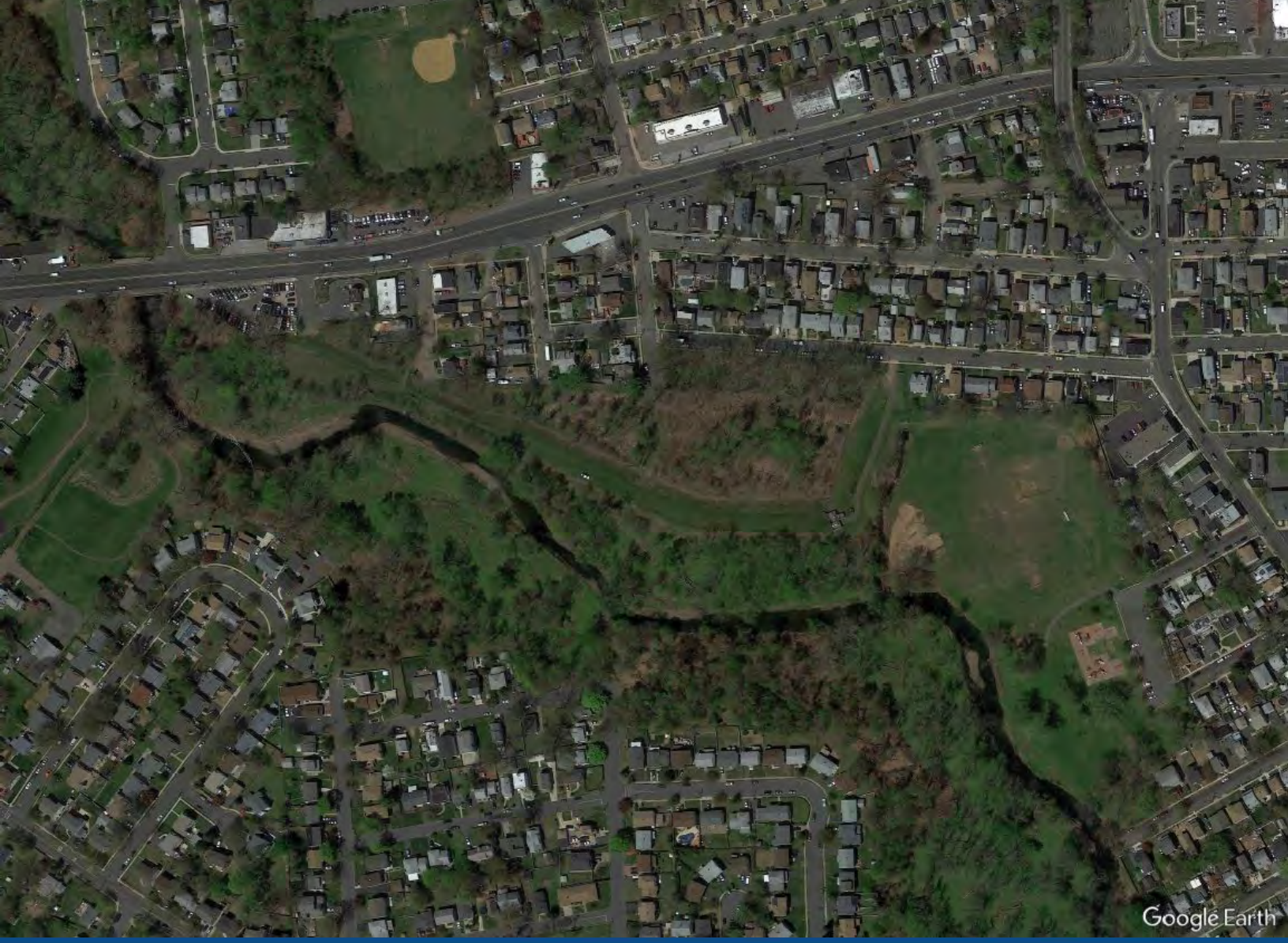

Levee Analysis and Mapping Plan
Elizabeth River Flood Control Project

Township of Hillside, New Jersey

June 2019

FEMA

RiskMAP
Increasing Resilience Together

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Acronyms

BFE	Base Flood Elevation
CERC	Community Engagement and Risk Communication
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
LLPT	Local Levee Partnership Team
LOMR	Letter of Map Revision
NFIP	National Flood Insurance Program
NJDEP	New Jersey Department of Environmental Protection
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 2018) in the Glossary. This guidance document is available from the FEMA Library at https://www.fema.gov/media-library/assets/documents/94095.

Base Flood Elevation (BFE) – The elevation of a flood having a 1-percent chance of being equaled or exceeded in any given year.

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 2018).

Leveed Area* – A spatial feature in the NLD defined by the lands from which flood water is excluded by the levee system.

Levee Reach* – Any continuous section of a levee system to which a single analysis and mapping procedure may be applied.

Levee System* – A flood hazard-reduction system that consists of one or more levee segments 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 leveed area, and which are constructed and operated in accordance with sound engineering practices.

Local Levee Partnership Team (LLPT)* – A work group that can be 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, flood plain management, and risk assessments.

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

Zone A – An area inundated by 1-percent-annual-chance flooding, for which no BFEs have been determined.

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

*Term description from FEMA's *Guidance for Flood Risk Analysis and Mapping, Levees* (February 2018)

Executive Summary

The effective and preliminary Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs) dated September 20, 2006 and April 18, 2016, respectively, for Union County, New Jersey shows the Hillside, Elizabeth River Left Bank Levee system (part of the Elizabeth River Flood Control Project) as providing reduced flood 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, and deemed complete, to show that the levee system meets the minimum requirements of Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44CFR§65.10). As of the date of this levee plan, no data has been received by FEMA in support of 44CFR§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 the Analysis and Mapping Procedures for Non-Accredited levees to provide a suite of flexible procedures to perform flood hazard analysis and mapping for non-accredited levees (see Section 1 of this report). In the Township of Hillside, FEMA Region II has initiated a Levee Discovery project where the Levee Analysis and Mapping Procedures for Non-Accredited Levees (see Section 2) are being applied to the Hillside, Elizabeth River Left Bank Levee system (Elizabeth River Left Bank Levee system).

In August of 2018, FEMA Region II partnered with local, regional, and federal levee stakeholders in the Township of Hillside to form a collaborative Local Levee Partnership Team (LLPT) and worked to determine potential Levee Analysis and Mapping Procedures that would be applicable to the Elizabeth River Levee System (see Sections 3 and 4 respectively). The process involved the collection and group evaluation of available data, creation, and evaluation of an Initial Data Analysis (see Section 5), and detailed discussions on mapping needs.

The information gained through the coordination and collaboration with the LLPT and through the Initial Data Analysis performed is summarized in this levee plan. This plan also outlines potential reach analysis procedures and paths forward for future mapping of the flood hazard within the levee impacted area of the Elizabeth River Left Bank Levee system within the Township of Hillside (see Sections 5 and 6).

The Township of Hillside expressed interest in considering Freeboard Deficient Procedure for the Elizabeth River Left Bank Levee system to show the levee flood hazard as Zone D plus interior drainage Special Flood Hazard Area (SFHA) on the future FIRM. This would require certified data compliant with 44§CFR 65.10 and Freeboard Deficient procedures to be submitted to FEMA and deemed complete. If no or insufficient data is provided, future FIRMs would depict the levee impacted area as Zone AE SFHA.

1 Introduction

Under FEMA's prior levee approach, a levee system that did not meet the National Flood Insurance Program (NFIP) requirements outlined in 44CFR§65.10 was analyzed and mapped as if the levee system did not exist and, therefore, provided no flood hazard reduction during a base (1-percent-annual-chance) flood. This was known as the "without levee" approach.

Stakeholders expressed concern about the "without levee" approach. Members of both the U.S. House of Representatives and the U.S. Senate echoed this concern and asked FEMA to consider discontinuing the "without levee" approach. Accordingly, FEMA drew on current modeling techniques to refine the identification of flood hazard reduction that non-accredited levee systems provide. This process recognizes the uncertainty associated with hazard identification of levee impacted areas by providing additional options to better depict the flood hazard. Known as the Levee Analysis and Mapping Procedures for non-accredited levees, this process offers a more refined approach to mapping flood hazards in levee impacted areas.

FEMA, its Production and Technical Services provider Strategic Alliance for Risk Reduction II (STARR II), and Community Engagement and Risk Communication provider (CERC) initiated the Levee Analysis and Mapping Procedures process for non-accredited levees in the Township of Hillside. Recent technological advances in data collection methods and hydrologic and hydraulic modeling were leveraged as part of this process, which 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 levee impacted areas; and
- Considers the unique characteristics of each levee system from an engineering perspective.

The Elizabeth River Left Bank levee system in the Township of Hillside would be considered non-accredited in a future mapping effort. FEMA is using the Levee Analysis and Mapping Procedures for non-accredited levees process to develop refined flood hazard mapping in levee impacted areas.

This report is the result of the collaboration between FEMA, the Township of Hillside, Union County, New Jersey Department of Environmental Protection (NJDEP), U.S. Army Corps of Engineers (USACE), and other stakeholders and summarizes the stakeholder coordination, Initial Data Analysis, and options to depict the flood hazard for the levee system on a future FIRM.

2 Levee System Description

2.1 Flood Control Project in the Township of Hillside

The Elizabeth River Left Bank Levee system is part of the Elizabeth River Flood Control Project, constructed by USACE in 2002. Upon completion, the project was turned over to the, Township of Hillside as the local sponsor. The Elizabeth River Left Bank Levee is an approximately 1,750 feet long grass covered earthen levee that extends from just downstream of Route 22 to the vicinity of Harvard Avenue, as shown in Figure 1. The levee system is equipped with a pump station and an approximately 1,050-foot long seepage berm adjacent to the levee system on the landside.

