Mississippi River Valley Division
Regional Planning and Environmental Division South

Amite River and Tributaries East of the Mississippi River, Louisiana (ART)

Appendix A: Engineering

November 2019

CONTENTS

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Section 1
General

This draft Engineering Appendix documents the feasibility level engineering and design for the structural study alternatives. 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 the Amite River Basin and tributaries. The Amite River Basin begins in southwest Mississippi and flows southward, crossing the state line into southeastern Louisiana. The Amite River Basin includes 2,200 square miles flowing into the Amite River and its tributaries. It includes portions of Amite, Lincoln, Franklin, and Wilkinson Counties in Mississippi as well as East Feliciana, St. Helena, East Baton Rouge, Livingston, Iberville, St. James, St. John the Baptist, and Ascension Parishes in Louisiana.

The study area is similar to the 1984 Amite Rivers and Tributaries Flood Control Initial Evaluation Study by the US Army Corps of Engineers (USACE); however, it was expanded to include areas that are impacted by backwater flooding to the southeast and east because they are hydraulically connected to the Amite River Basin and tributaries. The alternatives below were analyzed by the Civil, Geotechnical, and Structures Branches of USACE, Mississippi Valley Division, New Orleans District (MVN), Engineering Division.

Section 2
Structural Alternatives

2.1 DARLINGTON DRY DAM/DARLINGTON REDUCED WET DAM

Darlington Dry Dam/Darlington Reduced Wet Dam, the Darlington Dam alternative, consists of an earthen dam on the Amite River with the option of being a wet or dry dam. The dam would include an outlet feature (currently three 10 feet by 10 feet box culverts) and a large spillway. The spillway would require a concrete base and walls. Because it is on an earthen base, the spillway would likely require anchor piles and a seepage cutoff. Structural components would also require flip bucket or baffle field and there is the possibility that of gate control towers would be needed. Minor structures could include debris booms, trash racks, etc. Because this alternative was previously studied, data for analyzing it is available in the "Amite River and Tributaries, Darlington Reservoir Re-evaluation Study (Reconnaissance Scope)," dated September 1997.

2.2 DRY DAM ON SANDY CREEK

The Dry Dam on Sandy Creek alternative consists of an earthen dam on Sandy Creek, a tributary of the Amite River. Limited data is available; therefore, many assumptions were made such as the geology of the area, the dam theoretical section, the outlet and spillway structure design, and borrow material and quantities.

2.3 DRY DAMS ON DARLINGTON, LILLEY, AND BLUFF CREEKS

The dry dams for the Darlington, Lilley, and Bluff Creek alternative consists of three earthen dams on Darlington Creek, Lilley Creek, and Bluff Creek, all tributaries of the Amite River. Limited data is available; therefore, many assumptions were made such as the geology of the area, the dam theoretical section, the outlet and spillway structure design, and borrow material and quantities.

A map showing the locations of the dry retention dams is provided in Figure A:2-1.

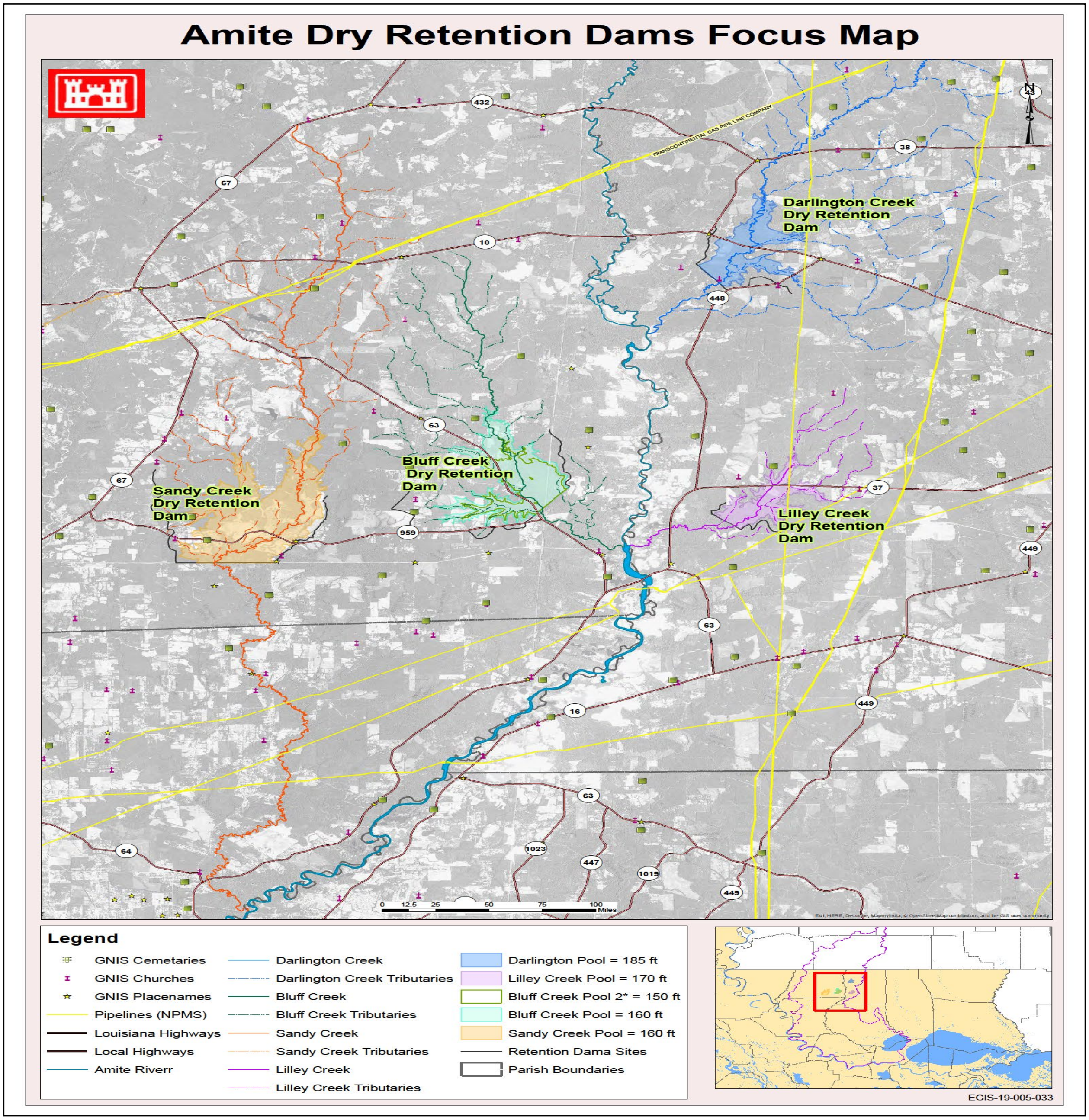

Figure A:2-1. Amite River Dry Retention Dams Focus Maps

Section 3
Geotechnical Investigations and Design

This portion of the report contains the initial feasibility level geotechnical review performed for the Amite River and Tributaries Study. Alternatives assessed within this study include:

