2021

Lake Pontchartrain & Vicinity GRR
Appendix A – Levees Design

US Army Corps of Engineers®
New Orleans District

U.S. Army Corps of Engineers, New Orleans District

Non-Federal Sponsor: Coastal Protection and Restoration Authority Board of Louisiana

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LAKE PONTCHARTRAIN & VICINITY GRR
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1 INTRODUCTION

1.1 OVERVIEW

This appendix describes the methodology used to calculate quantities based on the projected levee lifts required to achieve the estimated design elevations for two alternatives plans that will exclude the 1% AEP and 0.5% AEP coastal storms from the leveed area in the year 2073 for the intermediate sea level rise scenario. For the scope of this study and the size of the study area, certain reaches were chosen to represent the other reaches in the system in order to reduce the number of reaches that would need to be analyzed. Explanation of why certain reaches were chosen to represent others can be found in the Geotechnical Appendix B. This appendix contains examples of representative cross sections from the representative levee reaches around the Lake Pontchartrain and Vicinity (LPV) project areas which were used to calculate quantities for the system. The locations of the representative reaches used and discussed in this report are shown in Figure 1, highlighted in green. The quantity table in Enclosure 1 lists all of the reaches and has a representative reach column to show which representative reach was used to quantify each of the individual reaches. The below cross sections depict each of the representative sections at the time of the last levee lift, whether by USACE or by CPRAB and SLFPA-E or by Pontchartrain Levee District (PLD) as an allowed Section 408 alteration to the levee reach. The elevation of last levee lift and the design grade for each reach is stated in the paragraphs below. All elevations are referenced to NAVD88 (2004.65), unless otherwise noted.

Figure 1. Lake Pontchartrain and Vicinity Representative Reach Locations

2 REPRESENTATIVE REACHES

The following paragraphs discuss the construction history of the last lift of the representative reaches and include a map of their location and a typical cross section of the last lift. Armoring is not shown in the typical sections.

2.1 LPV-04.2A REACH 1A CROSS BAYOU TO ST. ROSE AND GULF SOUTH FLOODWALL, LPV-ARM-06 SYSTEM ARMORING, ST. CHARLES PARISH

LPV-04.2A is the representative reach for the St. Charles Levee Reaches 1A, 1B, 2A, and 2B (LPV-04.2 and LPV-05.2) which extend from the Bonnet Carre Lower Guide levee and Bayou Trepagnier to the Illinois Central Railroad (ICRR).

LPV-04.2A was last lifted to El. 17.0 by CPRAB and PLD as a Section 408 alteration and armored by USACE in 2017 under the same USACE contract, LPV-ARM-06.

The required Hurricane and Storm Damage and Risk Reduction System (HSDRRS) hydraulic design elevation for the levee is 14.5 ft. in 2007 and 16.5 ft. in 2057.

The LPV-ARM-06 contract included a lift of the 2.8-mile-long levee reach LPV04.2a and 04a.2b. The LPV 04.2a portion on the contract, was from baseline Station 260+00 to 354+18. The levee construction portion of this contract consisted of a straddle lift placing compacted embankment to elevation 17.0 and 1V:3H side slopes. At several locations, the scour protection was removed, embankment placed, and the pavement replaced to an elevation of 17.0 feet to achieve a smooth transition to the newly lifted levee. This occurred at the east side of the Cross Bayou Drainage Structure, both sides of the Gulf South Floodwall, both sides of the St. Rose Drainage Structure, both sides of the I-310 Floodwall, both sides of the Almedia Drainage Structure, both sides of the Walker Drainage Structure, and the south of the ICRR Gate.

The armoring portion of the contract consisted of placing HPTRM along the crown, a portion of the flood side slope, and on the protected side of the levee. The HPTRM was secured to the levee using percussion driven earth anchors placed at 5 ft. intervals and 12-inch metal pins placed between the percussion driven earth anchors. Once placed the HPTRM was covered with Bermuda sod and fertilized. The HPTRM in this contract abuts to concrete at several locations including tie-in at the newly placed scour protection locations, newly placed (as part of this contract) concrete ramp paving, and new concrete turn around pads. Where the HPTRM abuts to concrete, an anchor trench was placed running parallel to the edge of the concrete. In areas where the existing road was within 21 feet of the levee toe, the existing access roads had to be removed and relocated parallel to the existing road (a southeast shift). The existing access road was removed and the new access road consisted of separator geotextile and 8 inches of crushed stone.

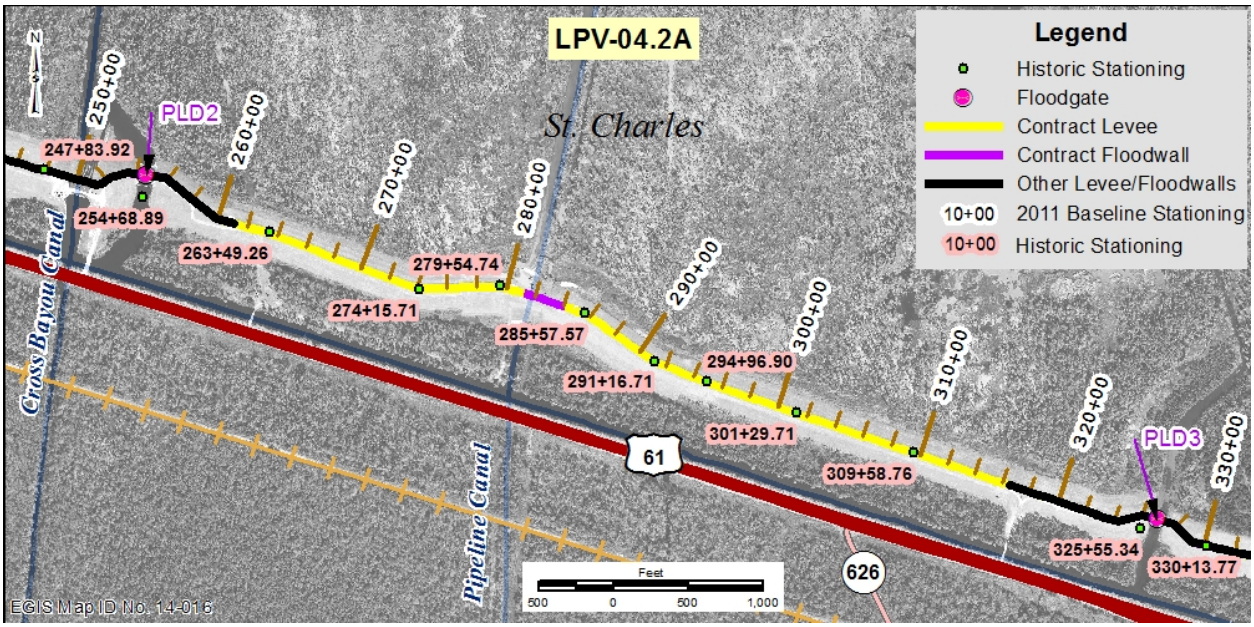

Figure 2. LPV-04.2A Levee Reach

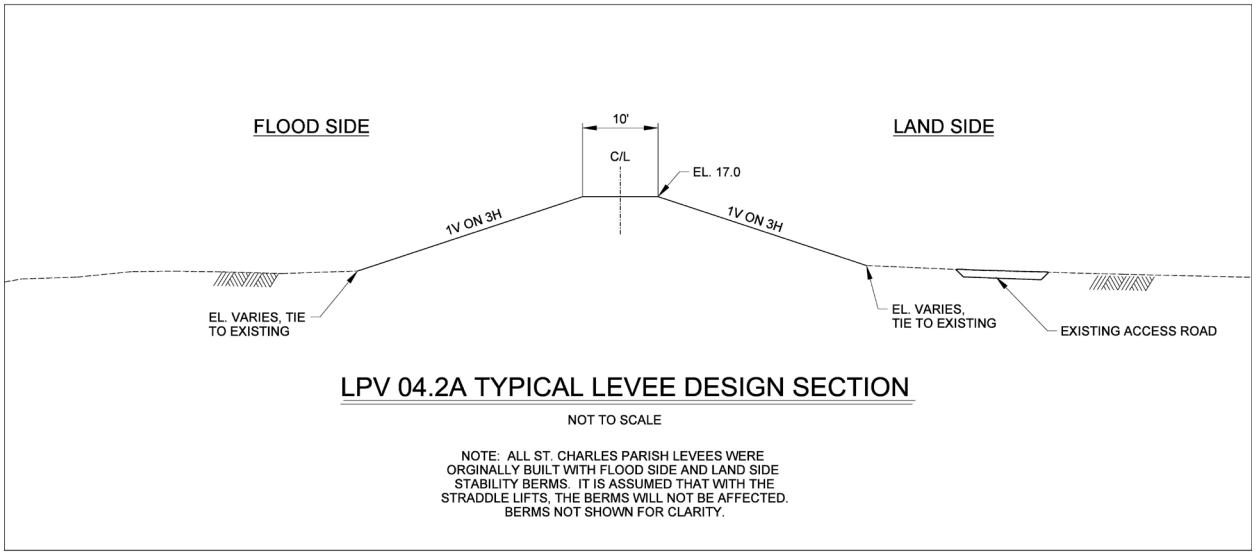

Figure 3. LPV-04.2A Typical Levee Section

2.2 LPV 103.01 ORLEANS PARISH LAKEFRONT, ORLEANS AVE CANAL TO LONDON AVE CANAL

The LPV-103.01 reach is the representative reach for LPV-102.01 (Lake Marina Ave. to Orleans Ave. Canal), LPV-103.01 (Orleans Ave. Canal to London Ave. Canal), and LPV-104.01 (London Ave. Canal to the IHNC).

