replaced (CY)	1,440
Steel H12x74 Piles (60 foot deep, 5-foot on center) (EA)	29
Sheetpile (30 foot deep) (SF)	4,200
Excavation for Wall (CY)	225
Compacted Backfill (CY)	185
Railroad Ties (EA)	40

Table J: 4-6 – Concrete Headwall for Levee to Cut-Off Wall Transition Quantities

Variable	Value
Length (FT)	50
Width (FT)	1
Depth (FT)	8
Concrete Volume (CY)	14.81
Excavation for Wall (CY)	67
Compacted Backfill (CY)	60
Steel H12x74 Piles (60 foot deep, 5-foot on center) (EA)	11
Sheet Pile (30 foot deep) (SF)	1,500

4.3 ALTERNATIVE 5: BEDICO CREEK

4.3.1 Roadway Elevation Assumptions

The sections of roadway to be elevated were identified by H&H and the roadway removal and replacement quantities were developed using the roadway typical section from the Louisiana Department of Transportation and Development (LA DOTD) shown in Figure J: 4-5. Roadway elevation designs were not done for Interstates 12 and 55 after life-safety analysis done by Economics indicated these highways would not receive any benefit from being elevated.

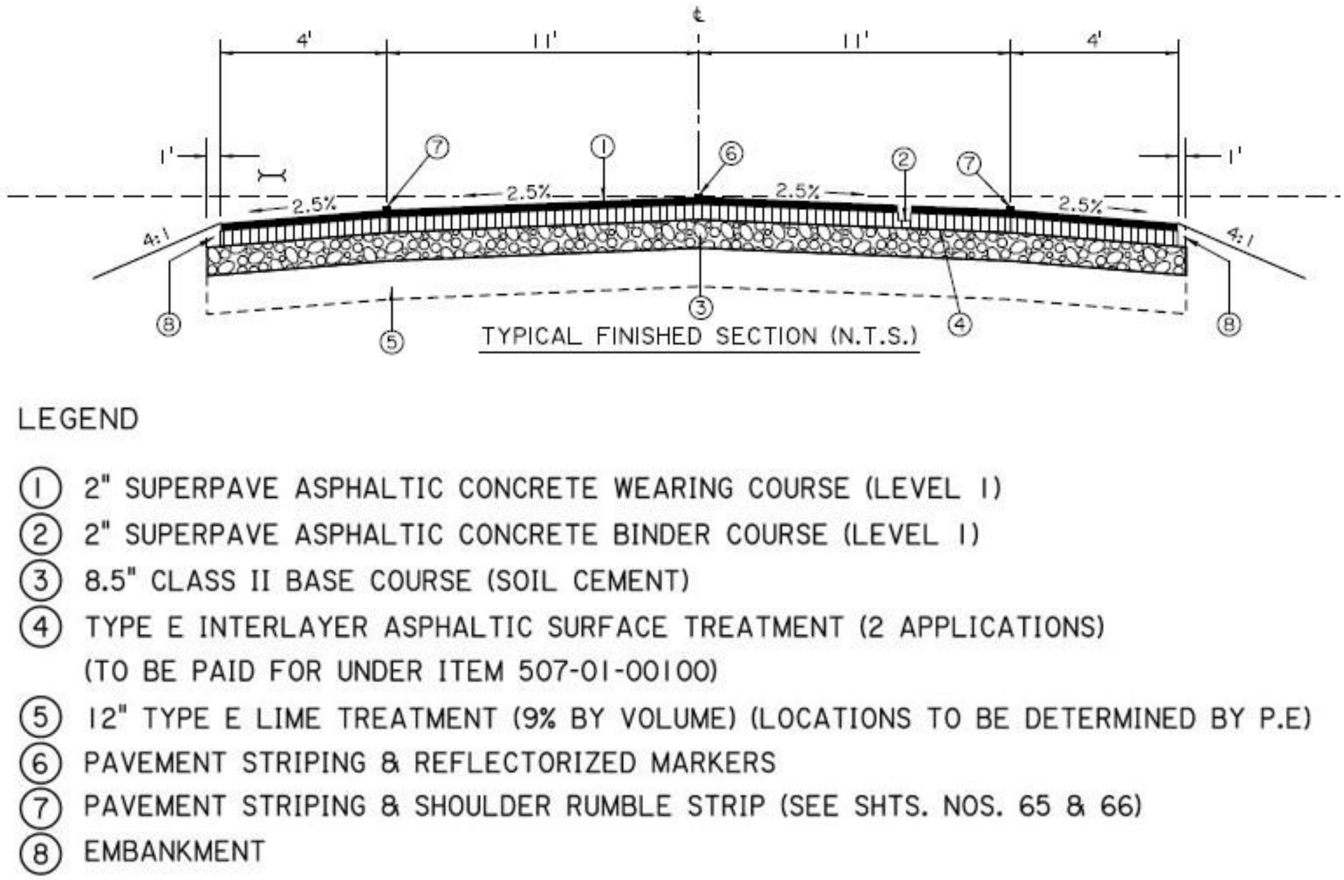


Figure J: 4-5 – LA DOTD Typical Highway Section

4.3.2 Quantities

Table J: 4-7 shows the removal quantities for the BED-1 and BED-4 roadway elevation measures. Table J: 4-8 shows the new pavement and compacted fill quantities required to elevate the roadways.

Table J: 4-7 – BED-1 and BED-4 Roadway Removal Quantities

Variable	BED-1	BED-4
Road Name	Firetower Road	LA-22
Length (FT)	425	2,775
Width (FT)	22	36

Variable	BED-1	BED-4
Asphalt Pavement Removed (CY)	3,120	33,300
Pavement Subgrade Removed (CY)	6,625	70,765

Table J: 4-8 – BED-1 and BED-4 New Roadway and Fill Quantities

Variable	BED-1	BED-4
Road Name	Firetower Road	LA-22
Length (FT)	425	2,775
Width (FT)	22	36
Superpave Asphalt Wearing Course (2") (FT^3)	1,560	16,650
Superpave Asphalt Wearing Course (2") (TONS)	113	1,210
Superpave Asphalt Binder Course (2") (FT^3)	1,560	16,650
Superpave Asphalt Binder Course (2") (TONS)	113	1,210
Class II Base Course (8.5") (FT^3)	7,225	74,700
Class II Base Course (8.5") (CY)	268	2,770
Prime Coat (2 Applications) (GAL)	545	5,705
Pavement Striping (LF)	957	6,245