- Darlington Dry Dam/Darlington Reduced Wet Dam alternative
- Dry Dam on Sandy Creek alternative
- Dry Dams on Darlington Creek, Lilley Creek, and Bluff Creek alternative

3.1 DARLINGTON DRY DAM/DARLINGTON REDUCED WET DAM

This section presents the results of the geotechnical design assessment of the proposed Darlington Dam. An initial feasibility level study was conducted in 1992 and revised in 1997 for the Darlington Dam. Findings from these studies are documented in the “Amite River and Tributaries, Darlington Reservoir Feasibility Study,” dated September 1992 (1992 study) and in the “Amite River and Tributaries, Darlington Reservoir Re-evaluation Study (Reconnaissance Scope),” dated September 1997 (1997 study).

No new borings or other subsurface investigation was conducted for this project and no additional geotechnical designs were performed as part of this study. In order to assess technical feasibility and update cost estimation, existing geotechnical investigations and analyses were re-evaluated to compare to the current design requirements as per USACE manuals, specifications, and criteria.

The Darlington Dry Dam/Darlington Reduced Wet Dam alternative were analyzed using the same design section, taken from the 1997 report. The dry dam would have a crown elevation 1 foot lower than the reduced wet. The dam would consist of a clay core with a random fill outer layer. The design section would consist of a reservoir with a 24 feet wide crown at elevation 202.8 feet National Geodetic Vertical Datum of 1929 (NGVD 29) and side slopes of 1 vertical on 3 horizontal from the crown to elevation 172.8 feet NGVD 29, the elevation of the flood control pool. On the flood side, from the flood control elevation to the conservation pool elevation, the slope is 1 vertical on 6 horizontal. The flatter slope is to reduce the chances of sudden drawdown failures that tend to occur in this zone. Below the conservation pool elevation, the slope is 1 vertical on 4 horizontal. On the protected side, from the flood pool elevation to the conservation pool, the slope is 1 vertical on 5 horizontal. The flatter slope in this area would increase stability and would resist seepage forces that may concentrate in the lower portion of the dam. Below the conservation pool, the slope is 1 vertical on 3 horizontal. The outlet structure for the dam is three 10 feet x 10 feet box culverts with an emergency spillway.

3.1.1 Geology

The Darlington Reservoir Feasibility Study report describes the geology in the project area as:

The study area is in the Southern Pine Hills of the Eastern Gulf Coastal Plain. Topography in the northern portion of the basin is dominated by plateaus and ridgetops underlain by the Citronelle Formation. The southern portion is dominated by gently sloping Pleistocene terrace surfaces.

The maximum elevation within the basin is approximately 500 feet MSL. Elevations are between 35 feet and 40 feet MSL near the junction of the Comite River and Amite River near Denham Springs. Minimum elevations are between 0 and 5 feet in the lower part of the basin near Lake Maurepas.

Although older sediments are found at depth in the study area, only the Plio-Pleistocene and Holocene sediments exposed at the surf ace and found near the surface are discussed. Four distinct geologic units are found within the basin: the Citronelle Formation, the Pleistocene terraces, the loess deposits and Holocene alluvium. The Citronelle Formation, which varies in age from late Pliocene to Pleistocene, generally consists of a gradational sequence of fluvial gravels, cross bedded sands, silts and clays with the coarser grained material occurring at the base of this sequence. South of the outcrop of the Citronelle Formation are found the relatively flat Pleistocene terraces of less variable lithology than that of the Citronelle Formation. Generally, these terraces are comprised of sediments consisting of silt and sandy clay which grade downward into a fine to coarse grained sand with some gravel.

The study area is located in a stable area of low seismicity. Earthquake activity is relatively rare and is usually less severe than average. Resulting damage to structures and levees (dikes) in the project area would be expected to be minor. (USACE, 1992)

3.1.2 General Dam Design Discrepancy

The design section developed using slope stability analyses in the 1997 study was designed with a top width of 24 feet. The top width of the dam does not meet EM 1110-2-2300 (General Design and Construction Considerations for Earth and Rock-Fill Dams), Article 4-3, which requires a minimum top width between 25 and 40 feet based on the dam height. However, EM 1110-2-2300 also states that the top width has little effect on stability and is governed by the functional purpose the top of the dam must serve. A thorough assessment of the dam section is recommended to account for design discrepancy prior to the Agency Decision Milestone (ADM). A field investigation plan can be developed pre-ADM with the intent of further exploration post-ADM for final changes.

3.1.3 Geotechnical Data Available for Assessment

No borings or soil testing were performed for this study. The assessment was based on borings and soil testing performed in the 1997 study. Seven undisturbed borings (DD-1U to DD-7U) were taken for the 1992 study, one on each dam abutment and five along the center of the dam. Four additional undisturbed borings (DD-8U, DD-9U, DD-10U, and DD-11U) were taken during the 1997 study (see Figure A:3-1), as well as two exploratory trench excavations. The earth core material data obtained from two exploratory trench excavations is adequate for embankment fill construction. There are gaps where no boring information is available along the east and west terraces. In addition, consolidation test data was limited to two borings (DD-9U and DD-10U) located at the center of the dam. It is recommended that additional boring data be taken to supplement existing borings used during the feasibility study.

Figure A:3-1. Boring Locations

3.1.4 Shear Strength Data

Shear strength tests, including unconsolidated undrained, consolidated undrained, direct shear, and consolidation, were performed on selected samples to obtain design values at MVN during the 1997 study. The shear strength values selected for design (i.e., clay core, embankment soils, and foundation clays, and granular foundation soils) are consistent with current design criteria.