LPV-103.01 was last lifted by USACE to 19.5 in 2008. The design grade is 16.0. This reach was armored in 2015.

The work within the LPV-103.01 reach was completed under three separate contracts: LPV-103.01, LPV-103.01a1, LPV-103.01a2 and LPV-ARM-02. Only the levee construction contracts, LPV-103.01 and LPV-ARM-02 will be addressed in this appendix.

This segment of the HSDRRS consists of 2.62 miles of levee and floodwall, including 2 new swing gates. The contract reach area is located on the south shore of Lake Pontchartrain in Orleans Parish. The LPV-103 reach begins along the east bank of Orleans Ave canal and continues east parallel to Lakeshore Dr. to the west bank of London Ave canal. It includes the reaches along the east side of Orleans Ave canal, both sides of Bayou St. John, and the west side of London Ave Canal. The portions of the contracts along the outfall canals extend from the lakefront levees to the interim closure structures on London Ave Canal and Orleans Ave Canal and the sector gates on Bayou St. John. Along the lakefront the levee ties into the Permanent Canal Closure and Pumps (PCCP) at London Ave canal and Orleans Ave canal.

2.2.1 LPV-103.01:

This segment begins near 2011 Baseline STA. 128+75 where it ties into the swing gate and floodwalls located at Marconi Drive (gate L-6 constructed under LPV-103.01a1). It then continues east parallel to Lakeshore Drive to the end of the contract reach at STA. 225+33 where it ties into the gate at the intersection of Lakeshore Drive and Lake Terrace (gate L-9 constructed under LPV-103.01a2), located on the west side of London Ave canal. Within the contract, STA. 222+45 to 223+79 was designated a no work area for utility crossings that went over the levee. The utilities were relocated and the levee lift was completed by Orleans Levee District Non-Flood Asset Management Authority after construction was complete. Along the east and west bank of Bayou St. John, there are two reaches of levee that were raised under LPV-103.01.

For the levee reach that parallels the lakefront, the required 1% hydraulic design elevation for the levee is 16.0 ft. in 2007 and 19.0 ft. in 2057. This levee reach was raised to a construction grade of 19.5 ft. providing approximately 3.5 ft. of overbuild to extend the period of effective risk reduction. For the levee reaches along Bayou St. John, the 1% required hydraulic design elevation is 15.0 ft. in 2007 and 16.5 ft. in 2057. This levee reach was built to elevation 16.5 ft. providing 1.5 ft. of overbuild to extend the period of effective risk reduction. The typical levee section for this contract includes a wave berm. The elevation of the wave berm must be monitored since it is a factor for establishing the required 1% hydraulic design elevation for the levee crown.

Scour protection is located throughout the reach where the levee transitions to floodwall.

2.2.2 LPV-ARM-02:

This armoring contract LPV-ARM-02 included armoring a segment of the HSDRRS from 2011 baseline STA. 37+74 to STA. 403+67, consisting of 3 miles of levee. The armoring contract is comprised of three contract reaches (LPV-102, 103, and 104) that were constructed under the original LPV contracts.

The armoring contract consisted of placing HPTRM along the flood side crown edge, levee crown, and the landside of the levee. Once placed, the HPTRM was covered with sod, fertilized and watered. The HPTRM was secured to the levee using percussion driven earth anchors placed at 5 ft. intervals and 12-inch metal pins placed between the percussion driven earth anchors. Additionally, the flood side and landside limits of the HPTRM were secured in a minimum 1 ft. by 1 ft. anchor trench. There are several locations in the contract reach where the HPTRM abuts concrete. At some locations this abutment occurs where concrete scour protection is placed at the intersection of a levee and floodwall. In addition to abutment at scour protection, the HPTRM also abuts to concrete ramps, miscellaneous concrete pads, and/or turn around pads throughout the reach. Where the HPTRM abuts to concrete, an anchor trench is placed parallel to the edge of the concrete. Existing crushed stone ramps located on the landside of the levee were concrete paved during the armoring contracts by placing 6 in thick concrete on top of the existing crushed stone.

