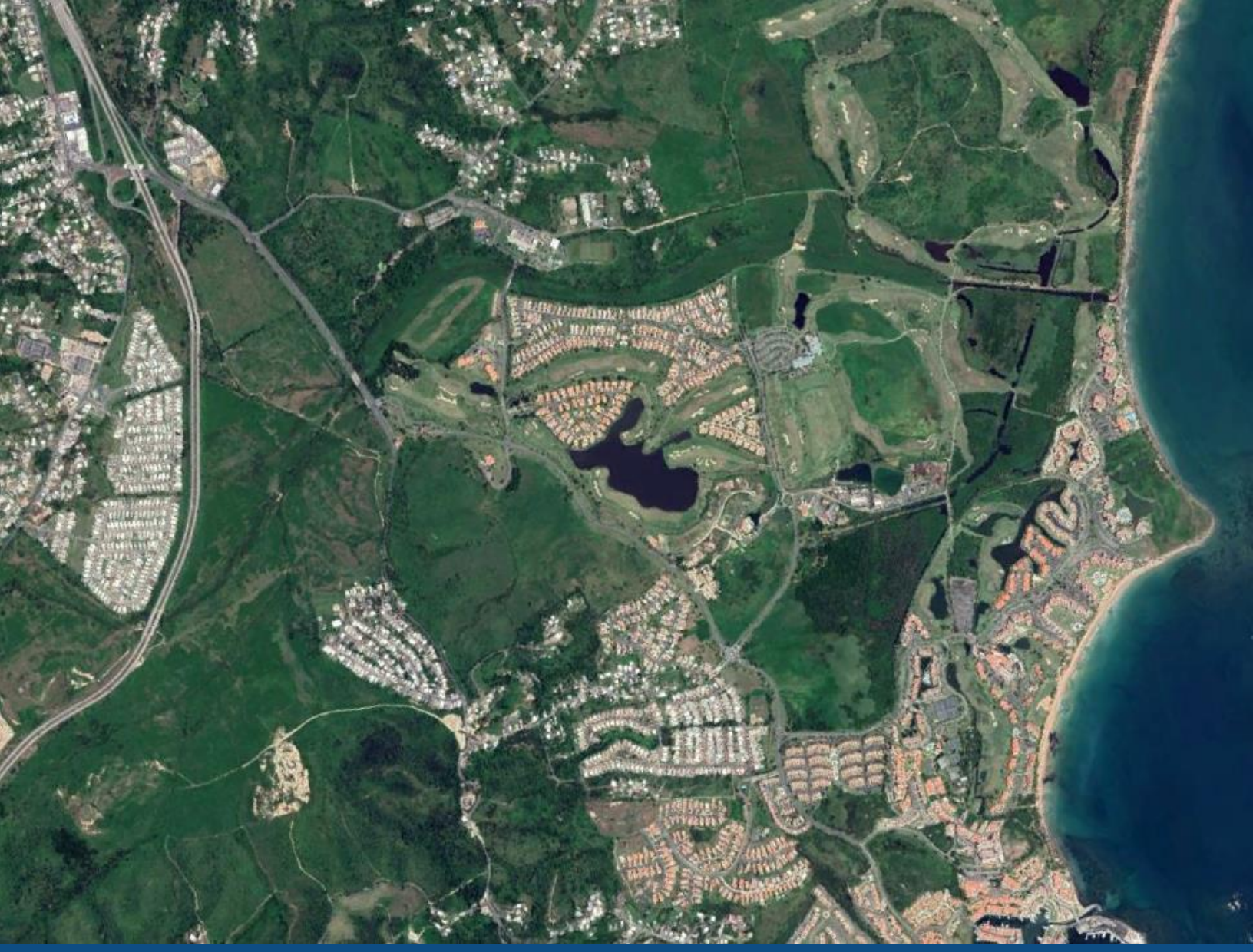

Levee Analysis and Mapping Plan
Palmas Del Mar Project

Municipality of Humacao, Puerto Rico

May 2020

FEMA

RiskMAP
Increasing Resilience Together

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Acronyms

44 CFR 65.10	Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations
BFE	Base Flood Elevation
CERC	Community Engagement and Risk Communication
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
HEC-HMS	Hydrologic Engineering Center Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center River Analysis System
LLPT	Local Levee Partnership Team
LAMP	Levee Analysis and Mapping Procedures
LOMR	Letter of Map Revision
NFIP	National Flood Insurance Program
NLD	National Levee Database
NOAA	National Oceanic and Atmospheric Administration
SCS	Soil Conservation Service
SFHA	Special Flood Hazard Area
STARR II	Strategic Alliance for Risk Reduction
USACE	U.S. Army Corps of Engineers

Definitions

The terms below have been used in this document. Additional terms are provided in FEMA's *Guidance for Flood Risk Analysis and Mapping, Levees* (February 2019) in the Glossary. This guidance document is available from the FEMA Library at https://www.fema.gov/media-library-data/1556726741363-2334a11b0de5b35a1e3210353c06148f/Levee_Guidance_Feb_2019.pdf.

Base Flood Elevation (BFE)** – Elevation of a flood having a 1-percent chance of being equaled or exceeded in any given year. Also referred to as the elevation of the 100-year flood. This elevation is the basis for the insurance and floodplain management requirements of the NFIP.

Levee Reach Analysis and Mapping Procedures* – Levee Analysis and Mapping Procedures include Sound Reach, Freeboard Deficient, Overtopping Analysis, Structural-Based Inundation, and Natural Valley. Details on these approaches can be found in FEMA's *Guidance for Flood Risk Analysis and Mapping, Levees* (February 2019).

Leveed Area – A spatial feature in the National Levee Database defined by the lands from which floodwater is excluded by the levee system.

Levee Reach* – A portion of a levee system (usually a length of a levee) that may be considered for analysis purposes to have approximately uniform representative properties.

Levee System* – A flood hazard-reduction system that consists of one or more levee segments/reaches and other features such as floodwalls and pump stations, which are interconnected and necessary to ensure exclusion of the design flood from the associated hydraulically independent levee-impacted area, and which are constructed and operated in accordance with sound engineering practices.