3.1.5 Stability Analyses

Stability analyses conducted in the 1992 and 1997 studies were performed for the dam section as per USACE EM 1110-2-1902 (Engineering and Design Stability of Earth and Rock-Fill Dams), dated 1 April 1970. As part of the 1992 study, stability analyses were performed for seven separate reaches along the length of the dam: the east abutment terrace, east abutment, river closure, east river terrace, west abutment terrace, west river terrace, and west abutment. Stability analyses for these runs included end of construction analyses (required Factor of Safety [FOS] of 1.3, long-term analysis (required FOS of 1.5), and a sudden draw-down analysis (required FOS of 1.0). In all cases analyzed in 1992, the construction case (short-term) governed the design cross-section of the dam. The scope of the stability analyses conducted for the 1997 study was limited to using new boring and strength data in order to determine if a reduced dam cross section is feasible in order to reduce cost of the structure. Analysis in the 1997 report was limited to the East River Terrace reach, which was chosen because it has clay strata closer to the ground surface and is more critical from a stability viewpoint. The 1997 study analyzed the critical end of construction analysis (both upstream and downstream) for this reach, but did not look at long-term, maximum surcharge pool, or sudden draw-down cases. The end of construction analyses resulted in a safety factor greater than 1.4. Several additional end of construction analyses were assessed using modified parameters to simulate a direct shear value for the core and strain softening of the foundation clay.

The current EM 1110-2-1902, (Slope Stability) dated 31 October 2003, specifies a minimum FOS 1.3 (for end-of-construction including stage construction for both upstream and downstream), 1.5 (Long-term for steady seepage, maximum storage pool, spillway crest or top of gates at downstream), 1.4 (maximum surcharge pool at downstream), and 1.1-1.3 (Rapid drawdown from maximum surcharge pool and storage pool, respectively at upstream). The analyses run for the 1997 study are adequate for cost estimation purposes for the Darlington Dam alternative. To comply with the current EM 1110-2-1902, the full range of stability analyses are required for final design and construction. USACE Method of Planes using the Stability with Uplift program and Spencer's method using the Slope/W program are recommended for stability analyses. This analysis can be completed post ADM with additional exploration data.

3.1.6 Seepage Analysis

Seepage analyses were not performed in the 1997 study due to lack of information. However, the following seepage control methods were recommended for embankment, foundation, abutments, and spillway section areas. A clay core with a 4 feet crest width at elevation 192 and 30 feet width at the ground surface was proposed to control seepage through the embankment. A 70 feet deep slurry trench was proposed to control seepage through the foundation. An upstream drainage control blanket was recommended to control seepage at abutment areas. The spillway section (i.e., see in the plate 12 in 1997 study report) with sheetpile at upstream and downstream were proposed to control the seepage. Boring DD-11U, taken near the location of the spillway, shows a clay layer of approximately 20 feet thick. The 20 feet clay layer, in combination with the clay core of the dam, were assumed to reduce seepage in spillway areas. To comply with EM 1110-2-1901, a thorough seepage analysis to include mitigation features, including proposed cutoffs and upstream blanket, is recommended to adequately assess and design seepage control measures for embankment, foundation, abutments, and spillway section areas. This analysis can be completed post ADM with additional exploration data.

3.1.7 Foundation Settlement

Settlement analyses were not performed in the 1997 study due to a limited scope and money restraints. Consolidation tests revealed a stiff clay deposit with high preconsolidation values, thus it was assumed that only one percent foundation settlement would occur. However, consolidation testing was only available in two of the 11 borings taken through the length of the dam. For this assessment, an additional 15 percent of embankment fill and 25 percent of compacted clay core fill was included in cost estimates to account for construction and foundation settlement. It is recommended that additional borings be taken and a complete settlement analysis be conducted during engineering design, to adequately assess settlement conditions. This analysis can be completed post ADM with additional exploration data.

3.1.8 Conclusion and Recommendations

It was determined that the limited analyses performed for the 1997 study are considered adequate for cost estimating purposes of the Darlington Reservior alternative. It is recommended that additional boring data be taken during engineering design to supplement existing borings used during the feasibility study. Complete stability designs on all reaches should be conducted to all cases specified in EM 1110-2-1902. It is recommended that a seepage analysis be performed based on EM 1110-2-1901, to better assess seepage conditions and accurately define seepage mitigation measures. A complete settlement analyses is recommended during engineering design to adequately assess settlement conditions.

3.2 DRY DAMS ALTERNATIVES

Two additional dry retention dam alternatives were considered as part of this study, the Dry Dam on Sandy Creek alternative and the Dry Dam on Darlington, Lilley, and Bluff Creek alternative. These dry dams would be placed on tributaries along the Amite River. These dry dams were considered as a conceptual alternative. Foundation conditions are unknown within the proposed alignments and no subsurface investigations were conducted as part of this study. For cost estimating purposes, a scaled down dam cross section was derived from the Darlington Dam cross section. These design sections are conceptually based on site specific assumptions used in the 1997 report. No site specific geotechnical analyses were performed at the individual dry dam locations.

Section 4
Datum and Topography

Light Detection and Ranging (LIDAR) was obtained from the Louisiana Department of Transportation (LADOTD). The datasource was LADOTD LIDAR for Amite Watershed, Louisiana. LIDAR data acquisition occurred from January to March 2018.

- 2 foot LIDAR; Digital Elevation Model (DEM) grid developed by LADOTD
- Vertical Control = North American Vertical Datum of 1988 (NAVD 88) (2009.55) GEOID12B
- LASOUTH 1702 NAD83 map projection

The geographic information system (GIS) software tool, ArcGIS, was used to extract raster data around the Amite Dam and dry dam sites and generate contours at 1 foot intervals for all sites.

Section 5
Civil Design

5.1 DARLINGTON DAM

5.1.1 Two Options: Dry Dam and Reduced-Wet Dam

The design section was taken from the 1997 report and consists of a reservoir with a 24 feet wide crown at elevation 202.8 feet (NGVD 29), side slopes of 1 vertical on 3 horizontal, from the crown to the elevation of the flood control pool at 172.8 feet (NGVD 29). On the floodside, from the flood control elevation to the conservation pool elevation, the slope is 1 vertical on 6 horizontal. The flatter slope is to reduce the chances of sudden drawdown failures that tend to occur in this zone. Below the conservation pool elevation, the slope is 1 vertical on 4 horizontal. On the protected side, from the flood pool elevation to the conservation pool, the slope is 1 vertical on 5 horizontal. The flatter slope in this area will increase stability and will resist seepage forces that may concentrate in the lower portion of the dam. Below the conservation pool, the slope is 1 vertical on 3 horizontal. The outlet structure consists of three 10 feet x 10 feet concrete box culverts with a spillway at the flood control pool elevation. Updated quantities were obtained and provided to Cost Engineering.

5.1.2 Borrow Assumptions

The top 5 feet of surface material would not be used for clay or random fill. For clay fill, assume a depth of 12 feet below the surface material, for a total depth of 17 feet. For random fill, assume a depth of 15 feet below the surface material, for a total depth of 20 feet. A ratio of 2:1 would be used for losses. For every 1.0 cubic yard (CY) of material needed, 2.0 CY of material would be obtained from the borrow source.