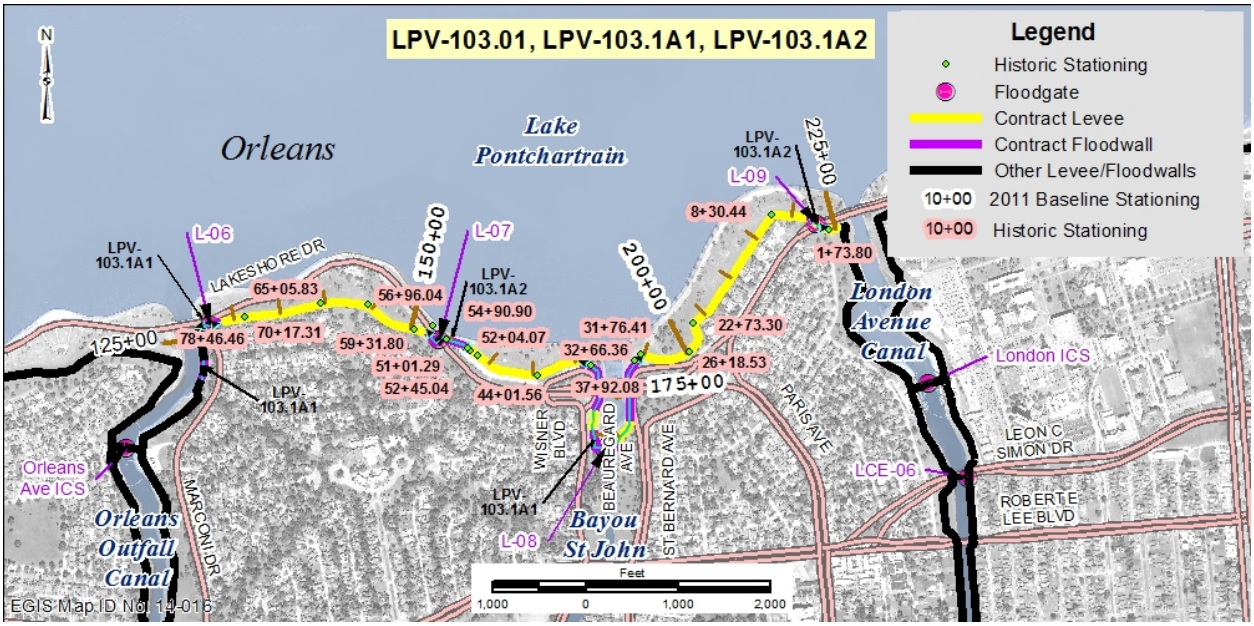

Figure 4. LPV-103.01, LPV-103.1A1, LPV-103.1A2 Levee Reaches

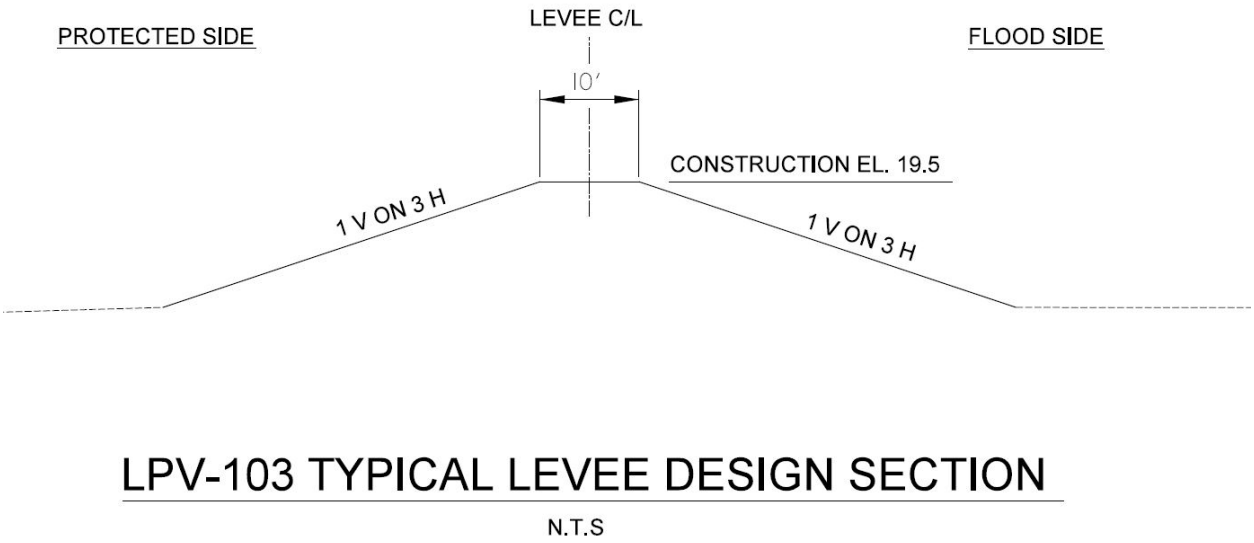

Figure 5. LPV-103 Typical Levee Section

2.3 LPV-109.02A

The LPV-109.02A reach is the representative reach for LPV-108 (Paris Road to Southpoint), LPV-109.02A (South Point to the CSX Railroad), and LPV-111.01 (CSX RR to Michoud Canal).

The last completed lift of this reach by USACE raised it to EL 18.5 in 2011. The design grade is 17. This contract is currently being lifted by CPRAB and SLFPA-E as a Section 408 alteration to the levee to previous construction grade plus six inches and armored by USACE under the same contract. Completion is estimated in early 2021.

This segment of the HSDRRS consists of 7.5 miles of levee and floodwall. There are two floodgates located where the reach crosses U.S. Highway (Hwy) 11 and U.S. Highway (Hwy) 90. The contract reach also includes four drainage structures and two pump stations. The contract reach is located on the south shore of Lake Pontchartrain in Orleans Parish, along the eastern side of the Bayou Sauvage National Wildlife Refuge. The levee portions of the contract were identified by five hydraulic reaches, each with its own design – reaches “NE31”, “NE10-A”, “NE10-B”, “NE10-C” and “NE11-A”. Only levee construction work will be addressed in the following sections.

2.3.1 LPV-109.02A1-2009

Prior to construction of the LPV-109.02a levee, this contract was constructed to install a test section for the wick drains. The test section included excavation of the existing berm, installation of the sand drainage blanket, placement of the wick drains, and then placement of embankment fill on top. Wick drains were used to accelerate consolidation and settlement of foundation soils to minimize the need for future lifts. The test section was installed between Baseline STA 1029+00 to Baseline STA 1032+00. The wick drain test section was removed during construction of LPV-109.02a. Refer to as-built drawing C-612 for details on removal of wick drain section.

2.3.2 LPV-109.02A2 - 2010

This contract was designed, awarded, and constructed prior to construction of the LPV-109.02a Levee enlargement. The contract was approximately 38,500 ft. long and extended from South Point to CSX railroad (RR) crossing. The purpose of the contract was to place a 2 ft. to 3 ft. sand drainage blanket, to improve the foundation of the levee, which would be offset from the existing levee and constructed under LPV-109.02a.

2.3.3 LPV-109.02A - 2011

The contract begins at 2011 Baseline STA 663+75. The work between 2011 B/L STA 663+75 and B/L STA 662+00, was constructed within the LPV-108 Right of Way. It extends to the drainage structure, which extends from B/L STA 667+01 to B/L STA 668+05. The levee resumes on the southeast side of the Drainage Structure No. 1 and continues to STA 719+81, where it ties into the I-10 crossing over the levee. The I-10 crossing was constructed under a separate contract designated as LPV-109.02b. From STA 663+75 to STA 719+81, the levee was constructed to elevation 18.5 ft. The required 1% hydraulic design elevation for the levee in this reach (hydraulic reach “NE31”) is 16.5 ft. in 2007 and 18.0 ft. in 2057.

The LPV-109.02a levee resumes on the south east side of the I-10 crossing at Baseline STA 724+38 and it continues southeast to approximate STA 761+30, where it ties into the concrete T-Wall monoliths constructed for the Hwy11 crossing. The required 1% hydraulic design elevation for the levee in this reach (hydraulic reach “NE10-A”), is 17 ft. in 2007 and 18.0 ft. in 2057. The levee ends and the T-Wall monoliths begin at approximate STA 724+38.

The levee resumes at STA 765+52 on the southeast side of the Hwy 11 crossing and continues to approximate STA 799+30, where there is a pump station (identified as Pump Station 1 on the as-built drawings). The drainage pipes for the pump station were constructed up and over the levee. Adjacent to the pump station is a Drainage Structure No. 2. The levee resumes on the southeast side of the drainage structure at STA 802+39 and continues to Drainage Structure No. 3, which begins at STA 928+33. The drainage structure ends and the levee resumes at STA 930+83. The levee continues to approximate STA 940+00, where it ties-into the T-Wall monoliths for the Hwy 90 crossing. From STA 765+52 to STA 940+00, the levee was constructed to an elevation of 19 ft. The hydraulic reach changes approximately at STA 799+76. Within this reach there are two hydraulic reaches, “NE10-B” and “NE10-C”. The required 1% hydraulic design elevation for “NE10-B” is 17 ft. in 2007 and 18 ft. in 2057. The required 1% hydraulic design elevation for “NE10-C” is 17 ft. in 2007 and 19 ft. in 2057. The typical levee section for both of these reaches includes a wave berm.

The levee ends and the T-Wall monoliths for the Hwy 90 crossing begin at approximate STA 940+00.

The levee resumes at STA 943+82.62 on the southeast side of the Hwy 90 crossing and continues to approximate STA 1055+00, where it connects to Drainage Structure No. 4. From STA 943+82.62 to STA 1055+00, the levee was constructed to an elevation of 25 ft. The required 1% hydraulic design elevation for the levee in this reach (hydraulic reach “NE11-A”), is 22 ft. in 2007 and 23.5 ft. in 2057. From STA 1028+00 to STA 1033+00, there is a wick drain test section constructed under LPV-109.02a1. During construction, the wick drain test section was removed, and rebuilt in conformance with the plans and specifications of the contract.

On the south side of the drainage structure, beginning at STA 1058+57 and extending to STA 1060+00 is floodwall. LPV-109.02a contract ends at STA 1060+00, and ties into the T-Wall constructed under LPV-110.

Throughout the contract reach the levee was offset from the original levee centerline towards the landside. The levee enlargement includes a wave berm and a stability berm. Throughout the contract reach a drainage blanket was placed (under LPV-109.02a2), and wick drains were installed prior to placing embankment for the levee enlargement. A 12-inch layer of 6-inch stone riprap was placed where the landside stability berm ties into the existing ground.

2.3.4 LPV-109.02A ADDITIONAL WORK -2011

2.3.4.1 LEVEE LIFT

This contract is currently being lifted by by the Government on behalf of CPRAB and SLFPA-E as a Section 408 alteration to the levee to the prior construction grade plus six inches. Initial Construction of the levee was completed in June 2011. In January 2013, prior to the completion of construction of the levee, a survey of the levee showed portions of the levee crown were below the initial construction grade. MVM Hired Labor Crew placed embankment to elevation 19 ft. From STA 724+42 to STA 781+85 a total of 2,227 ft. (non-continuous) was raised with a straddle of the levee centerline. From STA 745+80 to STA 938+85, a total 1,955 ft. (non-continuous) was raised by placing a cap on the levee crown (hydraulic reaches “NE10-A”, “NE10-B” and “NE10-C”). Levee maintenance lift was designated as LPV-109.02a3.

2.3.4.2 HWY 11 REMEDIAL ACTION

After completion of the construction contract, a Top-of-Wall survey was performed in October 2011. The data from the Top-of-Wall survey and a site visit confirmed differential movement of the floodwall monoliths. After completing the engineering analysis, remedial action was taken to reduce any potential future settlement in the area, and to reduce the stresses in the piles. Remedial action was completed by Keiland, which consisted of degrading the soil adjacent to monoliths to elevation 6 ft. Joints in the slope pavement which had separated were cleaned and filled with cold-mix asphalt. The vertical joints in the monoliths were repaired. The bypass ramp was repaired, and a 22-inch drainage culvert was installed.

2.3.4.3 VEGETATIVE FREE ZONE

Within the LPV-109.02a contract, the toe of the landside stability berm is at the edge of the U.S. Fish and Wildlife Refuge. In order to avoid clearing vegetation in the wildlife refuge, the stability berm was reanalyzed and it was determined that the effective width of the stability berm could be reduced by 15 ft. to accommodate the vegetative free zone. The non-federal sponsor is required to keep the stability berm free and clear of vegetation.