Local Levee Partnership Team (LLPT)* – A workgroup that is facilitated by FEMA when a levee system will be analyzed by levee analysis and mapping procedures for non-accredited levees. The primary function of this group is to share information/data and identify options based on stakeholder roles and knowledge.

National Levee Database (NLD)* – The NLD, developed by the United States Army Corps of Engineers (USACE) in cooperation with FEMA, is a dynamic, searchable inventory of information for all levee systems in the Nation. The database contains information to facilitate and link activities, such as flood risk communication, levee system evaluation for the NFIP, levee system inspections, floodplain management, and risk assessments. The NLD continues to be a dynamic database with ongoing efforts to add levee data from Federal agencies, States, and Tribes.

Non-Accredited Levee System* – A levee system that does not meet the requirements in the NFIP regulations at Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44 CFR 65.10), Mapping of Areas Protected by Levee Systems, and is not shown on a FIRM as reducing the base flood hazards.

Zone A –** The Special Flood Hazard Area (except coastal V Zones) shown on a community's Flood Insurance Rate Map where no base flood elevation is provided.

Zone D –** Area of undetermined but possible flood hazard.

*Term description from FEMA's *Guidance for Flood Risk Analysis and Mapping, Levees* (February 2019).

**Term description from FEMA's Floodplain Glossary (https://www.fema.gov/pdf/floodplain/nfip_sg_appendix_d.pdf).

Executive Summary

The Federal Emergency Management Agency's (FEMA's) Flood Insurance Study (FIS) report and Flood Insurance Rate Map (FIRM) for the Municipality of Humacao, Puerto Rico show the Palmas del Mar Levee System, which is part of the Palmas del Mar Project, as providing a reduced hazard from the 1-percent-annual-chance flood. To maintain this depiction of flood risk on the future FIRM, certified data must be provided to FEMA to show that the levee system meets the minimum requirements of Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44 CFR 65.10), and FEMA must confirm that the data is complete. As of the date of this levee plan, FEMA has received no data in support of 44 CFR 65.10; therefore, the levee system would be considered non-accredited in a future remapping effort.

FEMA's guidance was revised in 2013 to incorporate new Levee Analysis and Mapping Procedures for non-accredited levees. This guidance provides a suite of flexible procedures to perform flood hazard analysis and mapping for non-accredited levee systems (see Section 1 of this report). FEMA Region II has initiated a Levee Discovery project to apply the Levee Analysis and Mapping Procedures (see Section 2) to the Palmas del Mar Levee System.

In June 2019, FEMA Region II partnered with stakeholders from Puerto Rico representing the Municipality of Humacao to form a collaborative Local Levee Partnership Team (LLPT) and worked to determine potential Levee Analysis and Mapping Procedures that would apply to the Palmas del Mar Levee System (see Sections 3 and 4 respectively). The process involved collecting and evaluating available data, creating and evaluating an initial data analysis (see Section 5), and holding detailed discussions on mapping needs.

This levee plan summarizes the information gained through the extensive coordination and collaboration of the LLPT and through the initial data analysis performed. This plan also outlines potential reach analysis procedures and options for future mapping of the flood hazards within the areas affected by the Palmas del Mar Levee System in the Municipality of Humacao (see Section 6).

Representatives of the Municipality of Humacao expressed interest in pursuing accreditation of the Palmas del Mar Levee System to show the levee system as reducing flood risk on a future FIRM. This identification of flood risk within the levee-impacted areas would be similar to that shown on the effective FIRMs for the Municipality of Humacao, dated November 18, 2009. If the levee system is considered non-accredited, future FIRMs would depict much of the leveed area as a Zone AE Special Flood Hazard Area (SFHA).

1 Introduction

FEMA; its Production and Technical Services provider, Strategic Alliance for Risk Reduction II (STARR II); and its Community Engagement and Risk Communication (CERC) provider, Resilience Action Partners, initiated the Levee Analysis and Mapping Procedures process for non-accredited levees in the Municipality of Humacao. In addition to leveraging recent technological advances in data collection methods and hydrologic and hydraulic modeling, this process also:

- Leverages local knowledge and data, with proactive stakeholder engagement in LLPTs;
- Aligns available resources for engineering analyses and mapping commensurate with the level of risk in leveed areas; and
- Considers the unique characteristics of each levee system from an engineering perspective.

The levee system in the Municipality of Humacao is not currently accredited. FEMA is using the Levee Analysis and Mapping Procedures process to develop more refined flood hazard mapping in areas landward of the levees. Updated regulatory flood hazard mapping is not anticipated in this community for a number of years, so this effort is intended to provide a more realistic representation of levee-related flood hazards in the Municipality of Humacao for community officials and emergency managers to use in development and preparedness planning.

The Levee Analysis and Mapping Procedures process is conducted in four phases:

- **Phase 0: Flood Structure Identification and Review:** Levee systems are identified and verified as being constructed, operated, and maintained as flood risk reduction structures. An LLPT is established during this phase.
- **Phase 1: Analysis and Mapping Plan Preparation:** LLPT meetings are held periodically to review available data and documentation. Discussions assist in the preparation of an Analysis and Mapping Plan based on the available information.
- **Phase 2: Analysis Preparation and Results Review (if applicable):** Analysis is performed by FEMA and shared with the LLPT to validate results against available data and documentation. Results are compared to effective FISs to update the Levee Analysis and Mapping Plan, if necessary. Draft maps prepared at this stage may be used as best available data for floodplain management.
- **Phase 3: FIRM Update, Due Process and Effective FIRM Issuance:** FIRM panels are updated with Phase 2 results. Communities and FEMA follow all National Flood Insurance Program (NFIP) regulatory due process procedures, and updated FIRM panels are adopted as the regulatory basis for local floodplain management.

This levee plan is the result of the collaboration between FEMA, representatives from Puerto Rico including the local Palmas del Mar Homeowners Association and the Puerto Rico Emergency Management Agency, the U.S. Army Corps of Engineers (USACE), and other stakeholders. The plan summarizes the stakeholder coordination, initial data analysis, and options to depict the flood hazard associated with the levee system on a future FIRM.