A comparison of the levee crest elevation between the as-built plans and the 2010 NLD survey indicates that the levee crest of the 1,750 foot earthen levee appears to have settled up to 1 foot in height (from approximately station 0+00 to 10+00). According to USACE, the settlement exhibited by the levee system is greater than what was anticipated since the levee system was constructed. The levee system is currently "active" in the USACE Rehabilitation Program.

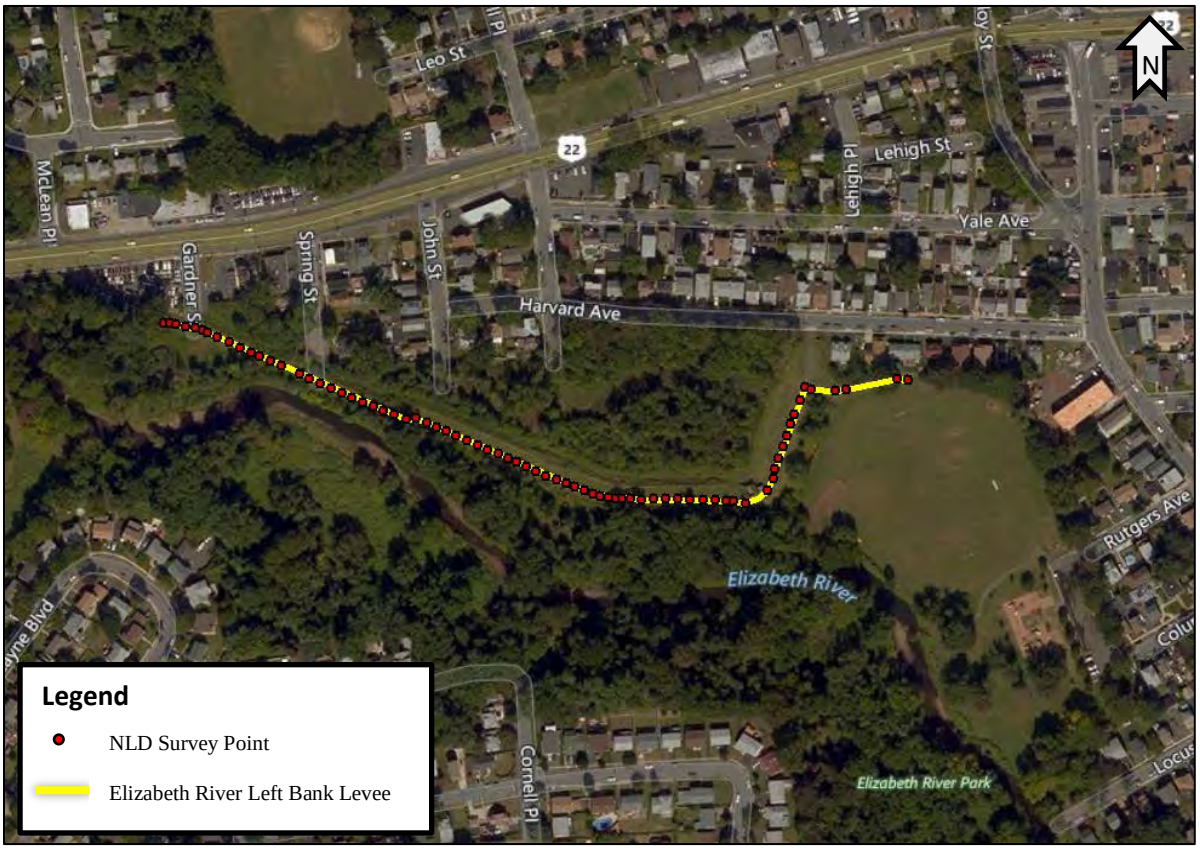

Figure 1: Location Map

2.2 Community NFIP and FIRM History

Tables 1 and 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]
Union	Township of Hillside	Yes	Approximately 80

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

Table 2. Community Map History

Community Name	Initial Identification	Flood Hazard Boundary Map Revision Date(s)	FIRM Effective Date	FIRM Revision Date(s)
Township of Hillside	January 9, 1974	N/A	September 14, 1979	September 20, 2006

The Elizabeth River Left Bank Levee system is shown as reducing flood hazard on the Union County, NJ effective FIRM dated September 20, 2006.The preliminary FIS report and FIRMs issued for the Union County New Jersey (All Jurisdictions), on April 18, 2016 also shows the levee system as reducing flood hazard for the 1-percent annual-chance flood and shows the same shaded Zone X flood zone for the levee impacted area.

3 Local Levee Partnership Team

The LLPT was formed to provide FEMA with data and input, including 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 3.

Table 3. LLPT Participants

LLPT Member	Contact Information
Hanifa Johnson	Township of Hillside, Director of Public Works 973.926.1110; hjohnson@hillsidenj.us
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Kunal Patel	NJ Department of Environmental Protection 609.292.2296; kunal.patel@dep.nj.gov
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LLPT Member	Contact Information
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Matt Kroneberger	CERC, Outreach Provider 212.237.6373; matt.kroneberger@ogilvy.com

4 Stakeholder Engagement and Data Collection

4.1 LLPT Meeting 1 and 2

A FEMA-led project team engaged the Elizabeth River Left Bank Levee stakeholders at the combined LLPT 1 and 2 Meeting on January 22, 2019 held at Township of Hillside Hall. The overall intent of the meeting was to gain local insight on the status and data available for the levee system, introduce the Levee Analysis and Mapping Procedures concepts for non-accredited levees, and confirm the stakeholders who would like to participate in the LLPT.

An overview of the reach analysis procedures used to depict flood risks for levee systems was provided, and a discussion was facilitated on the results of the Initial Data Analysis for the Natural Valley, Structural-Based Inundation, and Freeboard Deficient Procedures that were completed based on available data.,

A touchpoint call was held on March 19, 2019 to revisit the results of the Initial Data Analysis, discuss additional data collected, and ask if the LLPT had any items to discuss.

Additional details regarding the LLPT 1 and 2 meeting are provided in Appendix A.

4.2 LLPT Meeting 3

A LLPT Meeting 3 was held on May 30, 2019 at the Township of Hillside to review the draft levee analysis and mapping plan with the LLPT prior to it being finalized.

4.3 Data Collection

Through the Stakeholder Coordination and Data Collection process, FEMA requested all available data, information, and documentation associated with the levee system from the LLPT.

Table 4 provides a summary of the data and documentation collected during the Stakeholder Coordination and Data Collection process. The data has been included in Appendix D.

Table 4. Data Collection Summary

Data Type	Data Description	Source	Date Obtained
Levee Crest	Levee crest survey (2010)	National Levee Database	2018
Effective Flood Insurance Study	Union County, New Jersey (All Jurisdictions), FEMA, September 20, 2006	FEMA Map Service Center	2018
Preliminary Flood Insurance	Union County, New Jersey (All Jurisdictions), FEMA, Preliminary April 18, 2016	FEMA Map Service Center	2018
Hydraulic Model	Effective HEC-2 hydraulic model for Elizabeth River developed by USACE	FEMA Mapping Information Platform	2018

Data Type	Data Description	Source	Date Obtained
Topography	NOAA NCEI Coastal Digital Elevation Model (DEM) - 1/9 Arc-Second Resolution Bathymetric-Topographic Tiles, National Geophysical Data Center, 2018	NESDIS, NOAA	2018
Documentation	March 24, 2005 Levee Certification letter to FEMA from USACE, NY District	FEMA Engineering Library	2018
Documentation	Periodic Inspection Report No. 2, USACE, 2014	USACE	March 2019
Documentation	Flood Damage Reduction Segment/System Inspection Report, USACE, June 2018	USACE	March 2019
Documentation	Definite Project Report, Elizabeth River at Hillside, New Jersey Flood Control Study, Main Report and Environmental Assessment, USACE, August 1987	USACE	March 2019
Documentation	Definite Project Report, Elizabeth River at Hillside, New Jersey Flood Control Study, Supporting Documentation, USACE, August 1987	USACE	March 2019
Documentation	Report of Geotechnical Investigation, Flood Control levee, Elizabeth River in Hillside, New Jersey, French & Parrello Associates, P.A., March 4, 1987	USACE	March 2019
Documentation	Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual, Elizabeth River in Hillside, New Jersey, Flood Control Project, USACE, September 2001	USACE	March 2019
As-built Plans	Elizabeth River at Hillside Flood Control Project, 1998	USACE	March 2019

5 Initial Data Analysis

As a part of this levee discovery effort, STARR II conducted an Initial Data Analysis, , to estimate the potential inundation area of the 1-percent annual chance flood for each relevant Levee Analysis and Mapping Procedures approach. This informed the discussions of the combined LLPT 1 and 2 meeting and the touchpoint call prior to LLPT Meeting 3. Details of the reach analysis and application of reach analysis procedures are provided below. Supporting data is provided in Appendix E.

5.1 Reach Analysis

The levee crest survey from the National Levee Database (NLD) was 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 (listed in Sections 5.2 through 5.5) may be applied. For the Elizabeth River, only a small segment of the levee system near the downstream end is currently estimated to meet minimum freeboard requirements. As the majority of the levee system is considered Freeboard Deficient, the levee system will be considered a single reach. A profile exhibit showing the estimated levee crest elevations from the as-built plans and NLD compared to the 1-percent annual chance flood elevation is provided in Appendix B.

5.2 Natural Valley Procedure

The Natural Valley Procedure was modeled by keeping the topographic features of the Elizabeth Left Bank Levee reach in the terrain data but allowing the stream to flow on both sides of the levee structure. Using a steady-state model (HEC-RAS 5.0.6) with the effective FIS flowrates, the

Natural Valley Procedure was simulated and analyzed the 1-percent-annual-chance flood inundation.