2.3.5 LPV-ARM-05 SYSTEM ARMORING (LPV-109)

This contract is currently being armored be USACE in 2019 to 2020. The armoring contract also includes a lift to the prior construction grade plus 6 inches by the Government on behalf of CPRAB and SLFPA-E as a Section 408 alteration. The armoring contract will consist of placing HPTRM along the crown and land side of the levee. Once placed, the HPTRM was covered with sod, fertilized and watered. The HPTRM was secured to the levee using percussion driven earth anchors placed at 5 ft. intervals and 12-inch metal pins placed between the

percussion driven earth anchors. Additionally, the flood side and landside limits of the HPTRM were secured in a minimum 1 ft. by 1 ft. anchor trench.

There are a few locations in the contract reach where the HPTRM abuts a concrete surface. This abutment occurs where concrete scour protection is placed at the intersection of a levee and ramp. Where the HPTRM abuts concrete, the HPTRM is placed underneath the concrete.

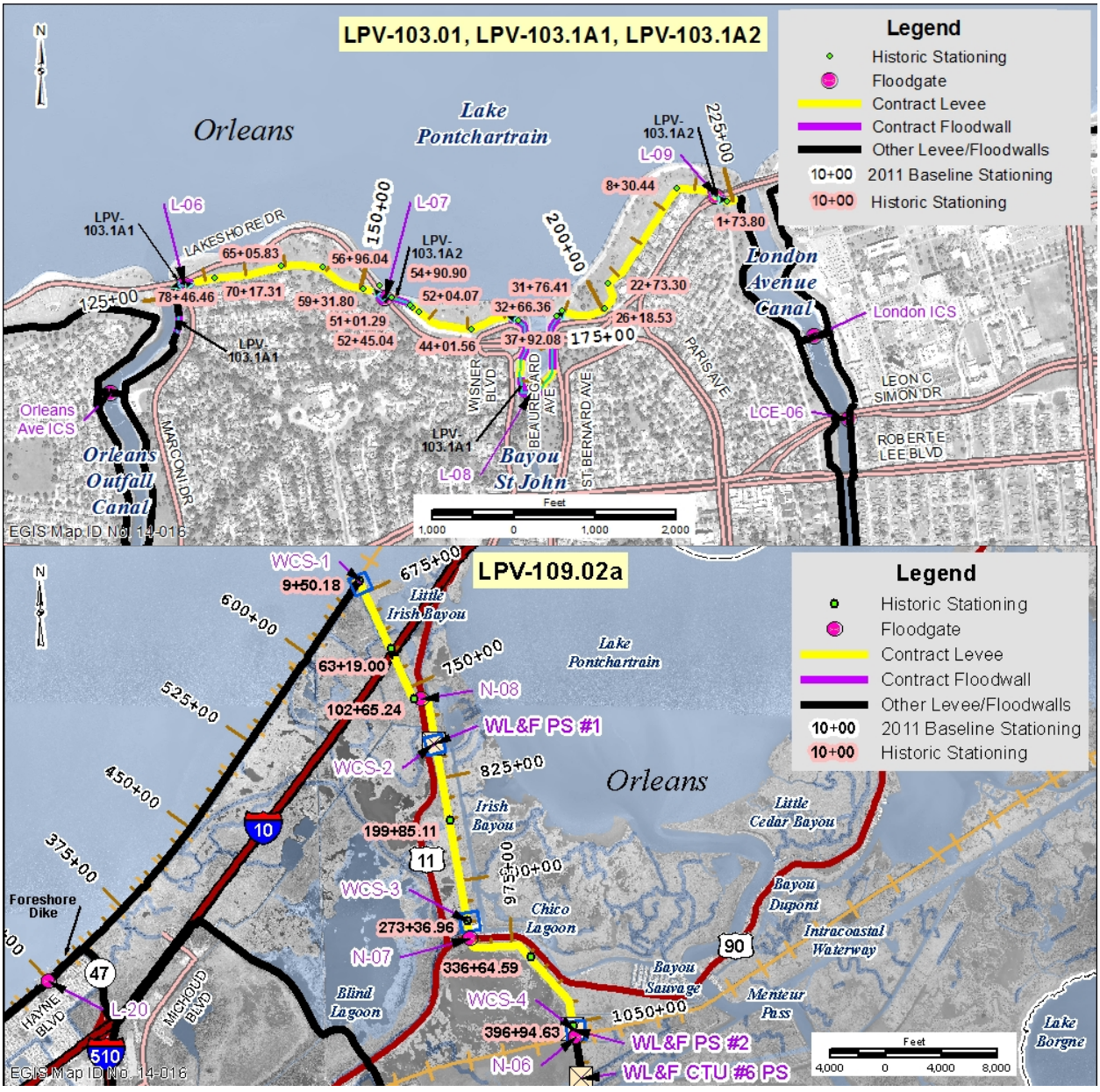

Figure 6. LPV-0109.02a Levee Reach

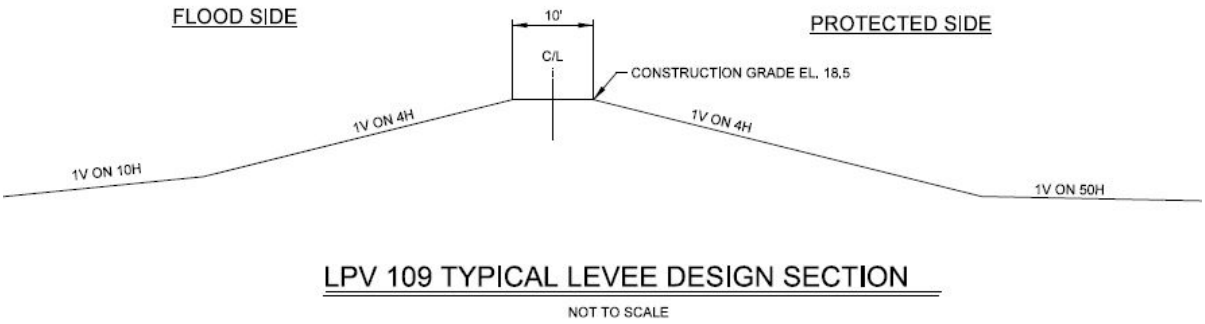

Figure 7. LPV-109 Typical Levee Section

2.4 LPV-00.2 REACH 1 LAKEFRONT LEVEE.

The LPV-00.2 reach is the representative reach for all of the Jefferson Parish Lakefront Levee reaches including Reach 1 (LPV-00.2), Reach 2 (LPV-1.1), Reach 3 (LPV-02.2), Reach 4 (LPV-Reach 19.2) and Reach 5 (LPV-20.1).

The LPV-00.2 segment of the HSDRRS consists of approximately 2.0 miles of levee along the East Jefferson lakefront. The contract begins at 2011 Baseline STA. 708+05.60, which is adjacent to the northern most end of the West Return Floodwall and proceeds East to STA. 813+91.89 where it ties-in to the floodwall of Pump Station #4 (Duncan). The required 1% hydraulic design elevation for the levee is 15.5 ft. in 2007 and 17.5 ft. in 2057. The Phase 1 contract (LPV-00.1) constructed the levee to an elevation of 17.0 ft. This levee reach was last lifted by CPRAB and SLFPA-E as an allowed Section 408 alteration in 2017 to elevation 17.0. The Jefferson Parish Lakefront levees contain a layer of high strength geotextile fabric at their base.

2.4.1 LPV-00.2

The USACE contract (LPV-00.2) expanded the crown of the levee to 10 ft. wide and softened the side slopes but did not add additional elevation since the levee elevation was already above the required 1% hydraulic elevation and therefore provided at least 1ft of overbuild achieving a construction grade of approximately elevation 16.5 ft. The typical levee section for this contract includes a wave berm. The elevation for the wave berm must be monitored since it was a factor for establishing the required 1% hydraulic design elevation for the levee crown.

On the protected side of the levee there is a stability berm and an adjacent landside rainfall runoff collection and drainage system that runs parallel to the levee for the entire levee reach,

which was not impacted by this contract. The landside rainfall runoff collection and drainage system is not essential to the function of the system.

Foreshore protection was constructed under contract LPV-01.2 on the flood side to provide erosion protection from daily wave action. Some additional features of this levee reach are (1) an all-weather access roadway that runs the entire length of the levee reach and (2) ramps that cross the levee.