Because the Palmas del Mar Levee System in Humacao would be considered non-accredited in a future remapping effort unless information is provided to support its accreditation, FEMA is using the Levee

Analysis and Mapping Procedures for non-accredited levees to develop more refined flood hazard mapping in the leveed areas.

2 Levee System Description

2.1 Flood Damage Reduction Project in the Municipality of Humacao

The Palmas del Mar Levee System was designed and constructed privately for the Palmas del Mar community as part of the Palmas del Mar Project to reduce flood risk within the Municipality of Humacao. The Palmas del Mar Levee System extends from 600 meters (1,970 feet) upstream of the mouth of Río Candelero to the Caribbean Sea to Puerto Rico Highway 906. This system is shown in Figure 1.

The Palmas del Mar Levee System is an earthen levee that extends for 2.30 kilometers (1.43 miles). The levee system is not currently enrolled in the USACE Rehabilitation Program; if damaged by flood the Palmas del Mar Levee System is unable to receive assistance from USACE to restore the levee system to its previous condition. Surveyed elevation data from USACE NLD was not available to inform the analysis of the Palmas del Mar Levee System. In lieu of this data source, an as-built survey of the levee system was provided, and terrain data informed the crest elevations for the Palmas del Mar Levee System.

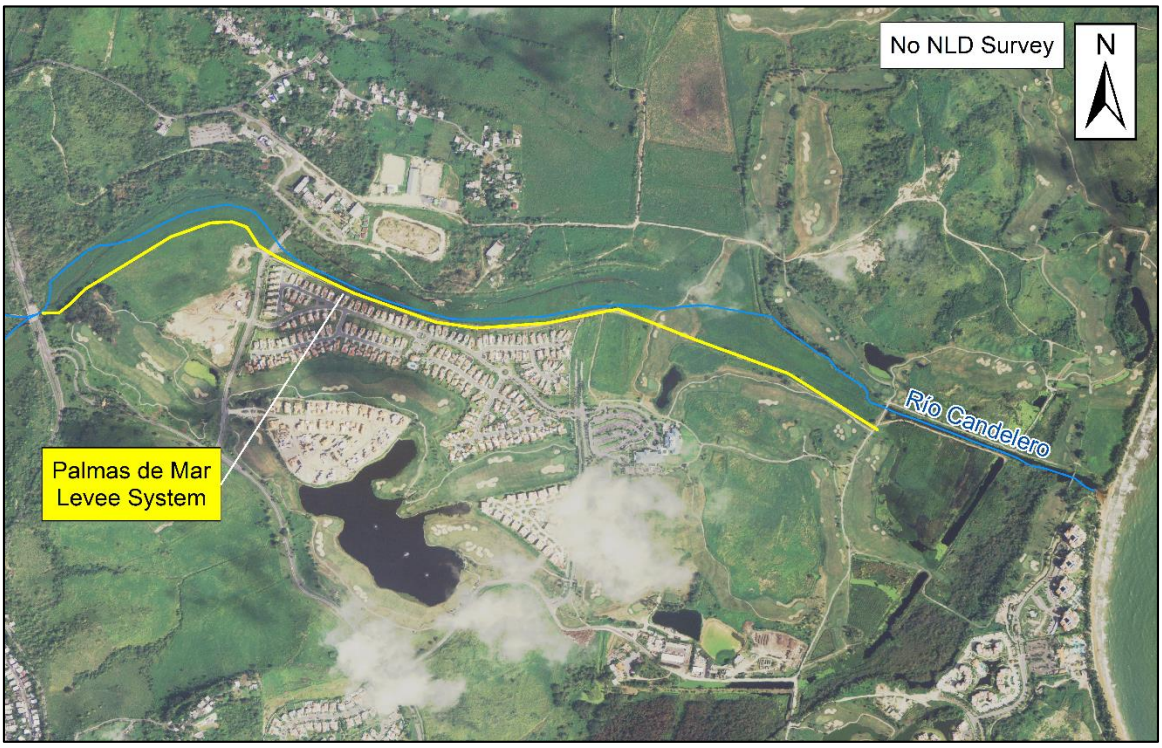

Figure 1: Palmas del Mar Levee System Location

2.2 Community NFIP and FIRM History

Table 1 and Table 2 summarize the communities' NFIP and FIRM history.

Table 1. Summary of Project Area

County	Community	Participating in the NFIP?	Estimated Number of Potentially Impacted Structures in Levee-impacted Area[1]
Municipality of Humacao	Municipality of Humacao	Yes	148

Table 2. Community Map History

Community Name	Initial Identification	Flood Hazard Boundary Map Revision Date(s)	FIRM Effective Date	FIRM Revision Date(s)
Municipality of Humacao	August 1, 1978	August 15, 1984 August 3, 1992 June 2, 1999 July 19, 2007	April 19, 2005	November 18, 2009

The Palmas del Mar Levee System is shown as reducing hazard of the 1-percent-annual-chance flood; however, the levee system has not been accredited.

2.3 Levee Analysis and Mapping Procedures Process Tasks

The Levee Analysis and Mapping Procedures (LAMP) process is divided into seven distinct tasks: LLPT Compilation, Field Reconnaissance, Initial Outreach, Initial Levee Analysis, Flood Risk Outreach, Complete Levee Analysis and Mapping Procedures, and Produce/Issue Preliminary Products (see Table 3).

Table 3. Project Tasks

Task	Details	Tentative Start/ End Dates*
LLPT Compilation (Phase 0)	Identification and outreach to individuals to serve on the LLPT.	4/1/2019 – 5/31/2019
Field Reconnaissance (Phase 1)	LLPT to determine levee reaches to study and potential analysis of those reaches. Perform field reconnaissance of these reaches.	6/3/2019- 6/7/2019
Initial Outreach (Phase 1)	LLPT convenes and discusses known flooding history and knowledge about the levees to be studied.	6/4/2019
Perform Initial Levee Analysis and develop Levee Analysis and Mapping Procedures (Phase 1)	FEMA to collaborate with the LLPT to develop analysis based on Field Reconnaissance findings and Levee Analysis and Mapping Procedures.	2/1/2019 - 7/31/2019

[1] See Table 5 for additional information regarding potentially impacted structures.