5.3 Structural-Based Inundation Procedure

Hypothetical breach analyses were completed at 3 independent locations along the levee reaches. Each breach was analyzed individually using HEC-RAS 5.0.6 (2-Dimensional, unsteady flow). The breach locations were developed for analysis purposes only and are not intended to indicate historic or future breach developments at these locations. All 1-percent-annual-chance inundation breach areas were composited to develop the final visual depiction of the Structural-Based Inundation Procedure results.

5.4 Freeboard Deficient Procedure

Based on the levee crest elevation data from the NLD compared to the 1-percent-annual-chance flood profile for the Elizabeth River, the Elizabeth River Left Bank levee system is estimated to be elevated at or above the BFE; however, the levee crest elevations do not meet minimum freeboard requirements of 44 CFR§65.10. The freeboard deficient procedure can be applied assuming certified data to 44 CFR 65.10 (b)(2) through (7) are provided. The profile comparison figure included in Appendix B shows the levee crest elevations from the NLD and as-built plans, the BFE, and the estimated minimum freeboard.

5.5 Sound Reach and Overtopping Procedures

A Sound Reach is a reach that has been designed, constructed, and maintained to withstand the flood hazards posed by a 1-percent-annual-chance flood, in accordance with the standards in 44 CFR§65.10, but is part of a levee system that cannot be accredited. In the case of the Elizabeth River Left Bank levee system, current available data shows that the Sound Reach Procedure does not apply. As the levee crest is elevated above the BFE of the Elizabeth River and was not designed to be overtopped, the Overtopping Procedure also does not apply.

5.6 Review of Initial Data Analyses[2]

The Natural Valley Procedure results identify the potential flood risk if the levee system was not reducing the levee flood hazard. Figure 2 illustrates the estimated inundation area for the 1-percent-annual-chance flood for the Natural Valley Procedure within the levee-impacted area. Figure 3 shows the approximate depth grid for the Natural Valley Procedure within the levee impacted area.

[2] It should be noted that the findings of the Initial Data Analysis are non-regulatory and are intended to inform the path forward for identification of flood risk associated with the levee system for the 1-percent-annual-chance flood. The findings may be used for emergency planning purposes; however, they are subject to change and due process, and should not be used outside of this levee stakeholder group for any regulatory activities. The flood risk due to interior drainage in the levee impacted area is also not depicted and would need to be evaluated in the future prior to updating the FIRM.

Figure 2: Natural Valley Procedure

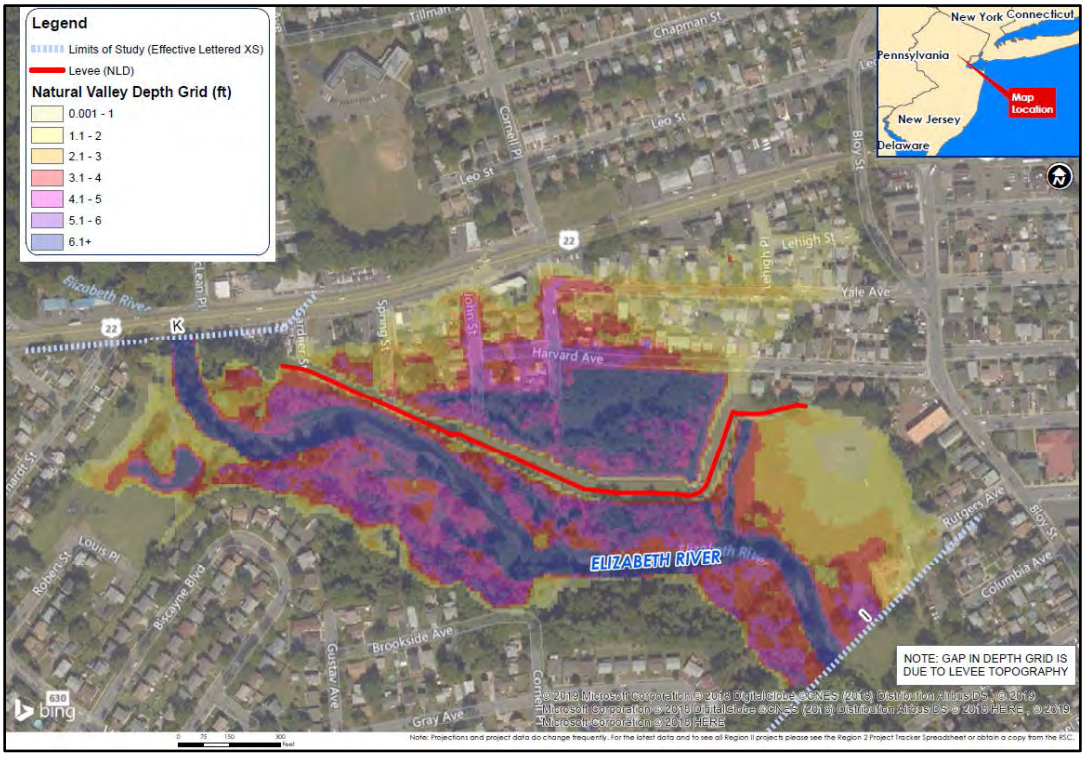

Figure 3: Natural Valley Procedure Flood Depth Grid

Figure 4 shows the resulting inundation area from the composite results of the Structural-Based Inundation Procedure, which would be mapped as Zone AE SFHA under this methodology.

Figure 4: Structural-Based Inundation Procedure

Figure 5 shows the approximate depth grid for the Structural-Based Inundation Procedure within the levee impacted area.

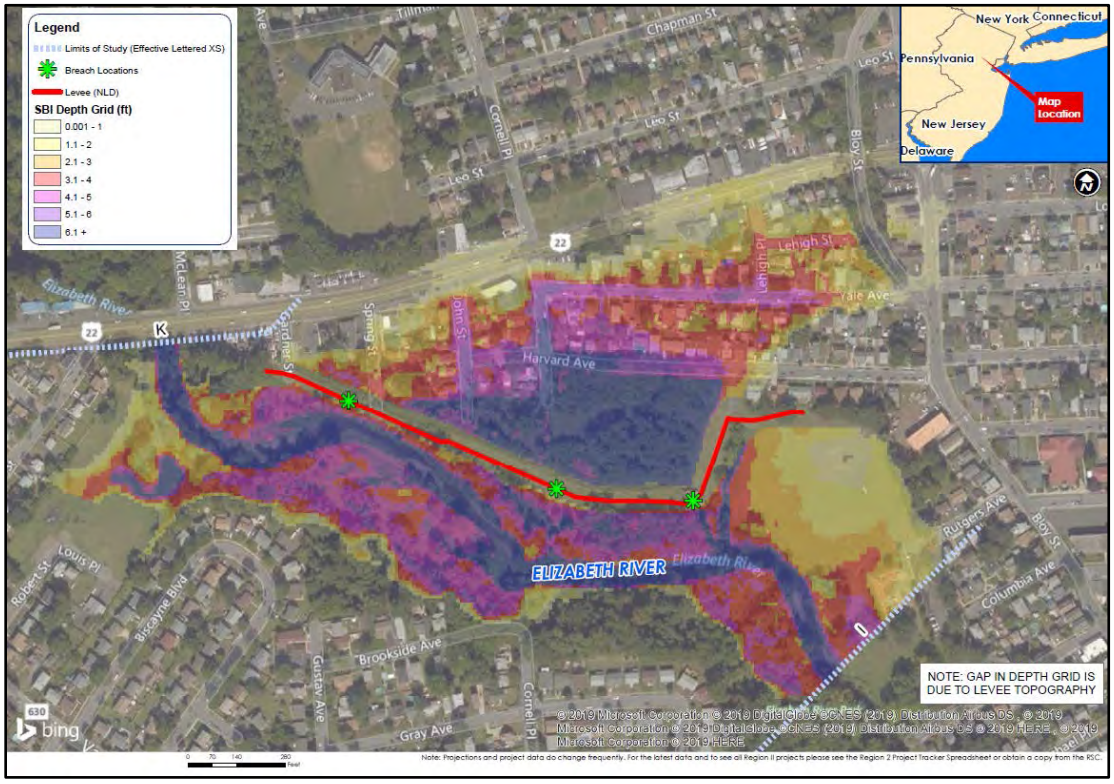

Figure 5: Structural-Based Inundation Procedure Flood Depth Grid

Figure 6 reflects the estimated flood hazard for the Freeboard Deficient Procedure. The flood hazard area would be mapped using the inundation area from the Natural Valley Procedure; however, the flood zone would be identified as Zone D plus the potential for interior drainage SFHA. The potential for interior drainage SFHA would need to be evaluated in the future prior to updating the FIRM. Certified data compliant with 44§CFR 65.10 and Freeboard Deficient procedures would be required to support future mapping by FEMA.

Figure 6: Freeboard Deficient Procedure

A summary of results from the Initial Data Analysis are provided in Table 5.

Table 5. Results from the Initial Data Analysis

Reach	Approximate Length of Levee Segment (ft)	Approximate # Structures Impacted[3]	Comments: Natural Valley Procedure[4] (Figure 2)	Comments: Structural-Based Inundation Procedure[5] (Figure 4)	Comments: Freeboard Deficient Procedures[6] (Figure 6)
Elizabeth River Left Bank	1,750	Natural Valley - Over 80 Structural Based Inundation - Over 100	Results from updated hydraulic model (1D). Estimates potential inundation/levee impacted area if levee system not mapped as reducing flood hazard.	Inundation extents greater than the Natural Valley Procedure for the 1-percent-annual chance flood. May be utilized for emergency planning.	Applicable. Insufficient freeboard available for the Elizabeth River Left Bank

[3] Approximate number of structures within levee impacted area estimated from aerial imagery.