2.4.2 LPV-ARM-08 SYSTEM ARMORING (LPV-00.2)

This contract was armored in 2017-2018 and consisted of placing HPTRM along the crown and landside of the levee. Once placed, the HPTRM was covered with sod, fertilized and watered. The HPTRM was secured to the levee using percussion driven earth anchors placed at 5 ft. intervals and 12-inch metal pins placed between the percussion driven earth anchors. Additionally, the flood side and landside limits of the HPTRM were secured in a minimum 1 ft. by 1 ft. anchor trench. There are a few locations in the contract reach where the HPTRM abuts concrete. This abutment occurs where concrete scour protection is placed at the intersection of a levee and ramp. Where the HPTRM abuts a hardened surface, the HPTRM is placed underneath the hardened surface.

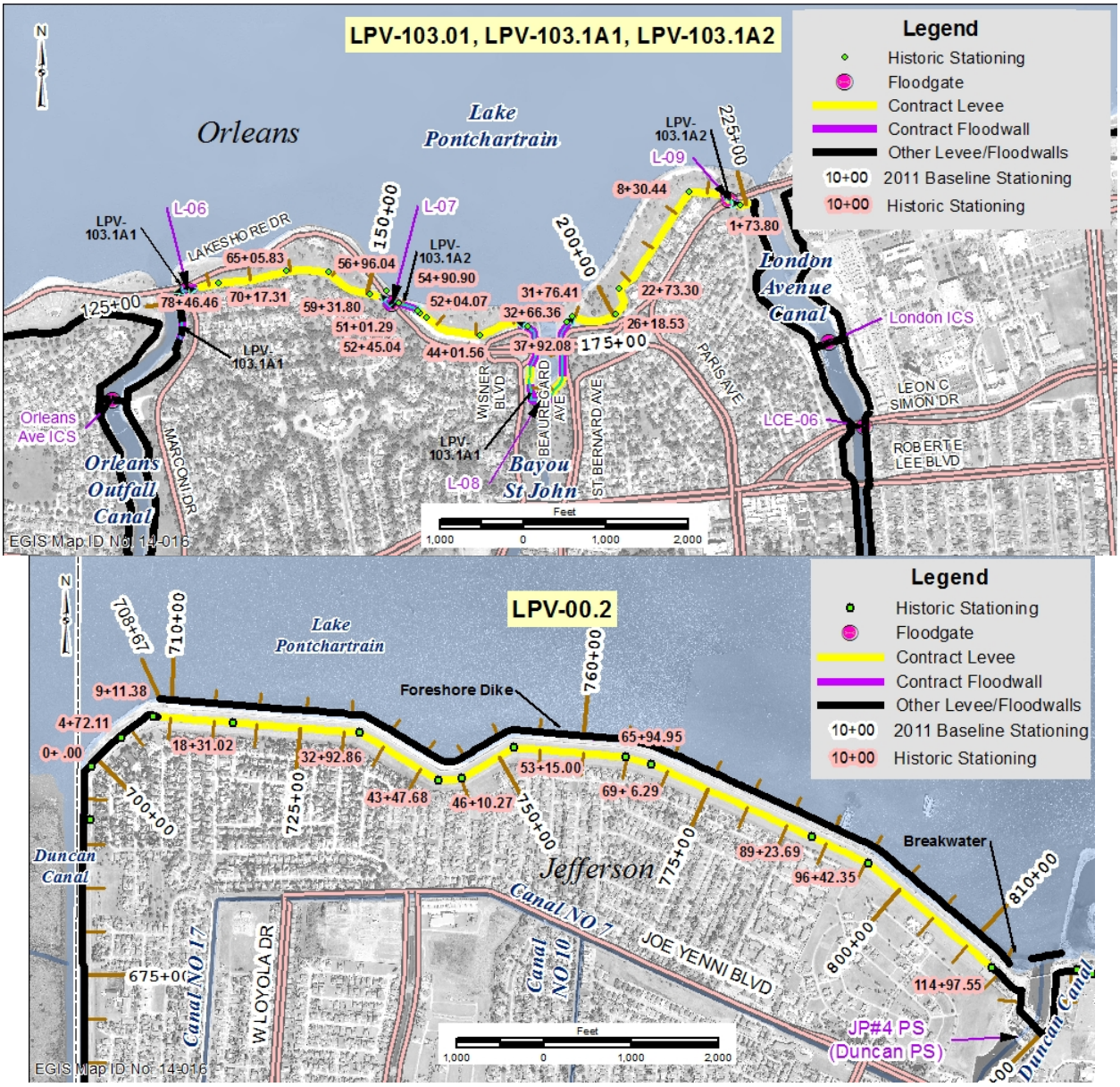

Figure 8. LPV-00.2 Levee Reach

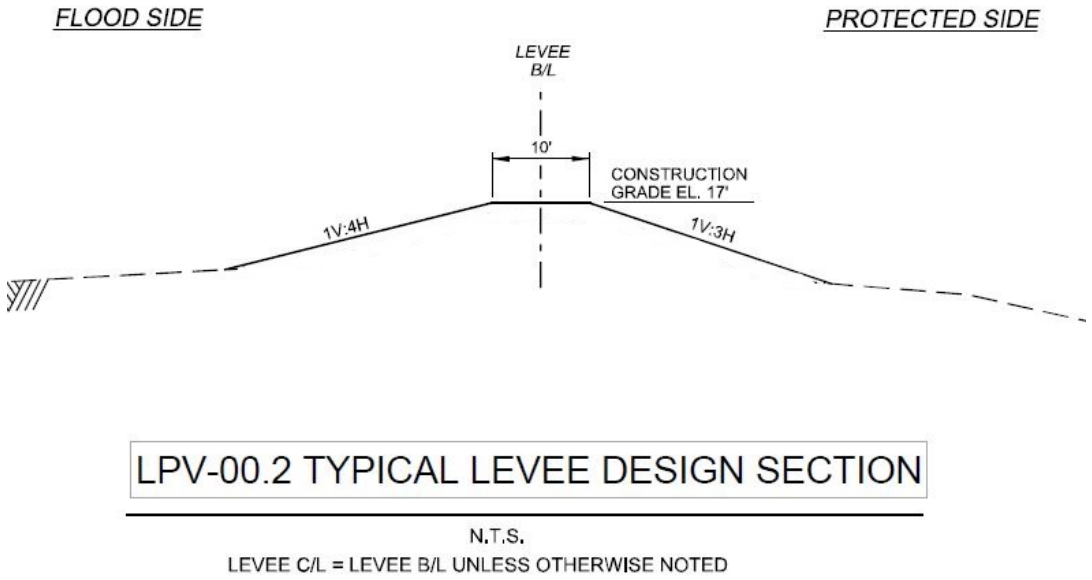

Figure 9. LPV-00.2 Typical Levee Section

2.5 LPV-MRL-1

This levee reach was not part of LPV HSDRRS system as it was north of the east bank 2011 1% HSDRRS cross over point at river mile 77.3. The new 2073 cross over point, however, is at river mile 90.5 for the intermediate condition. For explanation on adjusted crossover points see the H&H appendix. Included in the Lake Borgne Levee District, this levee reach of the LPV MRL starts east of the IHNC Lock runs along the MRL to Caernarvon. The MR&T design grade or MRL 1973 refined project grade for the reach varies from EL 21.5 to 19.8. The 1% 2011 HSDRRS design grade is EL 18.5. The MRL levees have a crushed stone surfacing crown and concrete slope paving (CSP) on the flood side slope. Between the upstream limit of this reach and the new crossover point at river mile 90.5 is a portion of the LPV-MRL-2 reach. This reach was not armored.

Several areas in this reach are highly industrial on both sides of levee which would involve complex utility relocations and land acquisitions. A flood side shift is required in most areas however in some areas the flood side batture is very narrow. For these reasons, floodwall as opposed to levee is the recommended plan between B/L STA 320+00 to 345+00, B/L STA 372+00 to 425+00, and B/L STA 450+00 to 488+00; and other areas would require a flood side shift. A previous report done in 2011 also confirmed these recommendations. The report is titled “Hurricane Storm Damage and Risk Reduction System & Mississippi River Levees Co-Located Areas, 65% Engineering Alternatives Report, Permanent Measures, East Bank, St. Bernard Parish, Louisiana.”

There are some areas of the MRL where bank factors of safety are critical and land side shifts or construction of sub-aqueous rock stability berms could be required. Analysis will be required during the PED phase.