Task	Details	Tentative Start/ End Dates*
Flood Risk Outreach (Phase 2)	FEMA presents initial Levee Analysis results to LLPT for their assessment. LLPT to work at local level to disseminate findings that could impact local communities. Determine expectations and delivery of LAMP Plan.	10/29/2019
Complete Levee Analysis and Mapping Procedures; Finalize LAMP mapping (Phase 2)	FEMA to complete detailed analysis based on chosen approach, develop mapping, and finalize Levee Analysis and Mapping Procedures; develop final analysis and mapping. Delivery of LAMP Plan is done at this time.	TBD
Produce / Issue Preliminary Products (Phase 3)	FEMA to develop Preliminary Products (including FIRM database) from revised analysis above and issue if that is the direction from FEMA and LLPT.	TBD

*All schedules are tentative and will be adjusted to the pace of the LLPT.

3 Local Levee Partnership Team

The LLPT was formed to provide FEMA with data and input, in addition to feedback on the procedures to be used for analyzing and mapping the levee reach, based on local levee conditions. The stakeholders who participated in the LLPT for this project are listed in Table 4.

Table 4. LLPT Participants

LLPT Member	Contact Information
Antonia Maldonado	Palmas del Mar Homeowners Association 787.285.6425, maldonadolopez@aol.com
Sandra Gracia	Palmas del Mar Homeowners Association 787.246.6088, sandragracia1205@gmail.com
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Servando Díaz	Palmas Athletic Club 787.342.4407, servando.diaz@gmail.com
Erasmo Reyes	Palmas del Mar Homeowners Association, Palmas Plantation 787.608.0501, erasmorp@prtc.net
Jesús E. Delgado	Palmas del Mar Homeowners Association 787.842.2169, pha_arb@live.com
Miguel E. Santiago	Palmas del Mar Homeowners Association 787.909.6624, miguelesantiago@gmail.com
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Rose Nieves	Office of Legal Affairs of Municipality of Humacao 787.852.3066, ext. 2322, rnieves@humacao.gov.pr

LLPT Member	Contact Information
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4 Stakeholder Engagement

4.1 LLPT Meeting 1

A FEMA-led project team engaged the Palmas del Mar Levee System stakeholders at the first LLPT Meeting on June 5, 2019, held at the Palmas del Mar Homeowners Association. The intent of the meeting was to establish contact, explain the Levee Analysis and Mapping Procedures process, and discuss the application of these procedures to the Palmas del Mar Levee System.

At the initial LLPT meeting (LLPT 1), representatives from FEMA provided an overview to the invited communities, answered questions concerning FEMA products, terminology, and procedures, and provided a timeline for the Levee Analysis and Mapping Procedures project. FEMA explained in detail the five procedures outlined in the Levee Analysis and Mapping Procedures Final Approach Document and the major distinctions between the Levee Analysis and Mapping Procedures and earlier levee analyses. FEMA and its contractors led a discussion about how each procedure applied to the levee system.

Representatives from local stakeholders provided additional background on the Palmas del Mar Levee System and discussed USACE involvement in the construction and the current condition of the levee system. (See Appendix A for the LLPT 1 meeting minutes.)

4.2 LLPT Meeting 2

At the next LLPT meeting, held on October 29, 2019, participants reviewed the initial data analysis and discussed outcomes from the data collection process. During the meeting, the FEMA project team discussed the results of the initial data analysis for the Natural Valley and Structural-Based Inundation procedures. The results of the Levee Analysis and Mapping Procedures led to a discussion about levee ownership and maintenance for the Palmas del Mar Levee System, to ensure the levee continues to provide reduced flood risk to the community.

Appendix B provides additional details on LLPT Meeting 2, and Appendices C through F provide information from the data collection.

4.3 LLPT Meeting 3

LLPT Meeting 3 was held on June 23, 2020 to review the draft Levee Analysis and Mapping Procedures Plan with the LLPT prior to finalizing it.

5 Initial Data Analysis

STARR II developed an initial data analysis to approximate the inundation area of the 1-percent-annual-chance flood for each relevant Levee Analysis and Mapping Procedures approach. This informed the discussions in LLPT Meeting 2 and the touchpoint call prior to LLPT Meeting 3. Details of the initial data analysis and application of reach analysis procedures are provided below. Appendix F provides supporting data.

5.1 Hydrologic Analysis

The 1-percent-annual-chance flow event for Río Candelero was analyzed, and flow hydrographs were calculated as part of the initial data analysis. To analyze the flow event, a Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) rainfall-runoff model was developed for Río Candelero. National Oceanic and Atmospheric Administration (NOAA) Atlas 14-point precipitation frequency estimates were used to estimate the 24-hour, 1-percent-annual-chance rainfall depth for the Río Candelero watershed, and frequency temporal distribution was used to define the 24-hour rain event. The Soil Conservation Service (SCS) Curve Number was used to estimate hydrologic losses, and a unit hydrograph procedure was applied to develop sub-basin hydrographs. The Muskingum-

Cunge method was used for channel routing. Hydrographs at significant points of interest were extracted and used in the hydraulic model.

5.2 Reach Analysis

Topographic data (USGS 3D Elevation Program ([3DEP] 1-meter Light Detection and Ranging [LiDAR, 2018], available through The National Map from USGS) were reviewed to define the levee system and establish reach boundaries for the initial data analysis. A levee reach is any continuous section of a levee system to which a single reach analysis procedure (Section 5.2 through 5.5) may be applied. For the initial data analysis, the Palmas del Mar Levee System was considered a single reach. The levee system is relatively short (1.43 miles), continuous, and was uniformly constructed.

Levee crest survey data was not available from the USACE NLD. Levee crest data was informed by As-Builts for the levee system and available topographic data. Topography data compared well with As-Builts, therefore topography was used for modeling and both sources were used to develop freeboard profiles. Based on the review of the available levee crest data, the Palmas del Mar Levee System does not meet the minimum freeboard requirements of 44 CFR 65.10 for the entirety of the levee system, as shown in the levee profile exhibit in Appendix C.