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

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

[6] Freeboard requirement (44 CFR§65.10(b)(1)) is not met, but the levee crest elevations are above the 1-percent-annual-chance flood. Certified data compliant with 44§CFR 65.10 and Freeboard Deficient procedures required to support future analysis and mapping.

6 Path Forward

6.1 Levee Analysis and Mapping Procedures

The Elizabeth River Flood Control Project includes the Elizabeth River Left Bank Levee that is shown as reducing flood hazard on the effective and the preliminary FIRMs. As FEMA currently does not possess data in support of the 44CFR§65.10 requirements for the levee system, the levee system would be considered non-accredited in a future remapping effort.

FEMA engaged the Township of Hillside through the Levee Analysis and Mapping Procedures for non-accredited levees process to help identify potential options to evaluate the flood risk within the levee impacted area. Through this process, the levee system was identified as not meeting minimum freeboard requirements of 44 §CFR 65.10 and is considered Freeboard Deficient.

As the levee system is considered Freeboard Deficient, the community may consider moving forward to submit certified data compliant with 44§CFR 65.10 and Freeboard Deficient procedures to FEMA to map the levee flood hazard as Zone D plus the interior drainage SFHA on a future FIRM.

Should the community be able to provide certified data compliant with 44§CFR 65.10 and Freeboard Deficient procedures for the Elizabeth River Left Bank Levee, the flood risk of the levee impacted area could be mapped as Zone D plus the interior drainage SFHA. If the community provides no or incomplete data in support of 44 CFR§65.10, the preliminary FIRM dated April 18, 2016 would be revised to show updated flood risk using the Natural Valley Procedure once the FEMA Regional Office incorporates updates into future mapping studies.

FEMA anticipates updating the flood risk maps in the near future. Should 44CFR§65.10 compliant levee data be provided prior to the Letter of Final Determination for any mapping update project, it could be incorporated into the final mapping. However, data in support of 44CFR§65.10 may be submitted at any time through the Letter of Map Revision (LOMR) process to update the FIRM. It is recommended that the community coordinate with FEMA Region II in advance of any submittal to keep the Region apprised of the levee status. FEMA's Levee Accreditation Checklist has been included in Appendix C for reference.

7 References

FEMA: *Flood Insurance Study*, Union County, New Jersey (All Jurisdictions), September 20, 2006.

FEMA: *Analysis and Mapping Procedures for Non-Accredited Levee Systems*, July 2013

FEMA: *Flood Insurance Study*, Union County, New Jersey (All Jurisdictions), Preliminary April 18, 2016.

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

USACE, National Levee Database (https://levees.sec.usace.army.mil/#/), 2018.

Appendix A
Stakeholder Engagement - LLPT Meeting 1 and 2 Information

Hillside, NJ LLPT 1&2 Meeting Notes

ATTENDEES

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TOWNSHIP OF HILLSIDE, NEW JERSEY

DATE: Tuesday, January 22, 2019 **TIME:** 2:00 PM – 3:30 PM
LOCATION:
Township of Hillside Offices – 1409 Liberty Avenue Hillside, NJ

Action Item	Owner
1. Meeting attendees to continue uploading data and relevant information to the project file transfer (FTP) site and email stephanie.nurre@stantec.com upon completion. **Project FTP Site - Login Information** **Browser link:** https://projsftp.stantec.com **Login name:** HILLSIDENJ1913 **Password:** 8151242	Community Leaders
2. Community leaders to e-mail Matt Kroneberger at matt.kroneberger@ogilvy.com to raise any questions.	Community Leaders
3. All: Work to identify individual owners / easements of levee system	Community Leaders, NJDEP

AGENDA

- Present initial analysis of levee systems modelling
- Continue dialogue on levee context
- Review, add materials on FTP site

Hillside, NJ LLPT 1&2 Meeting Notes

ATTENDEES *Continued*

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OVERVIEW

Matt Kroneberger, FEMA Outreach Support, opened the meeting and facilitated introductions of speakers, Shudipto (Shu) Rahman, FEMA Project Monitor, Stephanie Nurre and Sagar Neupane, STARR II FEMA technical support, and the attendees presented at the meeting and joined over the phone. Shu then provided an overview of the FEMA focus on levee hazard identification and risk communication. Shu shared a quote from the American Society of Civil Engineers, which emphasized that levees never eliminate all flood risk.

Detailed discussions covered potential analysis scenarios and the required technical data for each analysis option. Also discussed was the participation of interested community, state, and Federal officials and stakeholders in the Local Levee Partnership Team (LLPT). This levee stakeholder group will share data and participate in discussions on the potential analysis and mapping options to identify the flood risk associated with the levee system. The LLPT will also be able to review the plan document summarizing the activities and outputs from the project.

Stephanie then provided an overview of the Elizabeth River Levee system with respect to the levee system's status on the 2016 preliminary Flood Insurance Rate Map (FIRM), which depicts the levee system as reducing flood risk. The maps are still considered preliminary due to coastal mapping appeals and ongoing due process. Joe Ruggeri, from the New Jersey Department of Environmental Protection noted that the primary revision to the subject area from the effective 2006 FIRM to the 2016 preliminary FIRM is the update to the vertical datum.

Encer Shaffer, with U.S. Army Corps of Engineers (USACE) participated in the meeting over the phone. He noted that the levee system, which was completed in 2002, was inspected by USACE as part of a nationwide effort in 2010. Mr. Shaffer also pointed out the existence of a seepage berm on the eastern edge of the system near the pump station outlet.

Stephanie then discussed the levee system's current accreditation status. The levee system is considered non-accredited because FEMA does not have certified engineering data 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) to be recognized on the FIRM as reducing flood hazards posed by a 1-percent-annual-chance flood.

Hillside, NJ LLPT 1&2 Meeting Notes

ATTENDEES *Continued*

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Shu noted that, based on available USACE data and inspection reports, the levee system has exhibited more settlement than anticipated since it was constructed. According to USACE, the levee system has settled of up to 2 feet. Stephanie noted that the levee crest does not have a minimum of 3 feet of freeboard, and could potentially be identified as freeboard deficient. Freeboard is the vertical distance between the levee crest (top of the levee) and the water level that can be experienced during the 1-percent-annual-chance flood.

Stephanie then expanded on the Analysis and Mapping Procedures for Non-Accredited Levee Systems, which involves interactive stakeholder engagement and provides a suite of analysis and mapping procedures to utilize for identifying flood hazards associated with non-accredited levee systems. She also noted that the team would be sharing draft results of the initial data analysis for the Elizabeth River Levee system with the group.

Under the Analysis and Mapping Procedures for Non-Accredited Levee Systems, a levee system can also be evaluated as separate reaches, if necessary, each analyzed based on its unique characteristics, to develop a composite risk for the levee system. For the Elizabeth River Levee system, the system would be considered as a single reach as analyzing it as separate reaches did not appear to be beneficial.

Stephanie reviewed each levee reach analysis procedure listed below as they may pertain to the Elizabeth River Levee system. Based on available data, the Overtopping and Sound Reach Procedures would not be applicable:

- Natural Valley
- Structural-Based Inundation
- Freeboard Deficient
- Overtopping
- Sound Reach

Sagar and Stephanie then shared the results of the initial analysis for the Natural Valley, Structural-Based Inundation, and Freeboard Deficient mapping procedures for the levee system.

Hillside, NJ LLPT 1&2 Meeting Notes

Sagar and Stephanie shared mapping results for the Natural Valley Procedure which identifies the landside flood hazard as though the levee does not impact flood elevation and does not reduce flood risk. As modeled, the inundation area from Natural Valley Procedure would be similar to, but slightly smaller than, the shaded Zone X flood hazard area depicted on the effective FIRM.

For the Structural-Based Inundation Procedure, three hypothetical breach locations were chosen along the levee system based on FEMA's guidance for the procedure. It should be noted that this procedure is not intended to predict potential breach locations along the levee system, as the system could breach at any location or at multiple points along the levee system(s). The composite inundation area resulting from the Structural-Based Inundation Procedure is larger than the results of the Natural Valley analysis, and a higher number of structures could be inundated by the 1-percent-annual-chance flood using this procedure. This information can be used for emergency planning; however, the results of the Natural Valley Procedure could be used in the future for mapping purposes.

Sagar outlined the modelling for the Freeboard Deficient Procedure, which is similar to the Natural Valley model. Under this procedure, the inundation area is shown as Zone D, except any areas which would be impacted by interior flooding. The Zone D area does not require mandatory purchase of flood insurance for federally backed mortgages, or any mandated floodplain management requirements, although FEMA highly encourages both in these areas. Flood insurance could also be required by mortgage lenders.

Stephanie then discussed that future mapping of the levee flood hazard is data dependent. Should no or incomplete data be provided for the levee system with respect to 44CFR 65.10 requirements, the levee system would be considered non-accredited and mapped using the results of the Natural Valley Procedure. Should certified data for the levee system be received by FEMA and deemed complete with respect to 44CFR65.10, except freeboard is not met (but the levee crest is above the 1-percent-annual-chance flood elevation), the levee flood hazard could be depicted as Zone D. It should be noted that, should certified data meeting all minimum requirements of 44CFR65.10 become available in the future, the data can be submitted to FEMA in support of accreditation at any time.

Hillside, NJ LLPT 1&2 Meeting Notes

Shu then discussed next steps in the levee analysis and mapping process for non-accredited levee systems.
FEMA will prepare a Levee Analysis and Mapping plan that will include:

- Summaries of data collected and LLPT discussion
- Further results from the initial data analysis
- Path forward to map flood hazard in the levee impacted area

Community members actively discussed cost considerations for the various reach analysis procedures outlined and the levee history. Those questions and answers are summarized in the discussion below.

Matt, Shu, and Stephanie encouraged all in the discussion to reach out to share questions or comments at any point in this process, and contact information was distributed.