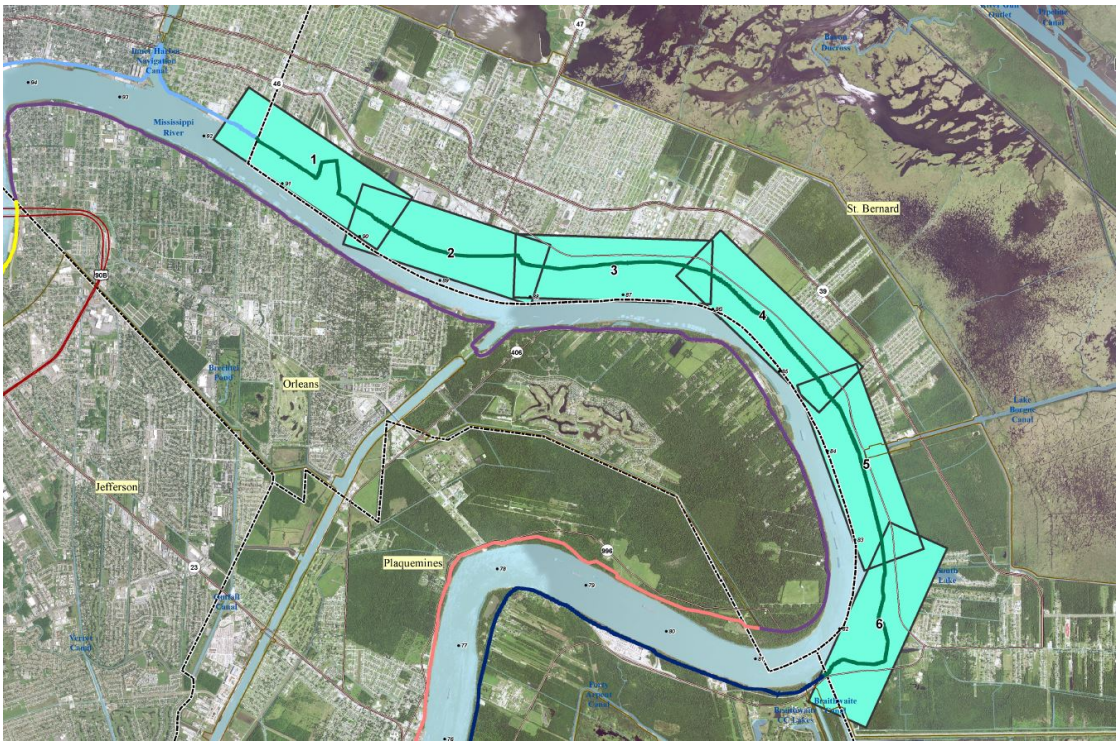

Figure 10. LPV-MRL-1 Levee Reach

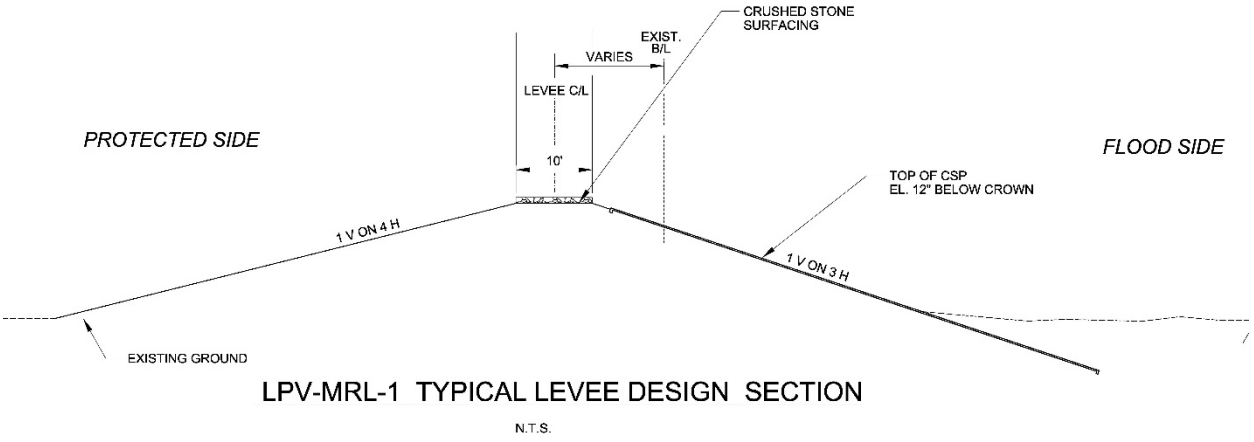

Figure 11. LPV-MRL-1 Typical Levee Section

2.6 LPV-MRL-23B BONNET CARRE LOWER GUIDE LEVEE

The LPV-MRL-23B reach is only representative of itself. This reach is the most western section of the HSDRRS system and is the Bonnet Carre Lower Guide Levee along the eastern side of the Bonnet Carre Spillway between the Mississippi River and Airline Highway (LA Hwy 61). The last lift was in 2003 to EL 12.5. It was determined that no additional lift would be required under the scope of this study. This reach was not armored.

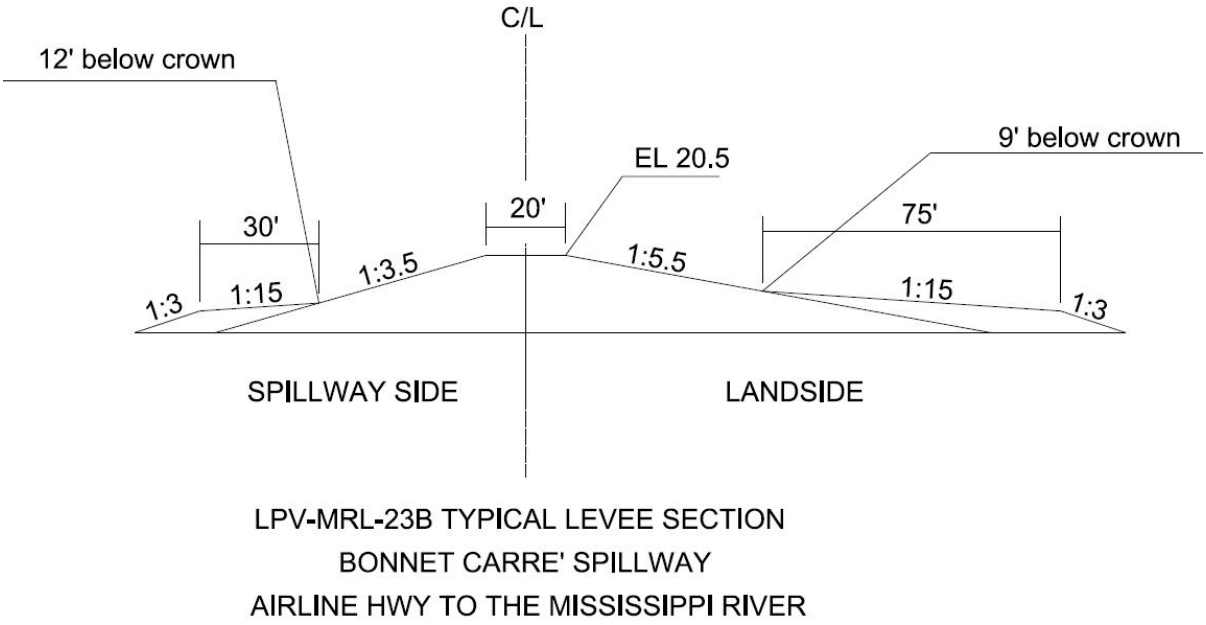

Figure 12. LPV-MRL-23B Typical Levee Section

3 QUANTITY CALCULATION – INTERMEDIATE 1% DESIGN STORM

Due to the enormity of the entire system, representative reaches were chosen and lift schedules were developed for some reaches and applied to representative reaches. For explanation on development of lift schedules refer to the Geotechnical Appendix B. The following table represents the results of the geotechnical analysis and lift schedules for each reach. These represent conservative estimates of when the next lift may be required and should NOT be interpreted as predictions of when a reach may become deficient. A short term delay in first lifts is not expected to adversely affect project performance.