5.3 Natural Valley Procedure

The Natural Valley Procedure was modeled by developing geometry to represent the natural topography as if the levee was never built. The resulting floodplain is a representation of the natural extent of the floodplain, assuming no flood hazard reduction is provided by the levee system. An unsteady two-dimensional (2-D) flow simulation would provide better depth/velocity information than a one-dimensional (1-D) steady flow analysis. Therefore, HEC-RAS 5.0.7 software, which has a 2-D flow analysis capability, was selected. A 1D/2D combined method HEC-RAS model was developed for the natural valley procedure. The 1-percent-annual-chance Natural Valley floodplain reflecting the levee-lowered scenario was developed using the HEC-RAS model of the Río Candelero floodplain.

5.4 Structural-Based Inundation Procedure

For the Structural-Based Inundation Procedure, hypothetical breach analyses were completed at two independent locations along the levee reach. Current guidelines recommend that one breach occur at the upstream end of the levee system and one at the downstream end of the levee system. This guidance was used in conjunction with engineering judgment based on available topographic and geologic data and available freeboard at each point along the levee system to develop two likely breach locations. The upstream breach width was determined to be 150 feet, and the downstream breach width was determined to be 130 feet. Each breach was analyzed individually using HEC-RAS 5.0.7 (2-D, unsteady flow). The breach locations were developed for analysis purposes only and are not intended to indicate historic or future breach development. All 1-percent-annual-chance inundation breach areas were composited to develop the final visual depiction of the Structural-Based Inundation Procedure results. Breach locations developed for this model are presented in Figure 2.

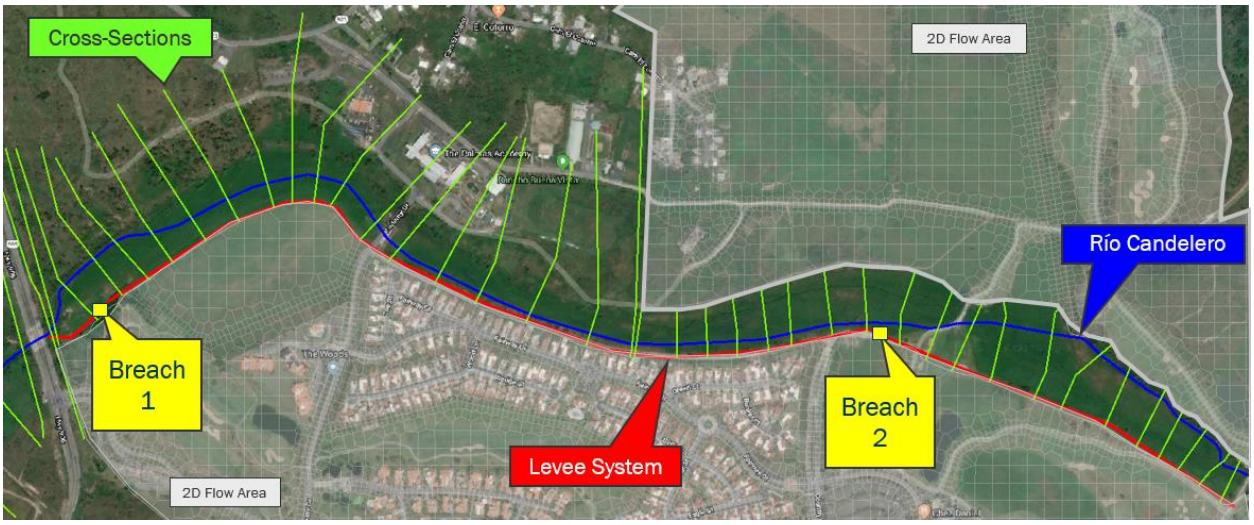

Figure 2: Breach Location Map

5.5 Freeboard Deficient and Overtopping Procedures

The Freeboard Deficient and Overtopping Procedures do not apply to the Palmas del Mar Levee System. Overtopping does not occur for the 1-percent-annual-chance flood using the methodology outlined in this report, and data requirements prevent the freeboard deficient procedure from being applied. The levee profile exhibit is included in Appendix C.

5.6 Sound Reach Procedure

A Sound Reach is described as a reach that has been designed, constructed, and maintained to withstand the hazards posed by a 1-percent-annual-chance flood, in accordance with the standards in 44 CFR 65.10 of the NFIP regulations, but is part of a levee system that has not been accredited. In the case of the Palmas del Mar Levee System, the currently available data does not show that the Sound Reach Procedure applies.

5.7 Review of Initial Data Analyses

The effective FIRMs show the land side of the levee as unshaded Zone X. The unshaded Zone X flood zone is defined as an area with a minimal risk of being inundated by the 1-percent-annual-chance flood. The Natural Valley procedure results identify the potential flood risk if the levee system were not providing flood hazard reduction during the base flood event. Figure 3 illustrates the approximate inundation area for the 1-percent-annual-chance flood, using the Natural Valley Procedure within the levee-impacted area. Figure 4 shows an approximate depth grid using the Natural Valley Procedure within the levee-impacted area.

It should be noted that an advisory base flood elevation steady 1-D HEC-RAS hydraulic model for Río Candelero was converted to an unsteady 1-D/2-D HEC-RAS hydraulic model to evaluate the reach analysis procedures. Appendix F (DVD) provides additional information regarding the methodology used in the initial data analyses.