DISCUSSION

QUESTION:
Union County Engineer – Tom Mineo:
Are there construction or as-built plans for the levee? Are there the original documents?

Response:
FEMA – Shu Rahman:
As part of the LLPT process, we seek to gather all of this information

U.S. Army Corps of Engineers – Encer Shaffer:
The Corps has most of the data that you're looking for, including the maintenance agreement and the as-built plans.
These were provided to the Department of Public Works Director for Township of Hillside, then Scott Anderson, in 2010-2011. The original project coordination document was signed by Barbara Rowen in May 1999.

Discussion continues on next page

Hillside, NJ LLPT 1&2 Meeting Notes

QUESTION:
Union County Engineer – Tom Mineo:
The levee has settled. What are the next steps to address this? Is it still reducing flood risk?

Response:
U.S. Army Corps of Engineers – Encer Shaffer:
Settling doesn't necessarily mean people will be greatly impacted.
This is a sound levee system and can withstand water pressure.
However, it hasn't been maintained well.

STARR II – Stephanie Nurre:
To address to what extent flood risk is being reduced, analysis needs to be completed to certify different levels of flood risk. There are options to both accredit the levee and continue without accreditation. Though the LLPT process can be used to advance the dialogue on certification, a levee can be certified at any time.

QUESTION:
Union County Engineer – Tom Mineo:
Is all of the analysis presented already done?

Response:
FEMA – Shudipto Rahman:
Analysis is ongoing as part of the LLPT process. The next step in the process is for FEMA to present a Levee Analysis and Mapping Procedure (LAMP) plan with finalized analysis based on what was presented at this meeting.
This will help give that information toward next steps for accreditation or for present and future hazard mitigation planning.

QUESTION:
Union County Engineer – Tom Mineo:
For dams, there are classifications. What about levees?

Response:
FEMA – Shu Rahman:
Levee systems and dams have different regulations. For the most part, the level of regulation is higher for dams.

Hillside, NJ LLPT 1&2 Meeting Notes

QUESTION:
Union County Engineer - Tom Mineo:
Would the area indicated in red (*Slide 24 | referring to the extent of the modelled Natural Valley flooding in a 1%-Annual Chance flood event)* be where the flooding would occur if there were no levee?

Response:
STARR II - Stephanie Nurre:
With current elevation data, this is the area that could be flooded during a 1-percent-annual-chance flood without the levee reducing flood risk

QUESTION:
Union County Engineer - Tom Mineo; Union County Planning - Kamal Saleh:
What would be the new flood zone under these scenarios?

Response:
STARR II – Stephanie Nurre, FEMA – Shu Rahman:
If all analysis is collected, the mapping could indicate one of three zones.
Zone D would apply if the Freeboard Deficient Procedure is applied.
Zone AE would apply [f the Natural Valley Procedure is applied.
Zone X would apply if the levee system can be accredited

QUESTION:
Union County Office of Emergency Management – Salena Lesniak:
Can I use this analysis and get disaster mitigation grants? What will this information produce?

Response:
STARR II – Stephanie Nurre, FEMA – Shu Rahman:
The information resulting from this project can be leveraged for updating your hazard mitigation plan and for sourcing state funding to address work that the community may seek.

Hillside, NJ LLPT 1&2 Meeting Notes

DEFINITIONS

(Source: *Guidance for Flood Risk Analysis and Mapping, Levees, February 2018*)

Accredited Levee System - A levee system that FEMA has shown on a FIRM that is recognized as reducing the flood hazards posed by a 1-percent-annual-chance flood. This determination is based on the submittal of data and documentation as required by 44 CFR 65.10 of the NFIP regulations. The area landward of an accredited levee system is shown as Zone X (shaded) on the FIRM except for areas of residual flooding, such as ponding areas, which are shown as Special Flood Hazard Area (SFHA).

Certification - As stated in 44 CFR 65.2(b), certification of analyses is a statement that the analyses have been performed correctly and in accordance with sound engineering practices. Certification of structural works is a statement that works are designed in accordance with sound engineering practices to provide risk reduction from the base flood. Certification of "as built" conditions is a statement that the structure(s) has been built according to the plans being certified is in place and is fully functioning. Certification documentation is the responsibility of the local project sponsor.

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.

Township of Hillside, Union County, NJ
Levee Flood Hazard Identification

Local Levee Partnership Team (LLPT) Meetings 1 and 2

January 22, 2018

FEMA

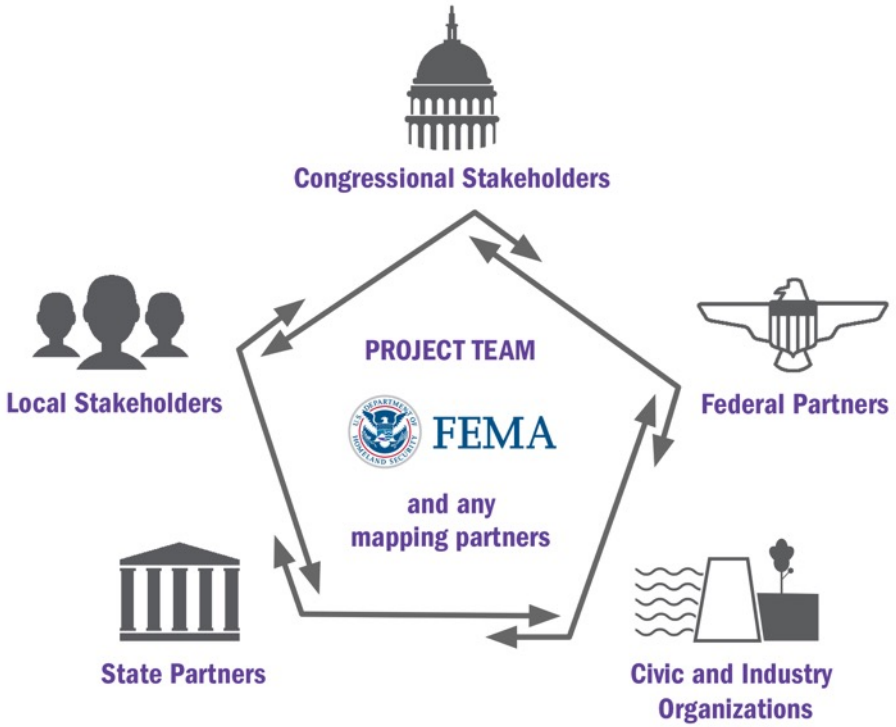
Photo credit NOAA/NASA

“ Levees reduce the risk of flooding. But no levee system can eliminate all flood risk. There is always the chance that a flood will exceed the capacity of a levee, no matter how well it was built. Levees do not always perform as intended. In fact, levees sometimes fail even when a flood is small.”

— American Society of Civil Engineers

The Focus is on Flood Risk

The Federal Emergency Management Agency (FEMA) works with Federal and State partners, local communities and other stakeholders to assess and communicate flood risks in areas impacted by non-accredited levees.



FEMA

Today's Agenda

1	2	3	4
Levee System Overview	Levee Flood Hazard Identification	Results of Initial Data Analysis	Path Forward & Next Steps