Contract ID	Contract	1st Lift			2nd Lift			3rd Lift		
		Year	Height (FT)	Fill (CY)	Year	Height (FT)	Fill (CY)	Year	Height (FT)	Fill (CY)
Lake Pontchartrain and Vicinity										
LPV-MRL-23B	Bonne Carre Guide Levee	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LPV-00.2	Reach 1 Lakefront Levee	2025	2	95,608	2044	2	95,608	2063	1	47,804
LPV-01.1	Reach 2 Lakefront Levee	2025	2	73,339	2044	2	73,339	2063	1	36,670
LPV-02.2	Reach 3 Lakefront Levee	2025	2	106,462	2044	2	106,462	2063	1	53,231
LPV-03d.2	Airport Runway 10 Levee	2024	3	18,037	2036	3	18,037	2047	3	18,037
LPV-04.2	Levee - Reach 1A and 1B from Cross Bayou to ICRR	2024	3	177,166	2036	3	177,166	2047	3	177,166
LPV-05.2	Levee - Reach 2A and 2B Bayou Trepagnier to Cross BayouGood Hope	2024	3	214,916	2036	3	214,916	2047	3	214,916
LPV-19.2	Reach 4 Lakefront Levee	2025	2	59,530	2044	2	59,530	2063	1	29,765
LPV-20.1	Reach 5 Lakefront Levee	2025	2	108,771	2044	2	108,771	2063	1	54,385
LPV-102.01	Lake Marina Ave to Orleans Ave Canal	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LPV-103.01	Orleans Ave Canal to London Ave Canal	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LPV-104.01	London Ave Canal to IHNC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LPV-108	Paris Road to South Point	2069	1	163,353	N/A	N/A	N/A	N/A	N/A	N/A
LPV-109.02a	South Point to CSX RR	2069	1	141,266	N/A	N/A	N/A	N/A	N/A	N/A
LPV-111.01	CSX RR to Michoud Canal	2069	1	231,060	N/A	N/A	N/A	N/A	N/A	N/A
LPV-MRL-1	IHNC to Caernarvon, Lake Borgne Levee District	2040	3	611,441	2053	3	650,515	2063	3	650,515

Figure 13. Intermediate 1% Design Storm Lift Schedules

3.1 LEVEE LIFT QUANTITY CALCULATION ASSUMPTIONS

Quantities for each lift were calculated based on cross sectional area. Although some areas may require a flood side shift due to right of way restrictions, it was assumed due to the scope of the study, that for the quantities, all lifts are straddle lifts and no berms are affected. The only site investigations that were done was a profile survey of the levee crown elevations.

Some levee reaches have concrete paved transitions from levee to floodwall. It is assumed that with each lift, the slope paving would need to be removed and replaced to 1 foot below the levee design elevation. Demolished existing slope pavement could potentially, as done in the past, be stockpiled as a dike at the toe to act as a wave break during high river stages.

Silt fence quantities were calculated by doubling the reach length, assuming it would be required on both sides of the levee, and a 25% contingency was added for staging areas.

Embankment quantities were calculated using cross sectional areas. Clearing and grubbing and seeding and mulching quantities are assumed to be the same, in acres per lift.

Staging areas and access routes are assumed to be the same as during the previous lifts.

Quantities calculated for each reach are located in Enclosure 1 at the end of this appendix.

3.2 ARMORING

It is assumed that all previously placed armoring for each reach would need to be removed before each lift and then replaced after construction of each lift. Armoring consists of either HPTRM or ACB. As previously done, because MRL levees have all-weather access roads on the crown, so ACBs were placed on these reaches as the method of armoring. All other reaches have HPTRM with the exception of LPV-108. This reach has an adjacent railroad and the crown is used for access so ACBs were also applied to this reach.

3.2.1 LPV-MRL-1 AND LPV-108

The HPTRM will be placed on the landside of the levee and generally extend a distance of 15-ft. past the land side levee toe and terminate in an anchor trench. After the initial placement of the HPTRM on the land side, the HPTRM is anchored using percussion driven earth anchors in a specific pattern so that the HPTRM maintains contract with the levee surface. Additional steel pins are used, in between the percussion driven earth anchors to further anchor the HPTRM.

ACBs will be placed on the crown of the levee, extending down the land and flood side levee slopes for a distance of approximately 7 feet. On the flood side, the ACBs will terminate in an anchor trench. On the land side, the ACBs and filter fabric are placed on top of the HPTRM and anchored. As part of the installation of the ACBs, crushed stone was added and graded on the levee crown and side slopes.

3.2.2 ALL OTHER LPV REACHES

HPTRM armoring is placed from a distance of 4 feet down the flood side slope from the levee crown and extends across the levee crown, down the land side slope, and then extends an additional 15 feet past the landside toe. The HPTRM was secured to the levee using percussion driven earth anchors placed at 5 ft. intervals and 12-inch metal pins placed between the percussion driven earth anchors. Additionally, the flood side and landside limits of the HPTRM

were secured in a minimum 1 ft. by 1 ft. anchor trench. Once placed the HPTRM was covered with Bermuda sod and fertilized.

3.3 MRL SLOPE PAVING

LPV-MRL-1 has concrete slope paving on the flood side slope. It is assumed for this alternative that the slope paving will need to be removed and replaced with expansion of the levee footprint. The quantities are included in enclosure 1.

3.4 FORESHORE FRONTING PROTECTION RIPRAP

Along the LPV Lakefront, foreshore protection was added per HSDRRS guidelines to prevent foreshore shore erosion along the lakefront. It is assumed that to maintain the 1% level of protection additional foreshore riprap would need to be replaced. It is assumed that additional 15 foot width of riprap, approximately 4 ft. in depth would need to be added to the existing riprap. Quantities are calculated in enclosure 1 at the end of this appendix.

4 QUANTITY CALCULATION – INTERMEDIATE 0.5% DESIGN STORM

Hydraulic design elevations were calculated for the 0.5% intermediate design or 200 year storm. For explanation on these calculations see the H&H appendix. Due to time constraints, lift schedules and curves were not developed for this option. Design elevations for the 200 year storm were interpolated from the 100 and 500 year intermediate design storm elevations to come up with an estimation of lifts. The increase in lift from the 100 year elevation was either added to the last 100 year lift or an additional lift was added, in keeping with the previous maximum lift of 3 feet. See enclosure 2 for lift schedules and estimates quantities. The same assumptions from the 1% design quantity calculations apply. This alternative is not the selected plan.

5 GENERAL ASSUMPTIONS

5.1 UTILITY RELOCATIONS

Because all lifts would generally straddle the footprint of a previous lift, it is assumed that no utility relocations would be required. If relocation of any existing utility that cross the levees as permitted is required, the utility would need to be lifted by and at the expense of the utility owner, at no cost to the Government.

For the intermediate and high 1% design storms, the new footprint was compared to the existing right of way limits for the last levee lift for the representative reaches to determine if any new right of way would be required. Generally, all lifts should be within the existing ROW limits for the intermediate condition with the exception of temporary access and staging areas. For the high condition, the only areas that stood out as possibly needing additional right of way were along the New Orleans Lakefront and the LPV MRL and are provided below for informational purposes only as it was not the selected alternative.

5.1.1 NEW ORLEANS LAKEFRONT

For the LPV-103 reach a lift would be bounded by Lakeshore Drive at the beginning project in the vicinity of C/L Sta. 62+89 to 65+22. In the vicinity of Sta. 101+00 an additional right-of-way may be required on the flood side and along Bayou St. John on the east side, because the

existing right of way limit is already at the existing toe. A possible t-wall may be required here between Sta. 119+31.70 to 121+10.55.

At LPV-104, between Sta. 9+00 and 14+00, the existing levee toe abuts the U.S. Naval & Marine Reserve property therefore a flood side shift is probably required however no additional easement should be required for the intermediate condition. Between Sta. 17+71 and 19+97, for the intermediate condition, if a land side shift is done, no additional easement will be required. From 65+50 to 69+00 and from 78+70 to 80+60, the existing flood side toe abuts Lakeshore Dr. therefore a land side shift might be required. All shifts would need to be analyzed for stability. This was not done during this phase of this study.

5.1.2 LPV MRL

A flood side shift toward the river should prevent the need for additional easements. Between Stations 320+00 to 345+00, 372+00 to 425+00, and 450+00 to 488+00 it was determined that a floodwall would be the most feasible alternative. The batture is narrow and there is a steep underwater slope. A landside shift isn't feasible due to an adjacent railroad.

6 REFERENCES

Lake Pontchartrain and Vicinity (LPV), Hurricane Damage Risk and Reduction System, LPV-ARM-08, LPV Levee System Armoring – LPV-00.2 Jefferson Parish Lakefront Levee Reach 1, Volume 3 OMRR&R Manual, Aug. 2019

Lake Pontchartrain and Vicinity (LPV), Hurricane Damage Risk and Reduction System, LPV-ARM-06, LPV-04.2a, Reach 1A from Cross Bayou to St. Rose and Gulf South Floodwall, Volume 3 OMRR&R Manual, Feb. 2020

Lake Pontchartrain and Vicinity (LPV), Hurricane Damage Risk and Reduction System, LPV-ARM-06, LPV-04.2b, Reach 1B from I-310 to Walker Drainage Structure, Volume 3 OMRR&R Manual, Feb. 2020

Lake Pontchartrain and Vicinity (LPV), Hurricane Damage Risk and Reduction System, LPV-ARM-02, Levee High Performance Turf Reinforcement Mat (HPTRM) Armoring Reaches LPV-102, LPV-103, and LPV-104, Volume 3 OMRR&R Manual, April 2017.