5.2 DRY DAM ON SANDY CREEK

5.2.1 Data & Analysis

No borings were taken or geotechnical analysis performed on this alternative. All embankment dimensions were copied from the 1992 study, for the dry dam alternative. The dam consists of a clay core with a random fill outer layer. Similarly, no hydraulic analysis was performed on the outlet structure. For cost purposes, the cost of the outlet structure for Darlington Dam on the Amite River would be used for the outlet structures for these dry dams, with a scale factor provided by the Hydraulic, Hydrology, and Coastal Engineering (HH&C) Branch. During a rain event, sluice gates would be closed to prevent flow and create a pool of water behind the dam. An emergency spillway would be placed at the flood control pool max elevation.

5.2.2 Borrow Assumptions

Borrow assumptions for this alternative are the same as those described in section 5.1.2.

Dam Dimensions:

- Crown Width: 24 feet
- Embankment Slope 1:5

5.2.3 Quantities

Table A:5-1 provides pertinent dam dimensions for the Sandy Creek Dam that was used to generate quantities for the development of cost estimates.

Table A:5-1. Sandy Creek

Maximum Elevation (ft) (NGVD29)	160		
Estimated Average Ground Elevation (ft) (NGVD29)	130		
0.01 (100 yr) Annual Exceedance Probability (AEP) Pool Elevation (ft) (NGVD29)	150.4		
0.002 (500 yr) AEP Pool Elevation (ft) (NGVD29)	155.3		
Length (ft)	7,719		
Contour 160 foot Acreage (AC)	3,552.37		
Dam Footprint (AC)	58		
Borrow Acres (AC) (clay + random = total)	20 + 132 = 152		
Outlet Cost Scale Factor	0.15		
Quantities	**Clay**	195,405.06	CY
	Random Fill	1,602,172.79	CY
	Foundation Excavation	463,140.00	CY
	Slurry Trench	540,330.00	SF
	Outlet Cost Factor	0.15	

5.3 DRY DAM ON DARLINGTON, LILLEY, AND BLUFF CREEK

5.3.1 Data & Analysis

Data and analysis for this alternative are the same as described in Section 5.2.1.

5.3.2 Borrow Assumptions

Borrow assumptions for this alternative are the same as those described in section 5.1.2.

Dam Dimensions:

- Crown Width: 24 feet
- Embankment Slope: 1:5

Tables A:5-2 through A:5-4 provide pertinent dam dimensions that were used to generate quantities for the development of cost estimates.

Table A:5-2. Darlington Creek

<table>
<tr><td>Maximum Elevation (ft) (NGVD 29)</td><td colspan="3">185</td></tr>
<tr><td>Estimated Average Ground Elevation (ft) (NGVD 29)</td><td colspan="3">165</td></tr>
<tr><td>0.01 (100 yr) AEP Pool Elevation (ft) (NGVD 29)</td><td colspan="3">179.4</td></tr>
<tr><td>0.002 (500 yr) AEP Pool Elevation (ft) (NGVD 29)</td><td colspan="3">182.6</td></tr>
<tr><td>Length (ft)</td><td colspan="3">3,975</td></tr>
<tr><td>Contour 185 foot Acreage (AC)</td><td colspan="3">1,399.03</td></tr>
<tr><td>Dam Footprint (AC)</td><td colspan="3">21</td></tr>
<tr><td>Borrow Acres (AC) (clay + random = total)</td><td colspan="3">8 + 31 = 39</td></tr>
<tr><td>Outlet Cost Scale Factor</td><td colspan="3">0.059</td></tr>
<tr><td rowspan="5">Quantities</td><td>Clay</td><td>81,773.19</td><td>CY</td></tr>
<tr><td>Random Fill</td><td>378,050.97</td><td>CY</td></tr>
<tr><td>Foundation Excavation</td><td>164,722.96</td><td>CY</td></tr>
<tr><td>Slurry Trench</td><td>277,970.00</td><td>SF</td></tr>
<tr><td>Outlet Cost Factor</td><td colspan="2">0.059</td></tr>
</table>

Table A:5-3. Lilley Creek

Maximum Elevation (ft) (NGVD29)	170		
Estimated Average Ground Elevation (ft) (NGVD29)	135		
0.01 (100 yr) AEP Pool Elevation (ft) (NGVD29)	161.9		
0.002 (500 yr) AEP Pool Elevation (ft) (NGVD29)	166.8		
Length (ft)	2,781		
Contour 170 foot Acreage (AC)	1,034.54		
Dam Footprint (AC)	24		
Borrow Acres (AC) (clay + random = total)	9 + 64 = 73		
Outlet Cost Scale Factor	0.057		
Quantities	**Clay**	84,627.38	CY
	Random Fill	770,837.07	CY
	Foundation Excavation	192,610.00	CY
	Slurry Trench	194,670.00	SF
	Outlet Cost Factor	0.057	

Table A:5-4. Bluff Creek

Maximum Elevation (ft) (NGVD29)	150		
Estimated Average Ground Elevation (ft) (NGVD29)	130		
0.01 (100 yr) AEP Pool Elevation (ft) (NGVD29)	143.5		
0.002 (500 yr) AEP Pool Elevation (ft) (NGVD29)	145.8		
Length (ft)	4,978		
Contour 150 foot Acreage (AC)	1,218.04		
Dam Footprint (AC)	26		
Borrow Acres (AC) (clay + random = total)	10 + 39 = 49		
Outlet Cost Scale Factor	0.033		
Quantities	**Clay**	98,868.61	CY
	Random Fill	477,164.35	CY
	Foundation Excavation	206,494.81	CY
	Slurry Trench	348,460.00	SF
	Outlet Cost Factor	0.033	

Section 6
Structural Design

Structures Branch evaluated all data from various reports and/or previous studies to confirm that their assumptions and findings are still valid. The only alternative that had structural design aspects was the Darlington Dam alternative. Within that alternative, a reinforced concrete spillway and reinforced concrete outlet were the only structures planned in the earthen dam. No design criteria or calculations are provided within the 1992 study or the 1997 study reports. Consequently, those structures were not able to be thoroughly analyzed, with the exception of their quantities. Quantities for the 1997 re-evaluation for the 0.04 (25 yr) AEP Reduced Wet Darlington Dam were completed and compared to the original 1992 report. For quantities that were not easily calculated (due to little or no information), best estimates with contingencies were made. Structures Branch also coordinated with others branches within Engineering Division to provide an assessment on the other proposed nonstructural alternatives.

6.1 QUANTITIES

Table A:6-1 provides estimated quantiites from the 1992 study for the Darlington Dam 0.04 (25 yr) AEP Reduced Wet alternative that were projected to the 1997 study.