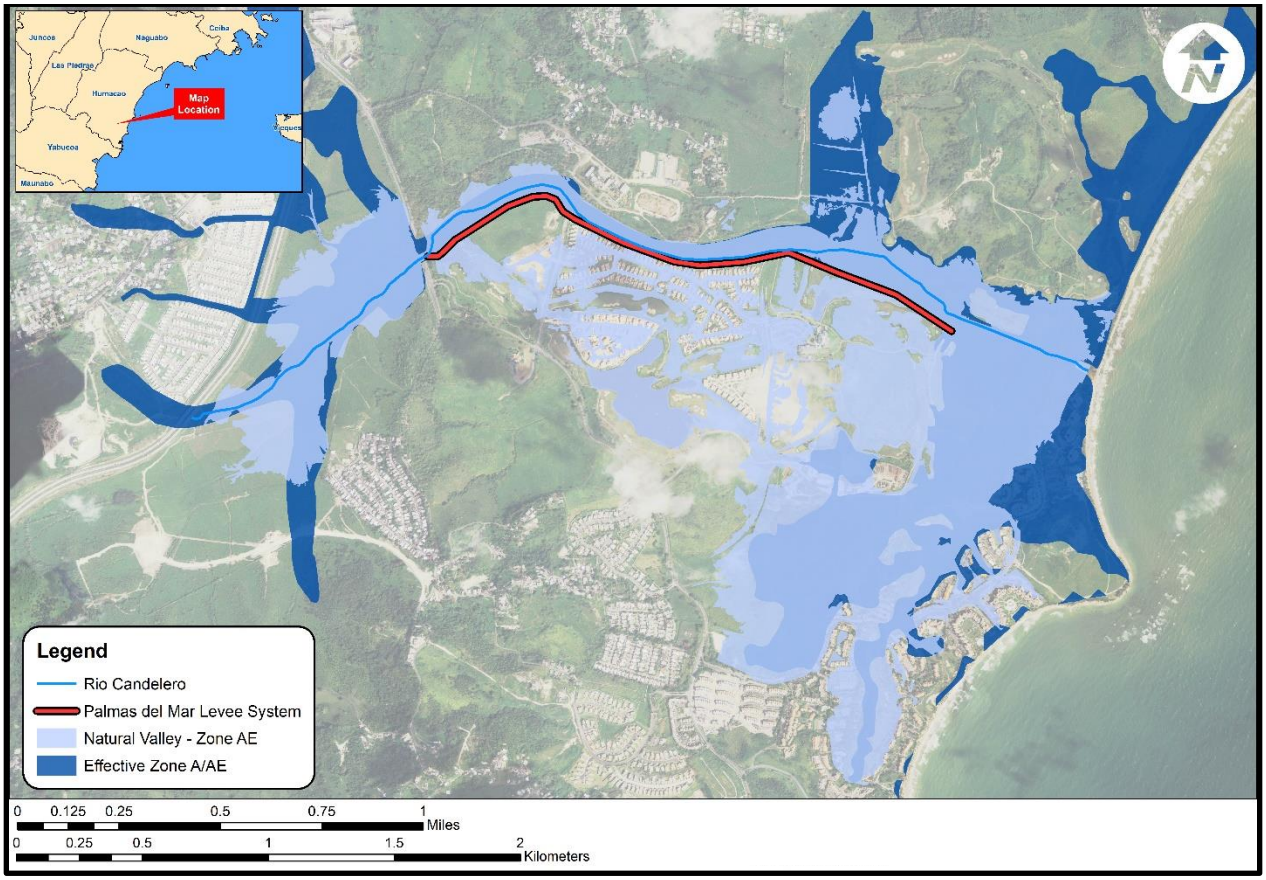

Figure 3: Natural Valley Procedure

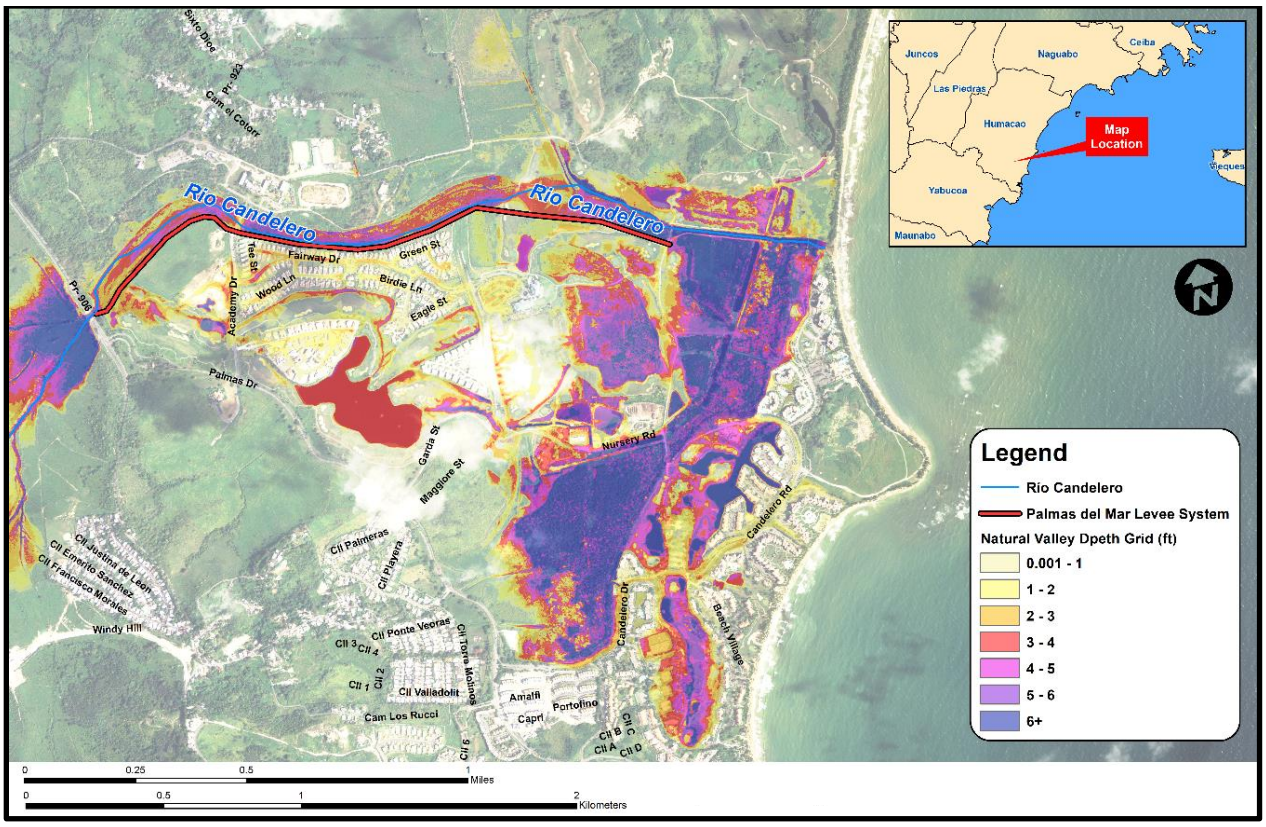

Figure 4: Natural Valley Procedure Flood Depth Grid

The composite results of the Structural-Based Inundation Procedure, shown in Figure 5 and Figure 6, yield a decrease in inundation area within the levee-impacted areas, compared to the Natural Valley Procedure. With less flow passing through the landward side of the levee system, a greater amount of flooding is seen in the non-leveed areas of Río Candelero. Since the Structural-Based Inundation Procedure is a composite of just two breach scenarios and does not reflect all possible flood risk due to breaching, the Natural Valley Procedure would be used to map the levee flood hazard if incomplete or no additional data is provided for the levee system.