Compacted Fill (CY)	132	1,502

4.4 ALTERNATIVE 6: LITTLE CHAPPEPEELA CREEK/COOPER CREEK

4.4.1 Roadway Elevation Assumptions

The roadway elevation quantities for Briar Patch Cemetery Road were developed using the same methods laid out in section 4.3.1. This measure includes the removal and replacement of an existing bridge that measures approximately 60 feet in length, 22 feet across and sits 8 feet above the creek bed below it. Information on this bridge was found in the Tangipahoa Parish “Roads and Bridges” database, where it is classified by the LA DOTD as a COPCSS, or Concrete Precast Slab Structure. The new bridge structure is assumed to need to be 3 feet higher and approximately 100 feet in length.

4.4.2 Quantities

Table J: 4-9 shows removal quantities for the LCC-1 roadway elevation measure. Table J: 4-10 shows the new pavement, compacted fill, and new bridge quantities required to elevate the roadways.

Table J: 4-9 – LCC-1 Roadway and Bridge Removal Quantities

Variable	Value
Length (FT)	1,295
Width (FT)	22
Asphalt Pavement Removed (CY)	9,500
Pavement Subgrade Removed (CY)	20,200
Existing 8-foot-tall Bridge Removal (SF)	1,320

Table J: 4-10 – LCC-1 New Roadway, Bridge, and Fill Quantities

Variable	Value
Length (FT)	1,295
Width (FT)	22
Superpave Asphalt Wearing Course (2") (FT^3)	4,750
Superpave Asphalt Wearing Course (2") (TONS)	345
Superpave Asphalt Binder Course (2") (FT^3)	4,750
Superpave Asphalt Binder Course (2") (TONS)	345
Class II Base Course (8.5") (FT^3)	22,015
Class II Base Course (8.5") (CY)	816
Prime Coat (2 Applications) (GAL)	1,655
Pavement Striping (LF)	2,915
Compacted Fill (CY)	2,800
New 11-foot-tall Bridge (SF)	2,200

4.5 ALTERNATIVE 7: TANGIPAHOA RIVER AND CHAPPEPEELA CREEK

4.5.1 Snagging and Clearing Assumptions

The construction methods for measures SNG-1 and SNG-3 were assumed to have construction equipment in the river channel to remove the debris, with the debris placed on barges and floated to construction access points. The debris would be chipped on site and hauled away to a disposal facility. A plan view detail of an example point of access is shown in Figure J: 4-6.