FEMA

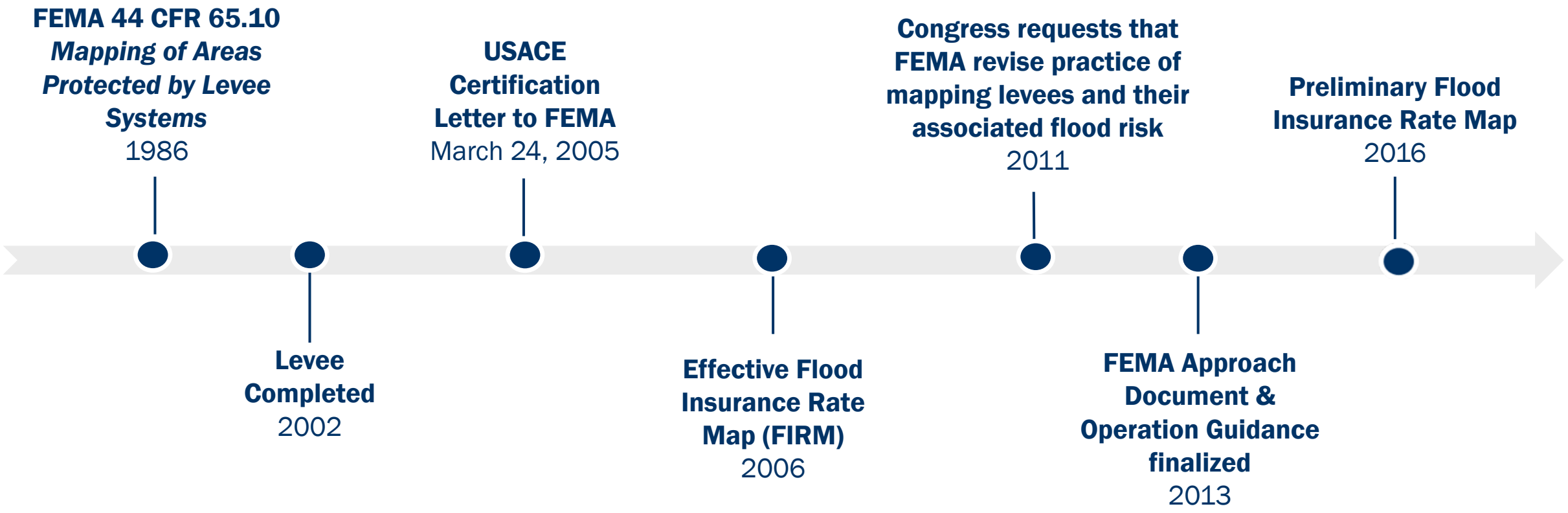
Levee System Overview

FEMA

Hillside, Elizabeth River Left Bank Levee System

FEMA

Hillside, Elizabeth River Left Bank Levee System



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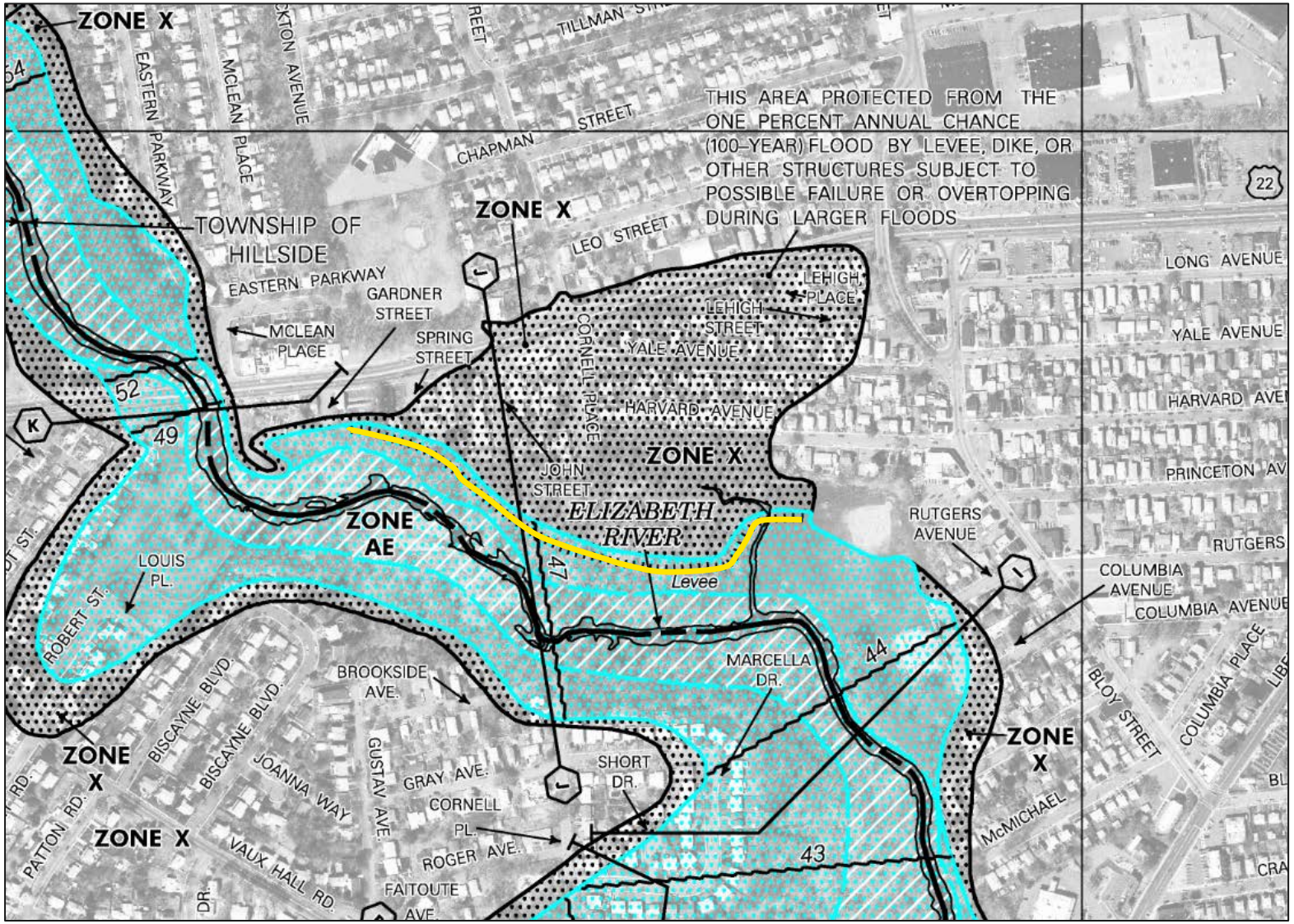
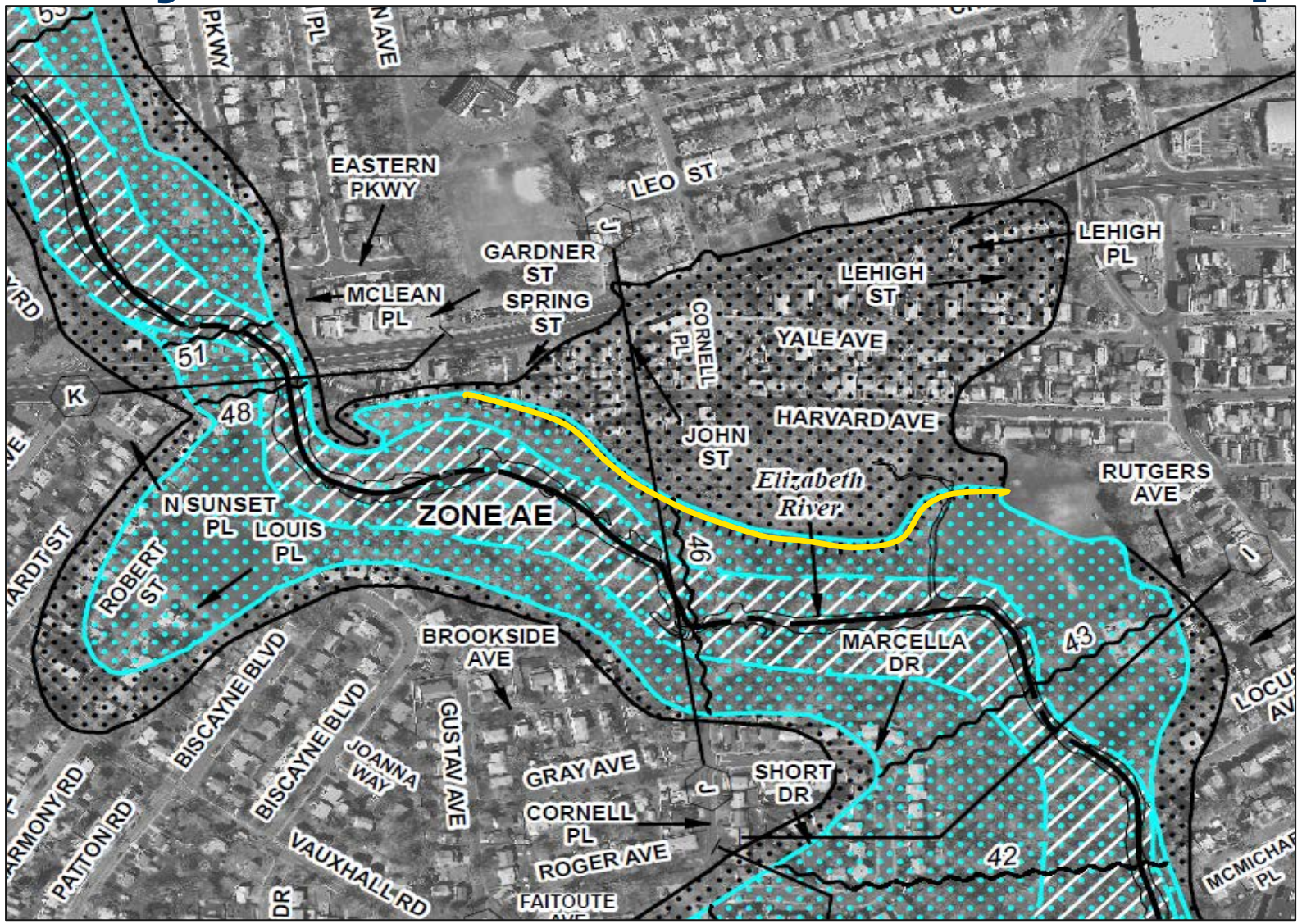
Effective Flood Insurance Rate Map