Community officials and emergency managers can use the results of the Structural-Based Inundation Procedure to inform emergency action planning and outreach to residents living and working within the levee-impacted area. The Structural-Based Inundation Procedure is an important reminder that if a breach of a levee system occurs, areas along or near a breach are potentially at increased risk to higher velocity flow and inundation, which could happen with little or no warning.

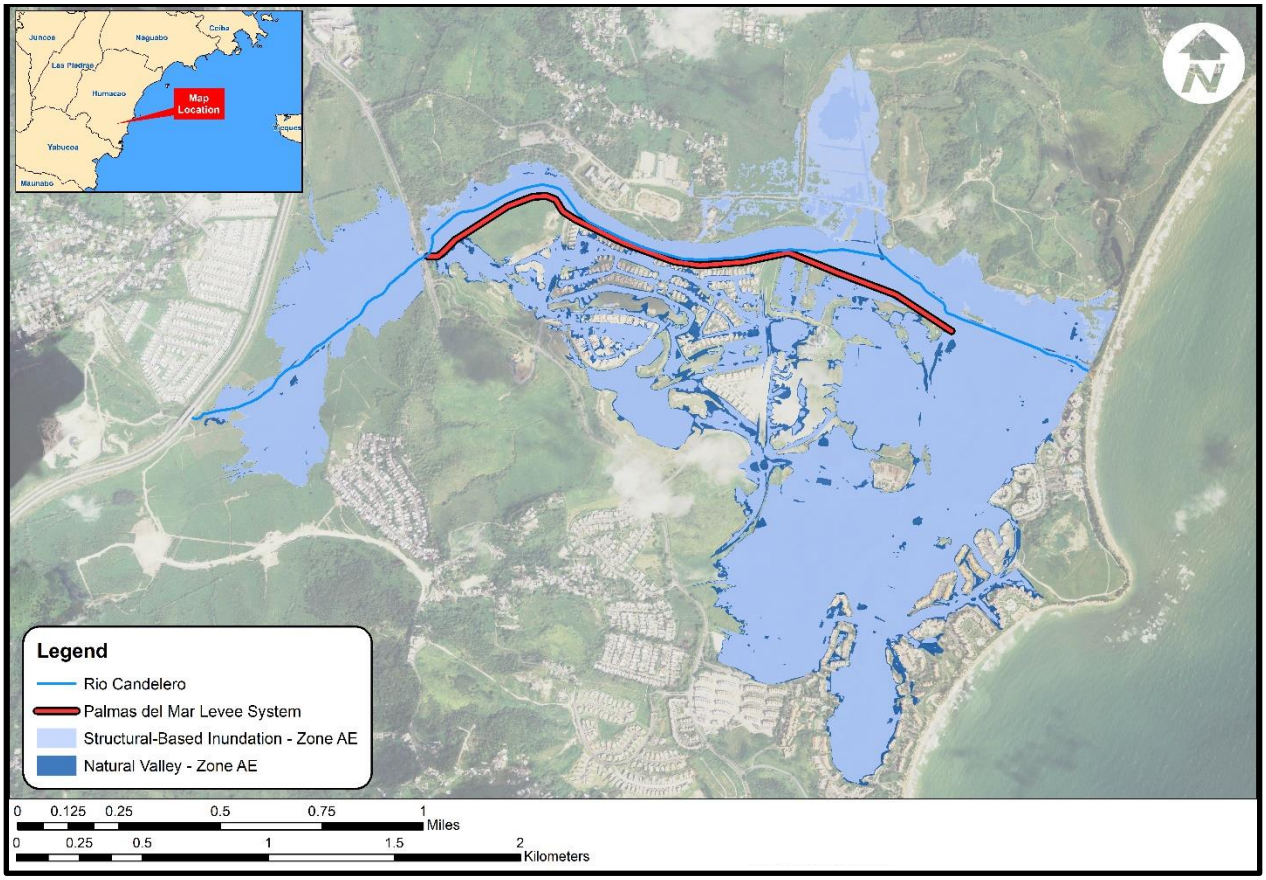

Figure 5: Structural-Based Inundation Procedure

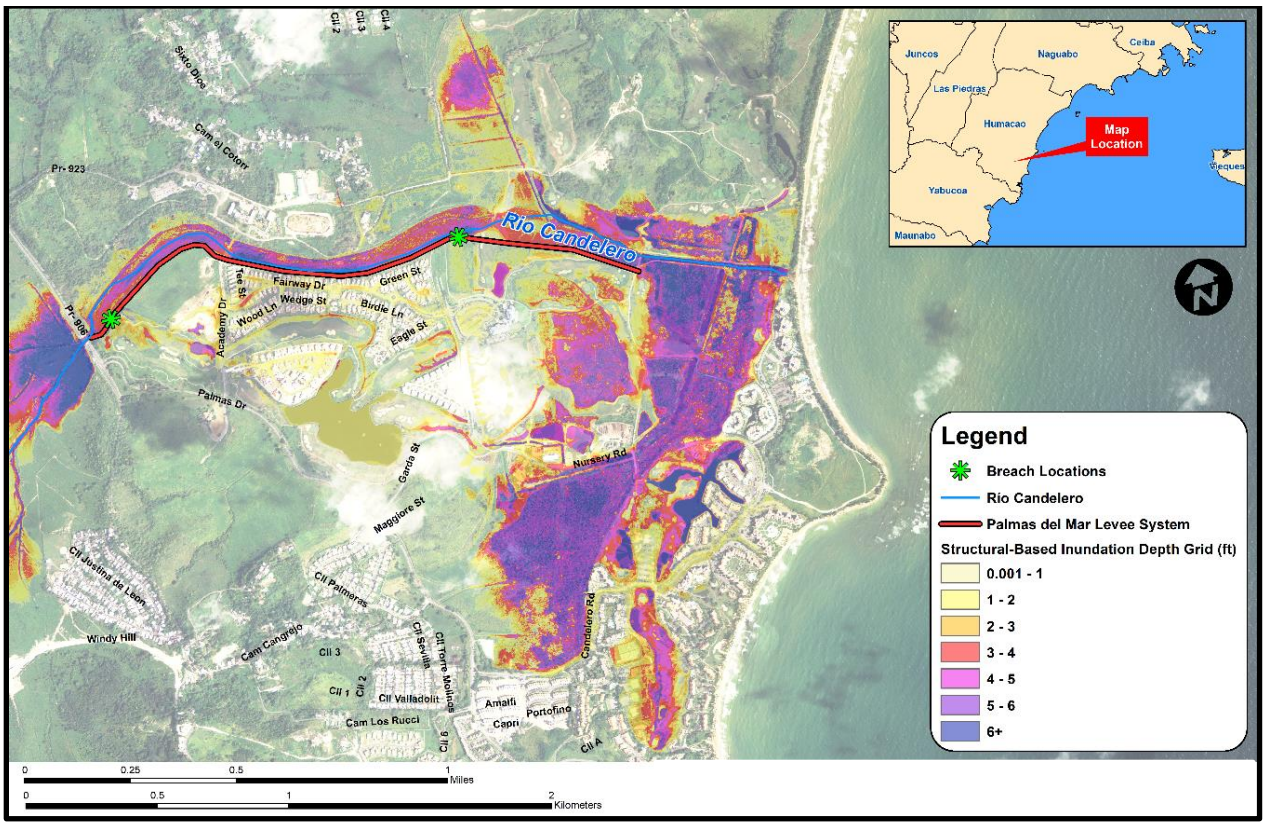

Figure 6: Structural-Based Inundation Procedure Flood Depth Grid

Table 5 includes a summary of the results obtained from the Initial Data Analysis.

Table 5. Results from the Initial Data Analysis

Reach	Approximate Length of Levee Segment m (ft)	Comments: Natural Valley Procedure[3] (Figure 2)	Comments: Structural-Based Inundation Procedure[5] (Figure 4)
		Approximate # Structures[7] Impacted by Zone A: 148	*Approximate # Structures Impacted by Zone A: 148*
Palmas del Mar Levee System	2,300 (7,560)	Results from updated hydraulic model (1D/2D). Estimates potential inundation/levee-impacted area if not mapped as reducing flood hazard.	Inundation extents similar to the Natural Valley Procedure for the 1-percent-annual-chance flood. May be utilized for emergency planning.

[3] Depicts levee reach as not reducing flood hazard. No additional data required to support future analysis or mapping.

[4] Hypothetical levee breach analysis. No additional data required to support future analysis or mapping.

[5] All minimum requirements of 44 CFR 65.10 are met. Certified data compliant with 44 CFR 65.10 required to support future analysis or mapping.

[6] 44 CFR 65.10 data can be submitted at any time for any hydraulically independent levee system.

[7] Approximate number of structures impacted estimated from aerial imagery.

6 Path Forward

6.1 Levee Analysis and Mapping Procedures

The Palmas del Mar Project includes the Palmas del Mar Levee System. The levee system is shown on the effective FIRM as reducing flood hazards. As FEMA has received no data in support of the 44 CFR 65.10 requirements for the levee project, however, the levee system would be considered non-accredited in a future remapping effort.