Table A:6-1. Darlington Dam Quantities

0.04 (25 yr) AEP Reduced Wet Amite River and Tributaries Probable Construction Cost Alternative 12 - Darlington Dam 0.04 (25 yr) AEP Reduced Wet Reservoir			
Item Descriiption	**New Quantity**	**Old Quantity**	**Unit**
Dam Structure	Heigtht of Dam: 202.8 LF	Levee Length: 19,100 LF	
Mobilization & Demobilization	1	1	JOB
Access Roads			
Low Level Outlet			
Site Access Roads	1	1	JOB
Spillway			
Site Access Roads	1	1	JOB
Care and Diversion of Water Dam			
Cofferdam	1	1	JOB
Low Level Outlet			
Dewatering Systems - Sumps & Pumps	1	1	JOB
Spillway			
Dewatering Systems - Sumps & Pumps	1	1	JOB
Earthwork for Structure			
Dam			
Site Work - General			
Clearing and Grubbing (no stumps)	450	270	AC
Foundation Excavation (with stumps) - Adjacent Disposal	3,069,000	255,000	CY
Slurry Trench Excavation - 70 ft Depth Avg	1,260,000	1,260,000	SF
Gravel Filter Material	0	1,165,000	CY
Filter Fabric	0	635,000	SY
Semicompacted Fill - Random (Neat + 15%) (includes foundation fill)	11,800,000	9,010,000	CY
Compacted Fill - Select Clay (Neat + 25%)	856,000	1,040,000	CY
Fertilizing & Seeding	450	275	AC

Pond Elevation Riprap 400 lb Stone 24 inch Thick	21,000		TN
Low Level Outlet			
Site Work - General			
Clearing and Grubbing	0	0	AC
Structural Excavation - Adjacent Disposal	90,000	120,000	CY
Site Work - Inlet and Outlet Channels			
Clearing and Grubbing	8	10	AC
Common Excavation - Adjacent Disposal	90,000	120,000	CY
24 inch Rip Rap	4,700	4,700	TN
36 inch Rip Rap	15,000	15,000	TN
6 inch Bedding	2,500	2,500	CY
Filter Fabric	0	22,000	SY
Spillway			
Site Work - General			
Clearing and Grubbing	20	20	AC
Structural Excavation - Adjacent Disposal	600,000	600,000	CY
Semicompacted Fill - Random	15,000	15,000	CY
Compacted Fill - Select Clay	115,000	115,000	CY
Compacted Fill - Select Sand	26,000	26,000	CY
42 inch Rip Rap	0	123,000	TN
36 inch Rip Rap	105,464	0	TN
6 inch Bedding Material	12,000	12,000	CY
Site Work - Drainage			
Slurry Trench Excavation - 75 ft Depth	76,000	76,000	SF
Gravel Filter Material	34,000	34,000	CY
6 inch Perforated PVC Pipe	46,000	46,000	LF
12 inch PVC Pipe	1,800	1,800	LF
Site Work - Spillway Channel			
Clearing and Grubbing	100	100	AC
Common Excavation - Adjacent Disposal	6,200,000	6,200,000	CY
Foundation Piling			
Low Level Outlet			
Sheetpile, PZ-22	5,000	5,000	SF
Spillway			
Sheetpile, PZ-27	33,000	33,000	SF
Concrete			
Low Level Outlet			
Culvert Structure - Reinforced Concrete			
Stabilization Slab	5,500	7,300	CY

Wall & Roof	10,400	10,400	CY
Gate Tower	380	380	CY
Alignment Collars	750	750	CY
Stoplogs	60	60	CY
Culvert Structure - Unreinforced Concrete			
Stabilization Slab	500	650	CY
Spillway			
Sand Cement Foundation Treatment	9,000	9,000	CY
Overflow Section - Reinforced Concrete			
Overlay	50,000	50,000	CY
Dowels	290,000	290,000	LB
Overflow Section - Unreinforced Concrete			
Roller Compacted Concrete	135,000	180,000	CY
Metals			
Low Level Outlet			
Trash Racks	30,000	30,000	LB
Miscellaneous Metals			
24 inch Vent Pipe	1,600	1,600	LF
3-Bulb Waterstop	3,500	3,500	LF
Expansion Joint Filler	11,500	11,000	SF
Gate and Equipment			
Low Level Outlet			
Sluice Gates (Wt. 7,500 lb ea)	3	3	EA
Mechanical			
Low Level Outlet			
Gate Operation Machinery	3	3	EA

Section 7
Relocations

7.1 GENERAL

The Fifth Amendment to the Constitution of the United States provides that just compensation will be paid for the taking of private property for public use. This “taking” of an interest in real estate, is necessary for Federal Government to subordinate such interest in real estate. In publicly-owned roads and utility systems, the Federal Courts have held that the liability of the United States for such acquisition is the cost of providing substitute facilities where substitute facilities are, in fact, necessary. This is the basis of the facility and utility relocation process. Therefore, it is incumbent that the MVN, Engineering Division, Design Services Branch, Relocations Team perform an investigation of the existing public utilities, facilities, and cemeteries located within the proposed project areas that may be impacted, while taking into account the current design requirements for the recommended plan. In the event that such a facility, utility, cemetery, or town would affect the construction, operation, maintenance, repair, replacement, or rehabilitation of a USACE project, then the MVN Relocations Team must determine the appropriate disposition of the impacted facility. Some facilities may require either a permanent or temporary physical adjustment or displacement to support project activities, engineering requirements, and operation and maintenance needs.

The MVN Relocations Team was tasked with investigating, identifying, and verifying public facilities and utilities located within four dry creek retention dams: Darlington Creek, Lilley Creek, Bluff Creek, and Sandy Creek. Database research included the National Pipeline Database, State Online Natural Resources Information System (SONRIS), Louisiana Department of Natural Resources (LADNR), HTST-IHS, Penwell, Google Earth Pro, and the National Pipeline Mapping System (NPMS) data.

Based on the research and investigations conducted by the MVN Relocations Team, multiple facilities or utilities have been marked, labeled, and identified within the project areas of the aforementioned alternatives. Figures A:7-1 through A:7-4 show the various roads, powerlines, pipelines, and cemetaries located within each alternative.