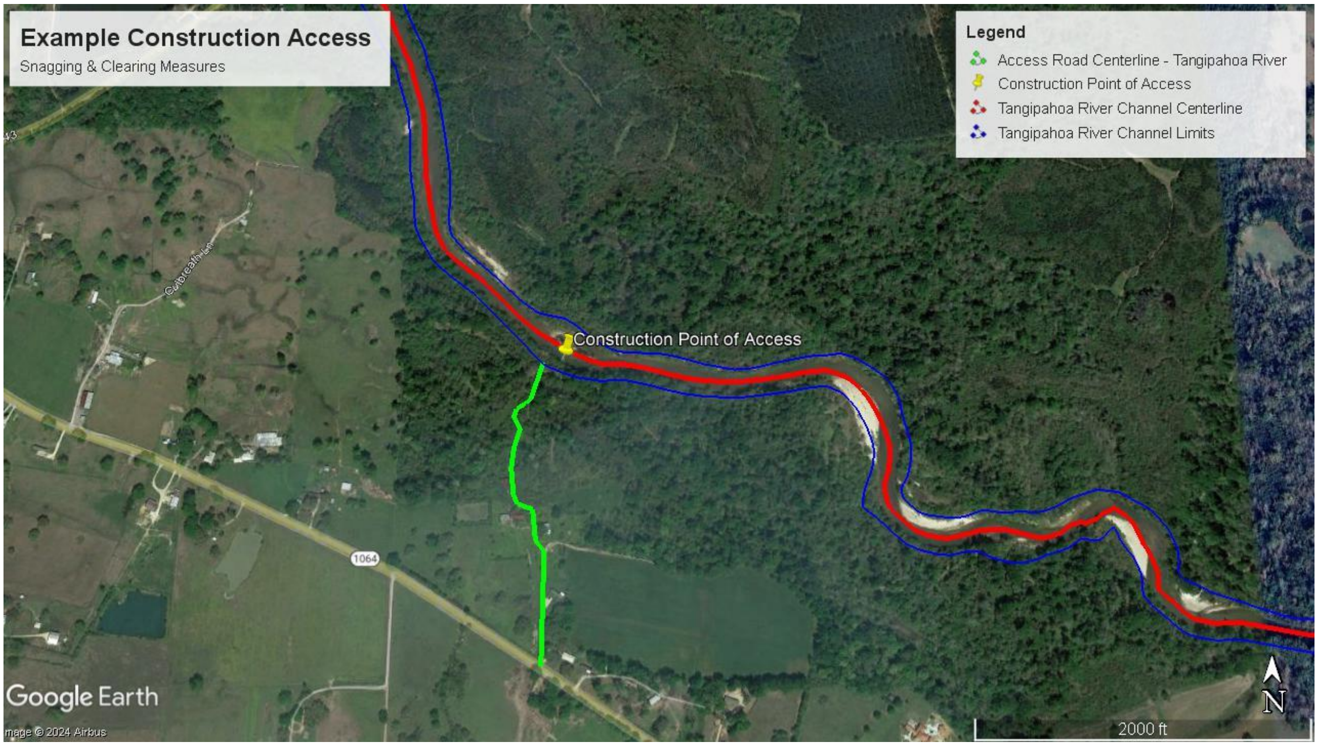


Figure J: 4-6 – Example Point of Access for Snagging and Clearing Work

Land access to the points of access on the river channels would need to be cleared and a gravel access road installed for construction equipment to traverse. The construction access roads would be left in place after the initial snagging and clearing work is done but would need to be replaced every ten years to ensure access for planned future clearing and snagging maintenance work.

4.5.2 Quantities

Table J: 4-11 and J:4-12 show the quantities for the work to install gravel access roads for snagging and clearing operations on the Tangipahoa River and Chappepeela Creek, respectively.