FEMA

Panel 34039C0013F, September 20, 2006

Preliminary Flood Insurance Rate Map



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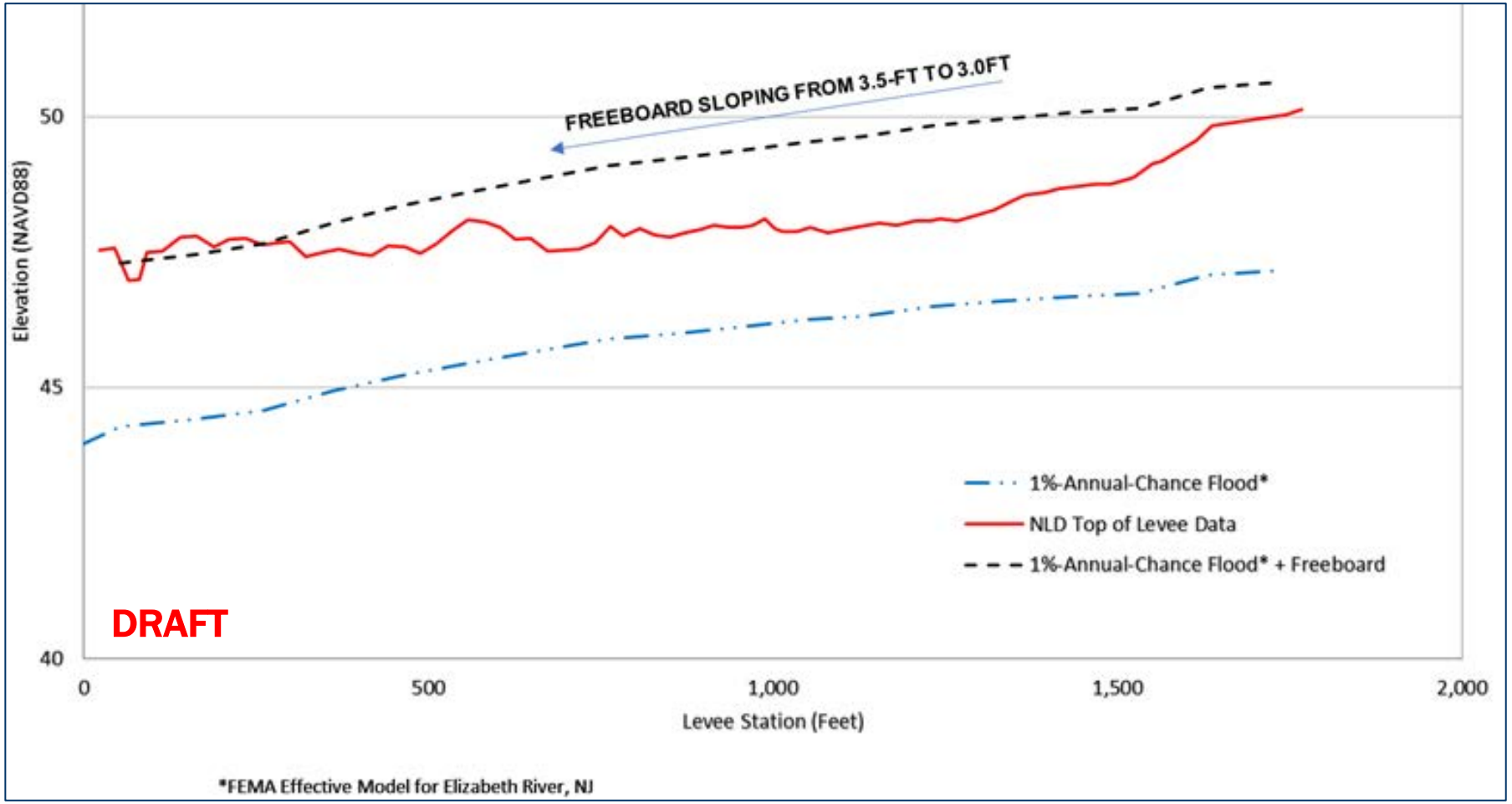
Panel 34039C0013G, April 18, 2016

Hillside, Elizabeth River Left Bank Levee

- Affected Community: Town of Hillside
- Levee System Information:
  - 1,750 foot earthen levee
  - Pump chamber
  - 1,050 foot seepage berm along most of levee
  - Paved drainage swale along inside toe
  - Settlement since construction in excess of anticipated settlement
- Initial Data Collection

FEMA

Levee Crest Profile vs. 1%-Annual-Chance Flood



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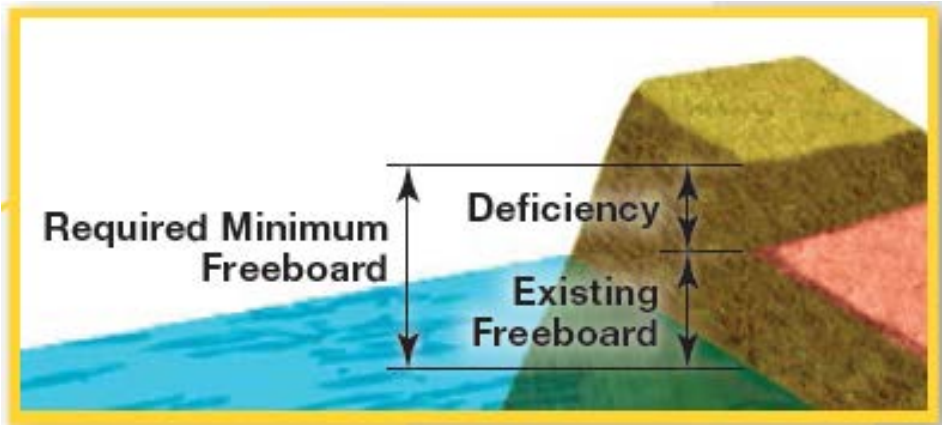
What is Freeboard?

- For levees and purposes of the NFIP, **freeboard is the vertical distance between the levee crest and the water level** that can be expected during the 1-percent-annual-chance flood.

- Freeboard tends to **compensate for the many uncertain factors** that could contribute to flood heights greater than the 1-percent-annual-chance flood (for NFIP) and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed.



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Levee Flood Hazard Identification

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How Levee Systems Are Categorized

Accredited Levee System:

1. Certified Levee documentation* has been provided that demonstrates all requirements of 44 CFR 65.10 have been met.
2. Levee impacted area shown on FIRM(s) as reducing risk from the one-percent-annual-chance flood.

Non-Accredited Levee System:

1. Certified Levee documentation* that demonstrates all requirements of 44 CFR 65.10 have been met has not been provided.
2. Levee impacted areas shown on FIRM(s) as not reducing risk from the one-percent-annual-chance flood.

*Certified levee documentation: As-built plans and additional data must be submitted to support that a given levee system complies with the structural requirements. This data must be certified by a registered professional engineer or a Federal agency with responsibility for levee design.

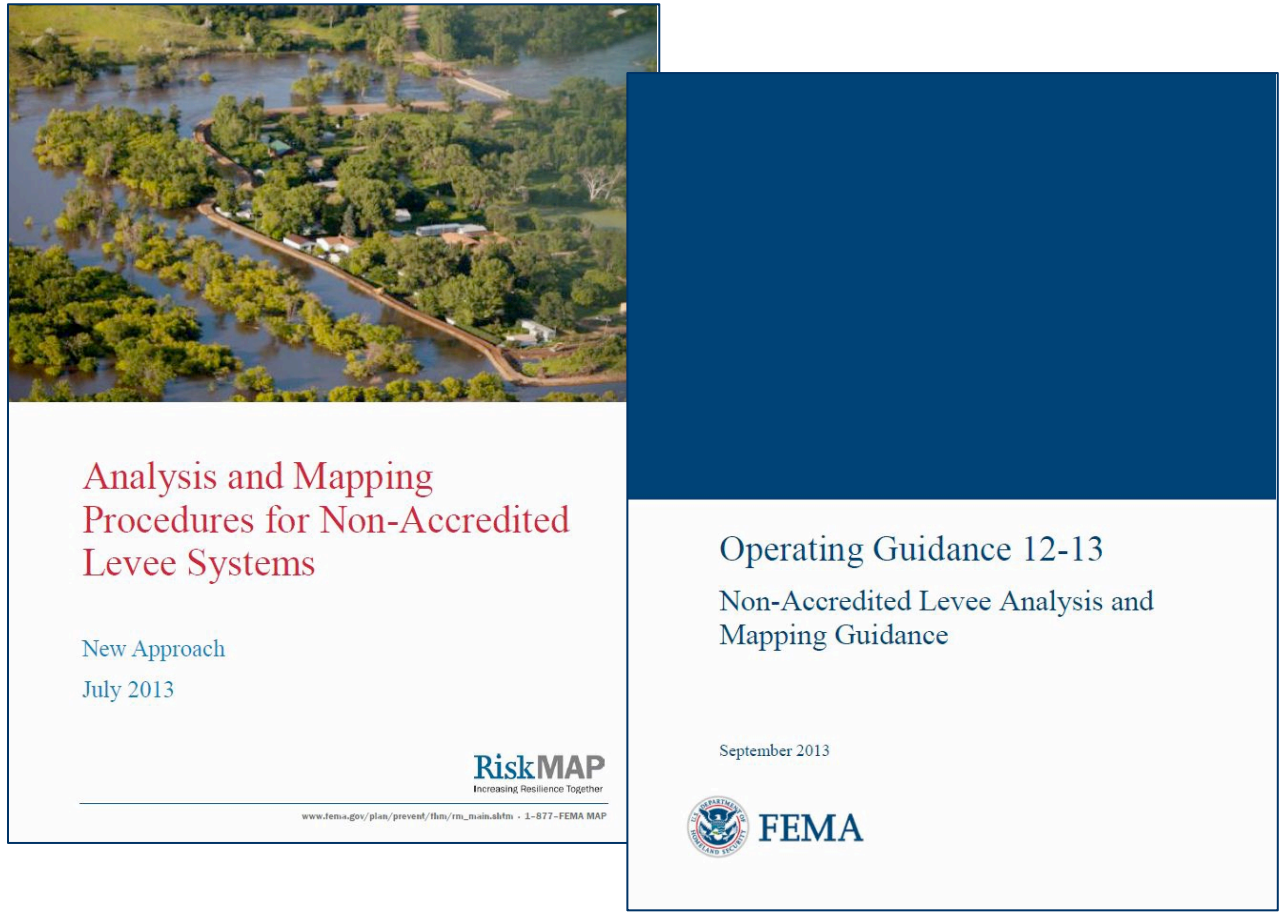
FEMA

FEMA Recognizes Non-accredited Levee Systems Do Impact Flood Risk

Developed Analysis and Mapping Procedures for Non-Accredited Levees

Approach Document
Finalized **July 2013**

Operation Guidance
Finalized **Sept. 2013**



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Analysis and Mapping Procedures for Non-Accredited Levees