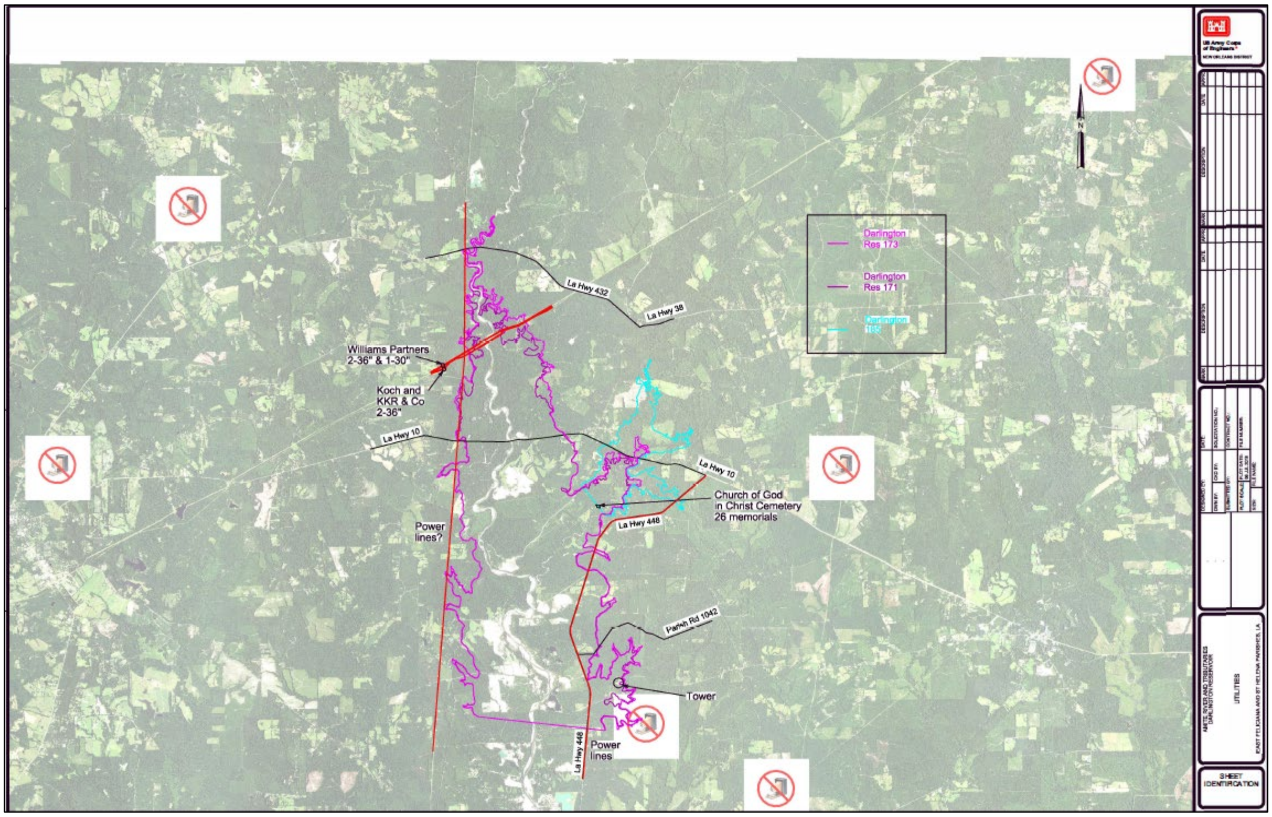

Figure A:7-1. Darlington Dam – Reduce Wet/Dry Reservoir Alternative

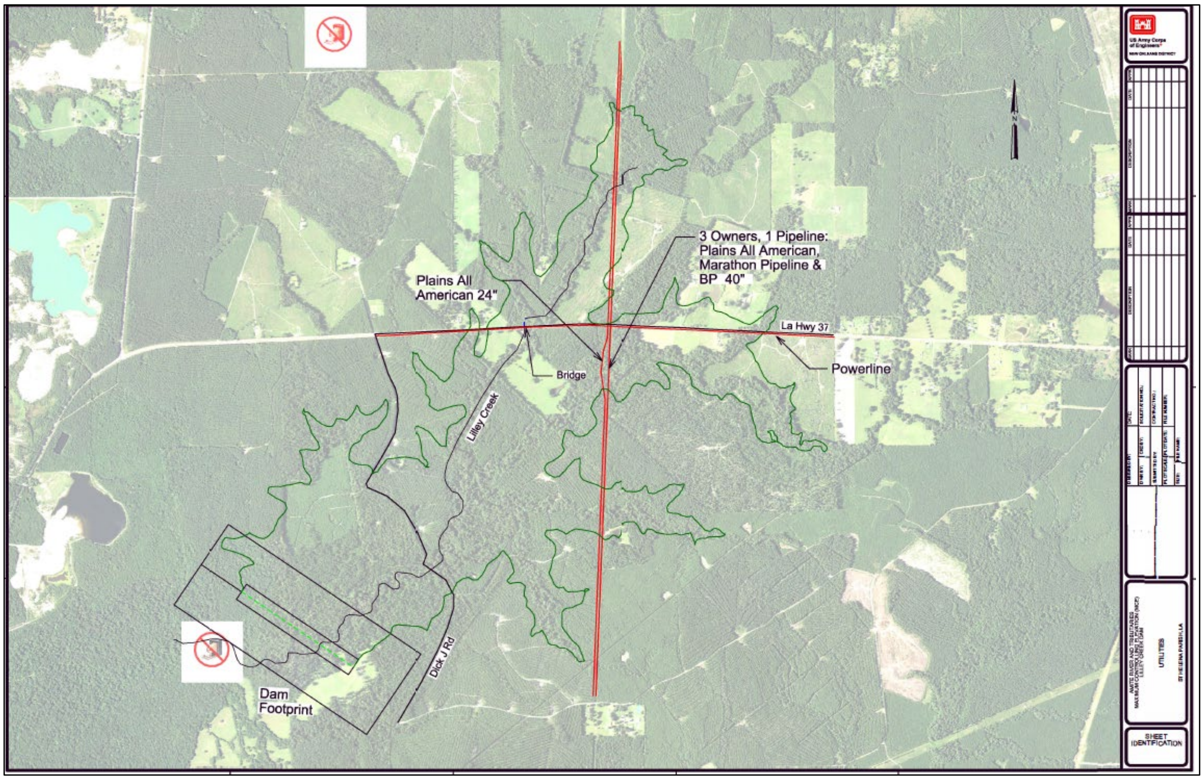

Figure A:7-2. Bluff Creek – Dry Dam Reservoir Alternative

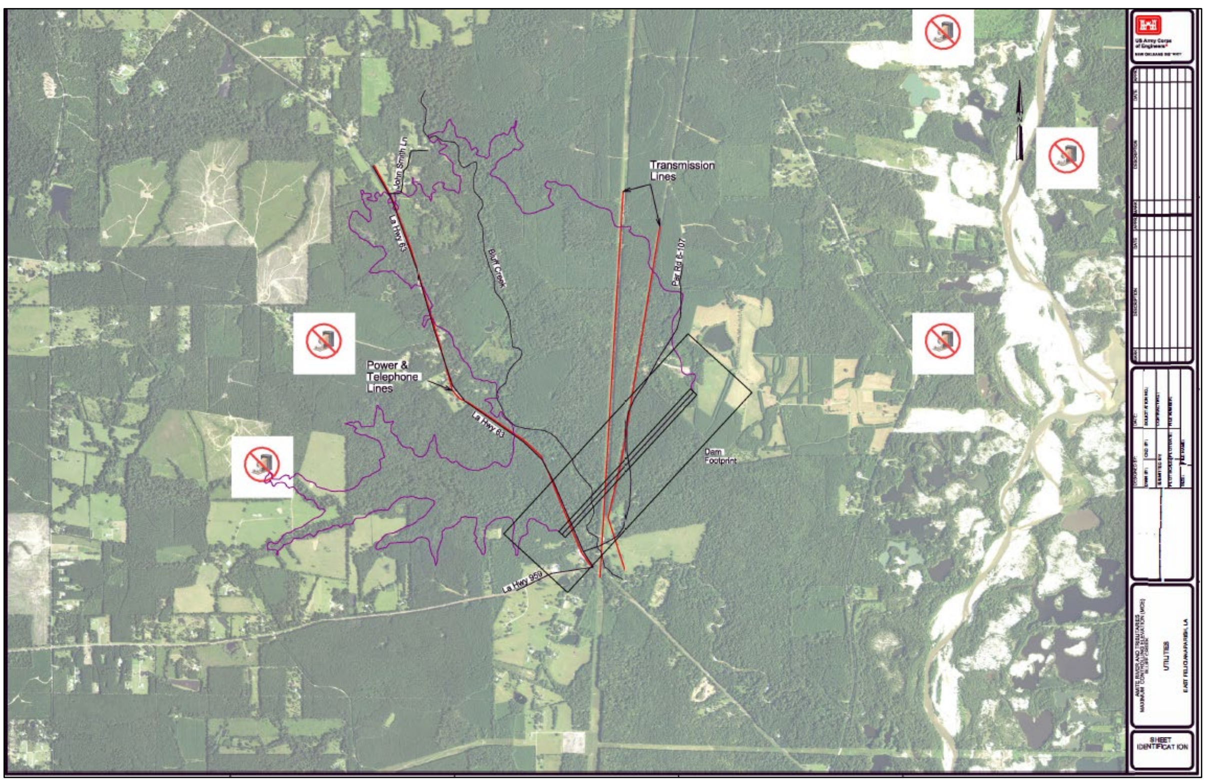

Figure A7:7-3. Lilley Creek – Dry Dam Reservoir Alternative

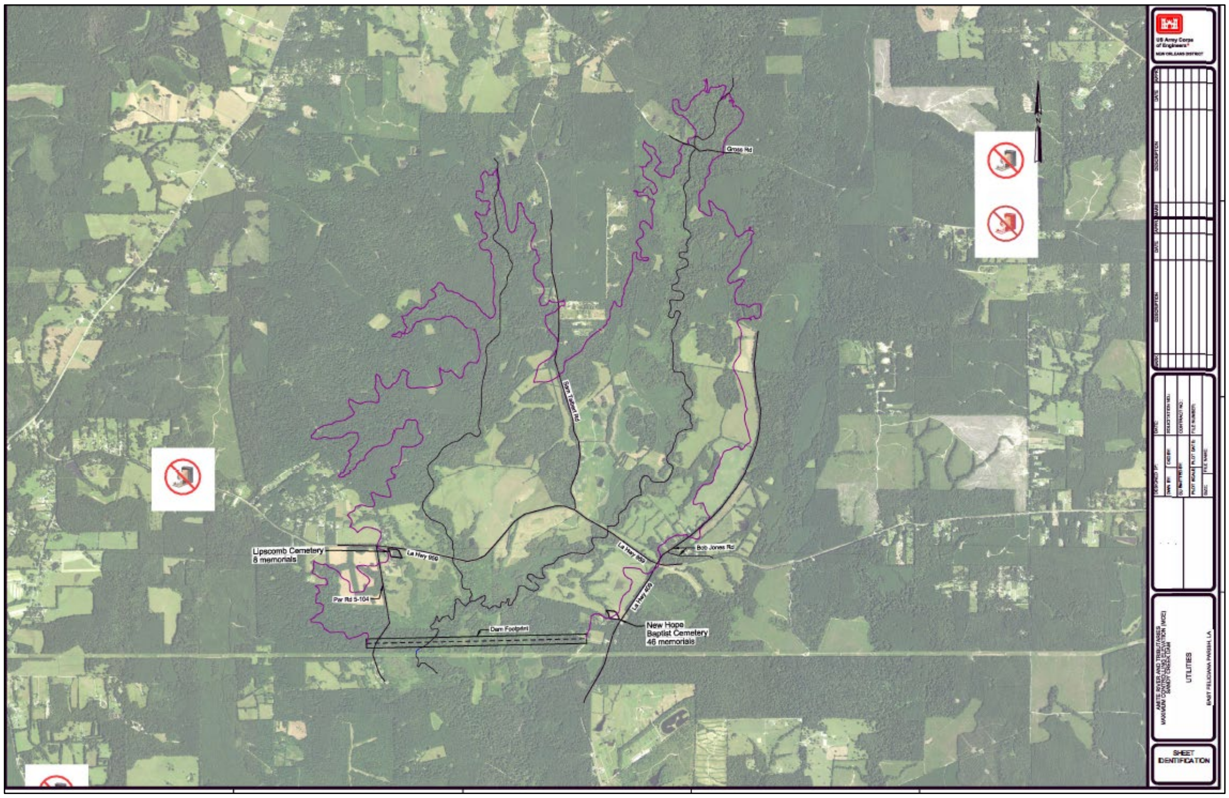

Figure A:7-4. Sandy Creek – Dry Dam Reservoir Alternative

7.2 ROADWAY RELOCATIONS

Roadway relocations were generally agreed upon to be raised above 0.01 (100 yr) AEP flood elevation full reservoir. Selective roadways were chosen for evacuation routes, only in the case of emergencies. All other existing highways and roads that traverse the proposed reservoir would not be considered to be relocated, rerouted, or raised to accommodate a 0.01 (100 yr) AEP flood event, in accordance with LADOTD standards. Roads that only provide access to areas inside the reservoir limits would be considered abandoned and therefore were excluded from this study. However, one highway (LA Highway 448) located within the Darlington Creek dry reservoir and two secondary roads (Otis and Willie Matthews Road and David Lee Lane) located within the Darlington Creek wet reduced reservoir were impacted by the proposed earthen dams alignments at these two reservoirs; thus, requiring them to be relocated up and over the proposed flood protection required for continuing access for local traffic.