FEMA engaged representatives from Puerto Rico throughout the process of applying the Levee Analysis and Mapping Procedures for non-accredited levees, to help identify potential options to evaluate the flood hazard for the levee-impacted areas. The community is considering moving forward with levee certification and the accreditation process, to have the future FIRM continue to map the reduced flood hazard due to the levee system.

If the community can provide data compliant with 44 CFR 65.10 for the Palmas del Mar Levee System, the flood hazard of the associated levee-impacted areas could be shown as shaded Zone X, with areas of interior drainage zoned as Special Flood Hazard Areas. If the community does not provide the required data, the effective FIRM, dated November 18, 2009, could be revised to show the updated flood risk using the Natural Valley Procedure, once the FEMA Regional Office incorporates updates into future mapping studies.

FEMA anticipates updating the flood hazard maps in the future and would inform the community before it initiates any update project. If levee data compliant with 44 CFR 65.10 is provided prior to the Letter of Final Determination for the countywide mapping project, it could be incorporated into the final countywide mapping. However, data in support of 44 CFR 65.10 may be submitted through the Letter of Map Revision (LOMR) process to update the FIRM at any time. FEMA recommends that the community coordinate with FEMA Region II in advance of any submittal, to keep the Region apprised of the levee status. For reference, Appendix D includes FEMA's Levee Accreditation Checklist.

7 References

FEMA, Flood Insurance Study, Commonwealth of Puerto Rico and Municipalities, November 2009.

FEMA: Guidance for Flood Risk Analysis and Mapping, Levees, February 2018

FEMA: Non-Accredited Levee Analysis and Mapping Guidance, September 2013

The National Map, USGS 3DEP 1-Meter LiDAR, Available at: https://viewer.nationalmap.gov/basic/

USACE, National Levee Database (https://levees.sec.usace.army.mil/#/), 2019.

Appendix A
Stakeholder Engagement - LLPT Meeting 1 Information

Appendix B
Stakeholder Engagement - LLPT Meeting 2 Information

Appendix C
Freeboard Profile Comparison

Appendix D
Levee Accreditation Checklist

Appendix E
Collected Data

(Full Appendix Provided on DVD)

Appendix F
Initial Data Analysis

(Full Appendix Provided on DVD)