Lake Pontchartrain and Vicinity (LPV), Hurricane Damage Risk and Reduction System, LPV-109.02, Volume 3 OMRR&R Manual, Dec. 2017.

Lake Pontchartrain and Vicinity

Contract ID	Contract	Representative Reach	Length (FT)	X-Section Distance(FT)	transitions	Toe to toe width (FT)	Silt Fence (LF/Lift)	Seeding and Mulching , C&G (Ac/Lift)	1st Lift			2nd Lift			3rd Lift			4th Lift			ARMORING	FORESHORE PROTECTION (CY)	FORESHORE DREDGING (CY)	FORESHORE PROTECTION (SF)	Contract ID	Slope Paving
									Year	Height (FT)	Fill (CY)	Year	Height (FT)	Fill (CY)	Year	Height (FT)	Fill (CY)	Year	Height (FT)	Fill (CY)	LPV					(SQ)
Lake Pontchartrain and Vicinity																									N/A	N/A
LPV-MRL-23B	Bonne Carre Guide Levee	BC levee	12715	120	N/A	70	31,788	43.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A		N/A
LPV-00.2	Reach 1 Lakefront Levee	LPV 00.2	10667	207	2	121	26,668	63.4	2025	2	95,608	2044	2	95,608	2063	1	47,804	N/A	N/A	N/A	ARM-08	23704	19810	5926	LPV-00.2	N/A
LPV-01.1	Reach 2 Lakefront Levee		7616	141	4	130	19,040	30.8	2025	2	73,339	2044	2	73,339	2063	1	36,670	N/A	N/A	N/A	ARM-10	16924	14144	4231	LPV-01.1	N/A
LPV-02.2	Reach 3 Lakefront Levee		11977	206	2	120	29,943	70.8	2025	2	106,462	2044	2	106,462	2063	1	53,231	N/A	N/A	N/A		26616	22243	6654	LPV-02.2	N/A
LPV-03d.2	Airport Runway 10 Levee	LPV 04.2	1691	157	2	96	4,228	7.6	2024	3	18,037	2036	3	18,037	2047	3	18,037	N/A	N/A	N/A	ARM-03	N/A	N/A	N/A	N/A	N/A
LPV-04.2	Levee - Reach 1A and 1B from Cross Bayou to ICRR		19445	218	12	82	48,613	121.6	2024	3	177,166	2036	3	177,166	2047	3	177,166	N/A	N/A	N/A	ARM-06	N/A	N/A	N/A	N/A	N/A
LPV-05.2	Levee - Reach 2A and 2B Bayou Trepagnier to Cross BayouGood Hope		23588	218	10	82	58,971	147.6	2024	3	214,916	2036	3	214,916	2047	3	214,916	N/A	N/A	N/A	ARM-01	N/A	N/A	N/A	N/A	N/A
LPV-19.2	Reach 4 Lakefront Levee	LPV 00.2	7802	166	4	103	19,506	37.2	2025	2	59,530	2044	2	59,530	2063	1	29,765	N/A	N/A	N/A	ARM-07	17339	14490	4335	LPV-19.2	N/A
LPV-20.1	Reach 5 Lakefront Levee		9178	125	2	160	22,944	32.9	2025	2	108,771	2044	2	108,771	2063	1	54,385	N/A	N/A	N/A		20395	17044	5099	LPV-20.1	N/A
LPV-102.01	Lake Marina Ave to Orleans Ave Canal	LPV 103	5458	200	2	140	13,645	31.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	ARM-02	N/A	N/A	N/A	LPV-102.01	N/A
LPV-103.01	Orleans Ave Canal to London Ave Canal		6817	200	14	106	17,043	39.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	LPV-103.01	N/A
LPV-104.01	London Ave Canal to IHNC		9994	200	9	140	24,986	57.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	LPV-104.01	N/A
LPV-108	Paris Road to South Point	LPV 109	32430	135	3	136	81,076	103	2069	1	163,353	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	ARM-04	N/A	N/A	N/A	LPV-108	N/A
LPV-109.02a	South Point to CSX RR		38142	110	6	100	95,354	12.5	2069	1	141,266	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	ARM-05	N/A	N/A	N/A	LPV-109.02a	N/A
LPV-111.01	CSX RR to Michoud Canal		27124	230	4	230	67,811	143	2069	1	231,060	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	ARM-09	N/A	N/A	N/A	LPV-111.01	N/A
LPV-MRL-1	IHNC to Caernarvon, Lake Borgne Levee District	LPV-MRL-1	39121	200	N/A	145	97,802	180	2040	3	611,441	2053	3	650,515	2063	3	650,515	N/A	N/A	N/A	N/A	N/A	N/A	N/A	LPV-MRL-1	19560

APPENDIX A - ENCL 2 0.5% DESIGN STORM

11/22/2020

Lake Pontchartrain and Vicinity Quantities

Contract ID	Contract	Representative Reach	Length (FT)	X-Section Distance(FT)	transitions	Toe to toe	Silt Fence (LF/Lift)	S&M , C&G (Ac/Lift)	1st Lift		2nd Lift		3rd Lift		4th Lift		ARMORING	FORESHORE PROTECTION (CY)	FORESHORE PROTECTION (SF)	Slope Paving (SQ)
									Height (FT)	Fill (CY)	Height (FT)	Fill (CY)	Height (FT)	Fill (CY)	Height (FT)	Fill (CY)	CONTRACT			
LPV-MRL-23B	Bonne Carre Guide Levee	BC levee	12965	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LPV-00.2	Reach 1 Lakefront Levee	LPV 00.2	10448	207	2	121	26,120	62.1	3	140,468	3	600,760	1.5	70,234	N/A	N/A	ARM-08	23218	5804	N/A
LPV-01.1	Reach 2 Lakefront Levee		4210	141	4	130	10,525	17	3	60,811	3	164,892	1.5	30,406	N/A	N/A	ARM-10	9356	2339	N/A
LPV-02.2	Reach 3 Lakefront Levee		19234	206	2	120	48,085	113.7	3	256,453	3	1,100,612	1.5	128,227	N/A	N/A		42742	10686	N/A
LPV-03d.2	Airport Runway 10 Levee	LPV 04.2	1565	151	2	96	3,913	6.8	2	11,129	2	11,129	2	11,129	1	5,564	ARM-03	3478	869	N/A
LPV-04.2	Levee - Reach 1A from Cross Bayou to St. Rose and Gulf South Floodwall		15561	218	12	82	38,903	97.3	2	94,519	2	628,203	2	94,519	1.5	70,889	ARM-06	N/A	N/A	N/A
LPV-05.2	Levee - Reach 2A Shell Pipeline to Goodhope and Shell Pipeline Floodwall		15022	450	10	82	37,555	194	2	91,245	2	1,251,833	2	91,245	1.5	68,434	ARM-01	N/A	N/A	N/A
LPV-19.2	Reach 4 Lakefront Levee	LPV 00.2	14116	166	4	103	35,290	67.2	3	161,550	3	650,904	1.5	80,775	N/A	N/A	ARM-07	31369	7842	N/A
LPV-20.1	Reach 5 Lakefront Levee		7471	125	2	160	18,678	26.8	3	132,818	3	259,410	1.5	66,409	N/A	N/A		16602	4151	N/A
LPV-102.01	Lake Marina Ave to Orleans Ave Canal	LPV 103	5800	200	2	140	14,500	33.3	3	90,222	N/A	N/A	N/A	N/A	N/A	N/A	ARM-02	12889	3222	N/A
LPV-103.01	Orleans Ave Canal to London Ave Canal		3900	200	14	106	9,750	22.4	3	45,933	N/A	N/A	N/A	N/A	N/A	N/A		8667	2167	N/A
LPV-104.01	London Ave Canal to IHNC		100000	200	9	140	250,000	573.9	3	1,555,556	N/A	N/A	N/A	N/A	N/A	N/A		222222	55556	N/A
LPV-106	IHNC to Paris Road Floodwall		25400	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	112889	14111	N/A
LPV-108	Paris Road to South Point	LPV 109	33264	135	3	136	83,160	103	2	335,104	2	335,104	2	335,104	N/A	N/A	ARM-04	147840	18480	N/A
LPV-109.02a	South Point to CSX RR		5280	110	6	100	13,200	12.5	2	39,111	2	39,111	2	39,111	N/A	N/A	ARM-05	N/A	N/A	N/A
LPV-111.01	CSX RR to Michoud Canal		27456	230	4	230	68,640	145	2	467,769	2	467,769	2	467,769	N/A	N/A	ARM-09	N/A	N/A	N/A
LPV-MRL-1	IHNC to Caernarvon	LPV-MRL-1	60460	200	N/A	145	151,150	278	3	974,078	3	974,078	3	974,078	N/A	N/A	N/A	N/A	N/A	30230