As potential evacuation routes, the following roadways were evaluated as ascertain whether they were above the 0.01 (100 yr) AEP flood elevation:

- Darlington Creek – LA Highway 10 (Figure A:7-1)
- Bluff Creek – Highway 63 (Figure A:7-2)
- Lilley Creek – Highway 37 (Figure A:7-3)
- Sandy Creek – LA Highway 409/Parish Road 104 (Figure A:7-4)

It was determined that only portions of Highway 37 and Highway 63 fell below the 0.01 (100 yr) AEP flood elevation; therefore, requiring minimum relocations to raise them. LA Highway 10 required no relocation. Highway 959 crossing Sandy Creek was considered an evacuation route; however, due to an initial high cost estimate to raise over 2 miles of roadway over the 0.01 (100 yr) AEP flood elevation, it was determine not to be a feasible alternative. The selective route chosen at Sandy Creek was to re-route traffic south, either onto LA Highway 409 or onto Parish Road 104 to Pride, Louisiana as a by-pass alternative route.

The proposed design elevation of the top surface of the replacement of the selected road relocations and the stringer beams of replacement bridges are the 0.01 (100 yr) AEP design flood elevation plus an additional 3 feet of freeboard. Roadway design calls for 24 feet surface roadway with 8 foot shoulders. Highways 37 and 63 would require one bridge replacement at each segment of road relocation.

7.3 POWERLINE AND TELEPHONE RELOCATIONS

There are minimum impacts of power distribution lines and telephone lines to be relocated. The only telephone and distribution power lines requiring relocation are along Otis and Willie Matthews Road, David Lee Lane, Highway 37, and LA Highway 448. No transmission lines would require relocation through Bluff Creek and no distribution power lines or telephone lines along Highway 63 would require relocation. Confirmation is required to determine what type of lines (distribution power or transmission lines) are located east of the Darlington Dam–Reduce Wet/Dry Reservoir Alternative; however, it does not appear that they would be impacted.

7.4 PIPELINE RELOCATIONS

Pipelines located under proposed permanent water would not be required to be relocated or weighted down to offset negative buoyancy. All pipeline crossings were buried below ground at a minimum of 3 to 5 feet in depth. Minimum requirement for crossing permanent water is 8 to 10 feet in depth.

A. Darlington Dam – Reduce Wet/Dry Reservoir Alternative (Figure A:7-1)
   1. Williams Partners (2 – 36 inch and 1 – 30 inch pipelines)
   2. Koch and KKR & Co. (2 – 36 inch pipelines)

B. Lilley Creek – Dry Dam Reservoir Alternative (Figure A:7-5)
   1. Plains All American (24 – inch pipeline)
   2. Plains All American/Marathon/BP (40–inch pipeline)

7.5 CEMETERIES AND CHURCH RELOCATIONS

Three cemeteries have been identified and would be required to be relocated:

- Darlington Creek: Church of God in Christ Cemetery (Figure A:7-5)
- Sandy Creek: Lipscomb Cemetery and New Hope Baptist Cemetery (Figure A:7-4)

Preliminary investigations were conducted to identify the number of memorials at each cemetery. Eight memorials were identified at Lipscomb Cemetery, 46 memorials were identified at New Hope Cemetery, and 26 memorials were identified at Church of God in Christ Cemetery. There is easy access to relocate each cemetery to a nearby proposed site location that is within a 1 mile distance outside of each creek reservoir. Historical investigations, including contact of descendants, excavations, and re-interments including grave markers and burial vaults must meet state and local guidelines and regulations.

The Church of God in Christ Church, located adjacent to its cemetery, would have to be relocated outside the limits of Darlington Creek. This church's structure is estimated to have a living space of 5,000 square-feet, which services the local community. It is recommended that the church, along with its cemetery, be relocated to one location.

7.6 RELOCATIONS COST

This section details the relocation costs developed for each alternative.

7.6.1 Darlington Dam - Reduced Wet Alternative

The relocation costs for this alternative are for one church, one cemetery, Matthew Road, Lee Lane, and LA 448. The base cemetery cost is $195,000. Including a 226 percent contingency, the cost is $637,000. The reason the cost contingency is very high is due to the likelihood for significant impacts related to Scope Growth. Using internet based research, only one known cemetery was physically located within the boundaries of the flood pool of the dam, but it's believed that further in-depth research would reveal many smaller, unknown cemeteries throughout the project site that would need to be relocated. The base cost for the remaining relocations is $2,839,000. Including a 36 percent contingency, the cost is $3,863,000. The total relocations cost for this alternative is $4,500,000.

7.6.2 Darlington Dam - Dry Alternative

The relocation costs for this alternative are the same as those described in section 7.6.1 for the Darlington Dam – Reduced Wet Alternative.

7.6.3 Three Tributary Dry Dams Alternative

The relocation costs required for this alternative are for one cemetery, three roads (O&W Rd/David Lee Rd, LA37 & LA63), and two bridges (LA37 & LA63). The base cost for the Cemetery Relocation is $195,000. Including a 222 percent contingency, the cost is $627,000. The cost contingency is very high for cemeteries due to the likelihood for significant impacts related to Scope Growth. Using internet based research one known cemetery was physically located within the boundaries of the flood pool of the dam, but it's believed that further in-depth research would reveal several smaller, unknown cemeteries throughout the project site that would need to be relocated. The base cost for the remainder relocations is $7,525,000. Including a 51 percent contingency, the cost is $11,350,000. The total relocations cost for this alternative is $11,977,000.

7.6.4 Sandy Creek Dry Dam Alternative

The only relocation costs required for this alternative are for two cemeteries. The base cost is $415,600. Including a 222 percent contingency, the cost is $1,337,000. The cost contingency is very high due to the likelihood for significant impacts related to Scope Growth. Using internet based research two known cemeteries were physically located within the boundaries of the flood pool of the dam, but it's believed that further in-depth research would reveal several more smaller, unknown cemeteries throughout the project site that would need to be relocated.

Section 8
References

USACE, New Orleans District, Amite River and Tributaries, Darlington Reservoir Feasibility Study, dated September 1992.

Harza Consultants (Response to original feasibility study), *Harza Engineering Report*, dated April 1995.

USACE, New Orleans District, (response to Harza Engineering Report), *Amite River and Tributaries, Darlington Reservoir Re-evaluation Study (Reconnaissance Scope)*, dated September 1997.