Table J: 4-11 – Tangipahoa River Snagging and Clearing Access Road Quantities

Variable	Value
Gravel Access Road - 12" Depth (CY)	14,770
Geotextile Fabric (SF)	398,750
Clearing and Grubbing (AC)	19

Table J: 4-12 – Chappepeela Creek Snagging and Clearing Access Road Quantities

Variable	**Value**
Gravel Access Road - 12" Depth (CY)	17,290
Geotextile Fabric (SF)	466,750
Clearing and Grubbing (AC)	22

SECTION 5
Structural Engineering

5.1 STRUCTURAL ALTERNATIVES

Structural engineers were not directly a part of the study team due to the structural alternatives being screened out prior to the final array. Structural engineers from both MVS and MVN were consulted to find the example closure structure and pump station projects and the associated assumptions that the team used to complete the cost estimates for the levee alternatives.

5.2 NON-STRUCTURAL ALTERNATIVES

Refined alternative design and cost estimating will be required during the Preconstruction Engineering and Design (PED) phase. This will include the development of criteria to group residential structures to be elevated by the type of construction, such as mobile home or framed house, foundation, such as pier supported or slab supported, and how high the structure must be raised. A structural PDT member will be added to the team to assist with this effort, alongside the geotechnical and civil design PDT members already on the team.

SECTION 6
References and Resources

Study References:

USACE, New Orleans District, Tangipahoa, Tchefuncte, and Tickfaw Rivers Reconnaissance Report, 1991

USACE, New Orleans District, Louisiana Coastal Protection and Restoration (LACPR) Final Technical Report, 2009

Louisiana Coastal Protection and Restoration Authority, Louisiana's Comprehensive Master Plan for a Sustainable Coast, 2017

USACE, New Orleans District, Silver Jackets Study – Tangipahoa Watershed Analysis, 2020

Louisiana Coastal Protection and Restoration Authority, Louisiana's Comprehensive Master Plan for a Sustainable Coast, 2023

Tangipahoa Parish Government, Comprehensive Master Plan, 2024

McCulloh, R.C., 2001, Active Faults in East Baton Rouge Parish, Louisiana, Public Information Series No. 8, Louisiana Geological Survey

McCulloh, R.P., Heinrich, P.V., and Snead, J., 2003, Ponchatoula 30 x 60 Minute Geologic Quadrangle, Louisiana Geological Survey, Geologic Quadrangle Map, Scale 1:100,000.

McCulloh, R.P., Heinrich, P.V., and Snead, J., 2009, Amite 30 x 60 Minute Geologic Quadrangle, Louisiana Geological Survey, Geologic Quadrangle Map, Scale 1:100,000.

Snead., J.I., and McCulloh, R.P., 1984, Geologic Map of Louisiana, Louisiana Geological Survey, Geologic Map 5, 1:500,000.

Stevenson, D.A., and McCulloh, R.C., 2001, Earthquakes in Louisiana, Public Information Series No. 7, Louisiana Geological Survey.

Websites:

Tangipahoa Parish Government, GIS Database, https://tangipahoa.org/residents/gis-mapping/tangis/

Coastal Plain Province, 30 Apr. 2018, U.S. National Park Service, www.nps.gov/articles/coastalplain.htm.

Geology of the Pine Grove 7.5-Minute Quadrangle, LA, Louisiana Geological Survey, Scale 1:24,000, https://www.lsu.edu/lgs/maps/24k-Geology.php.

Latest Earthquakes, United States Geological Survey (USGS), Latest Earthquakes (usgs.gov).

United States Geological Survey (USGS), 2002, Environmental Atlas of the Lake Pontchartrain Basin, pubs.usgs.gov/of/2002/of-02-206/.

Software:

Bentley OpenRoads Designer

Engineering Manuals and Regulations:

EM 1110-2-1913, Design and Construction of Levees

EM 1110-2-2902, Conduits, Culverts, and Pipes

ER 1110-2-1150, Engineering and Design for Civil Works Projects

SECTION 7
List of Acronyms and Abbreviations

AC	Acre
AEP	Annual Exceedance Probability
CPRA	Coastal Protection and Restoration Authority
CY	Cubic Yard
EA	Each
EM	Engineering Manual
ER	Engineering Regulation
FT	Feet
GAL	Gallon
H&H	Hydraulics and Hydrology
LA DOTD	Louisiana Department of Transportation and Development
LB	Pound
LF	Linear Feet
MVS	St. Louis District
MVN	New Orleans District
NED	National Economic Development
PED	Preconstruction Engineering and Design
SF	Square Feet
TN	Ton
USACE	US Army Corps of Engineers
NNBF	Natural and Nature-Based Features
COPCSS	Concrete Precast Slab Structure
PDT	Project Delivery Team