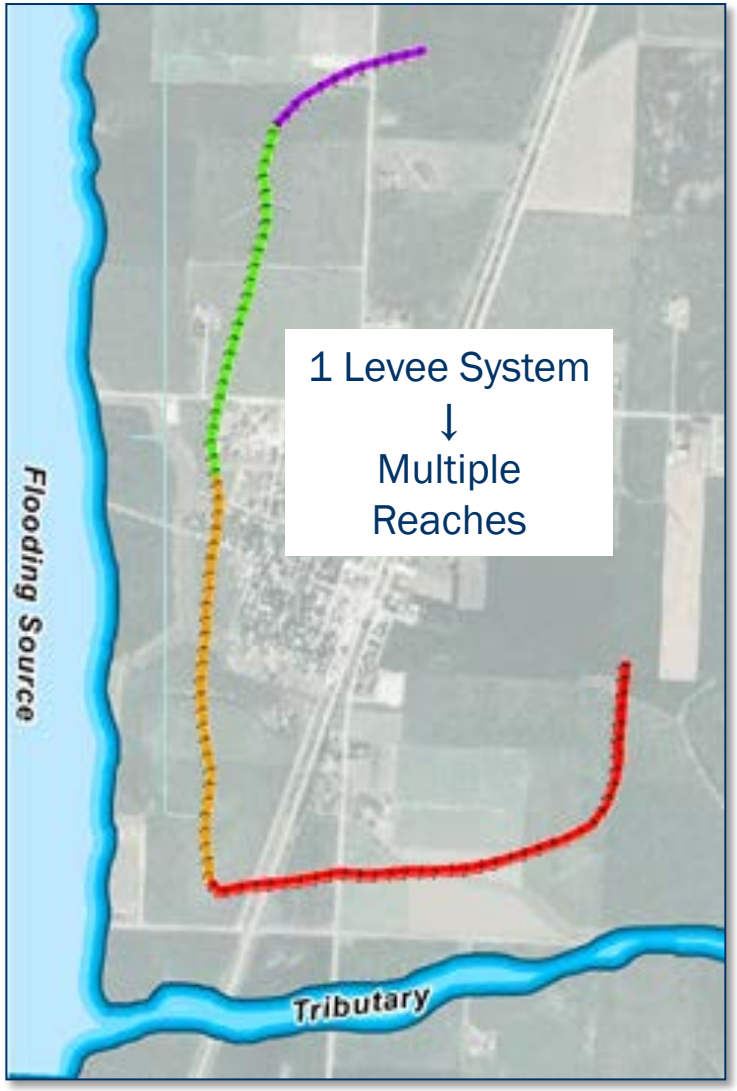
Includes:

- Interactive stakeholder engagement
- A suite of analysis and mapping procedures to review the flood hazard associated with levee systems.
- Allows for levee system to be analyzed based on the attributes of specific "**Reaches**" to develop flood hazard.

FEMA

What is a Levee Reach?

- A levee reach is a segment of a levee system, generally with similar characteristics, where a single technical procedure may be applied.
- Used to identify SFHA within the levee impacted area.



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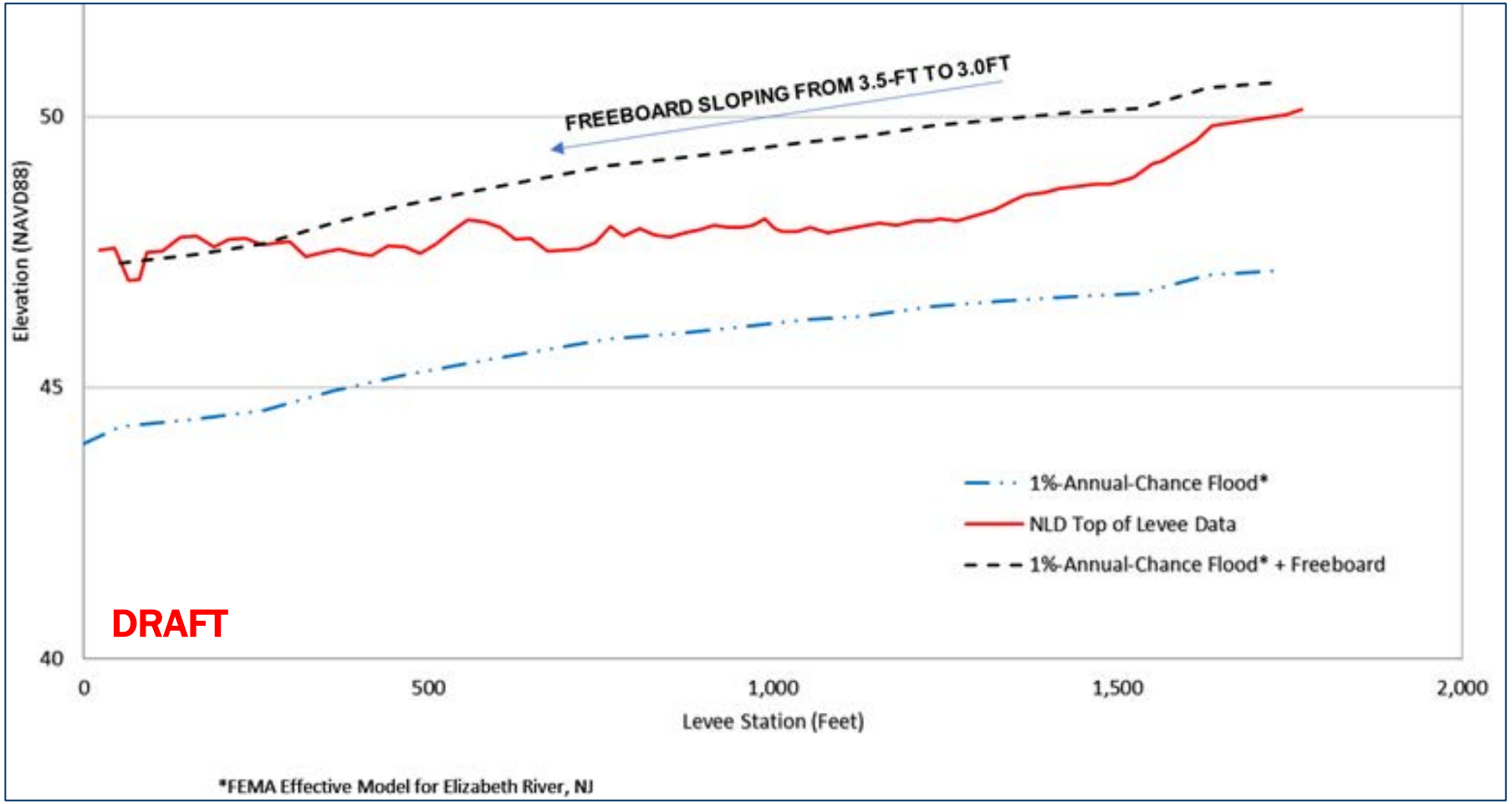
Levee Crest Profile vs. 1%-Annual-Chance Flood



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Reach Analysis Procedures

- Natural Valley Procedure →
  - Applicable to all levee systems
  - Identifies levee impacted area
- Structural Based Inundation Procedure →
  - Hypothetical breach analysis
- Overtopping Procedure →
  - Not applicable. Levee crest not overtopped.
- Freeboard Deficient Procedure →
  - Applicable. Levee crest above 1-percent-annual-chance wsel
- Sound Reach Procedure →
  - Not applicable. System considered one reach that does not meet minimum freeboard.

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Results of Initial Data Analysis

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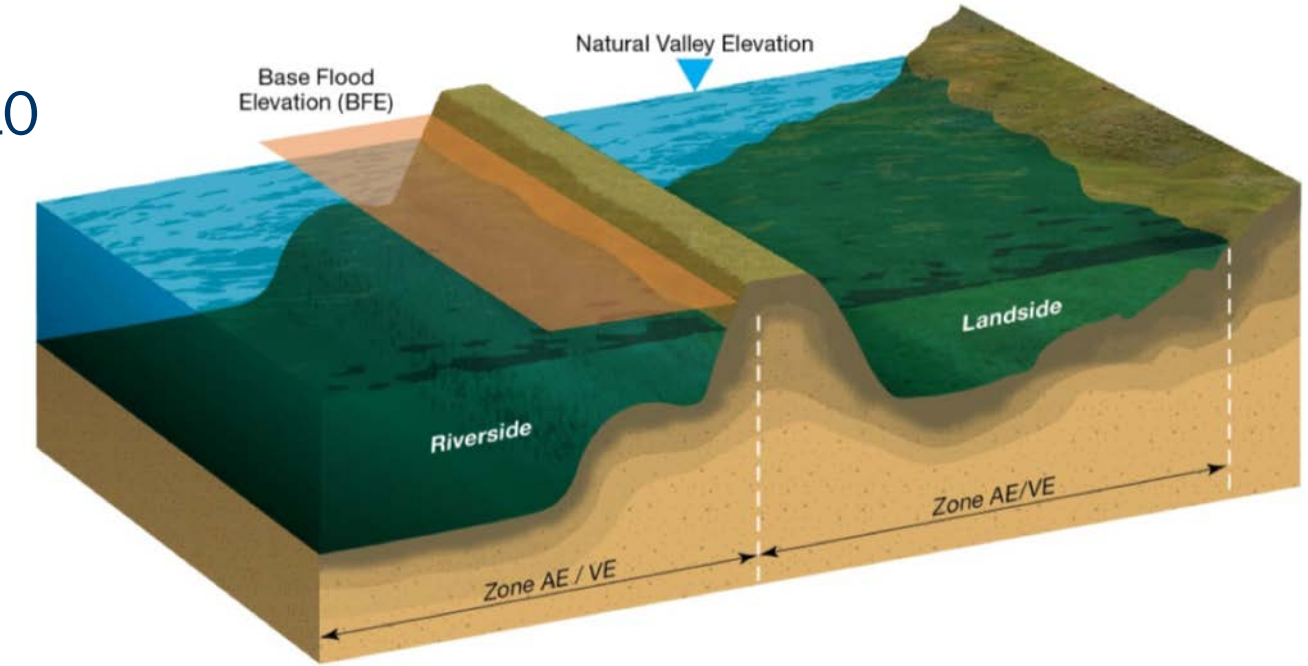
Natural Valley Procedure

This analysis identifies the landside flood risk as though the levee does not impact the flood elevation.

Applications:

- Levee does not meet 44CFR65.10
  - → Zone AE SFHA
  - → Zone D if used in coordination with another reach analysis procedure



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Natural Valley Procedure

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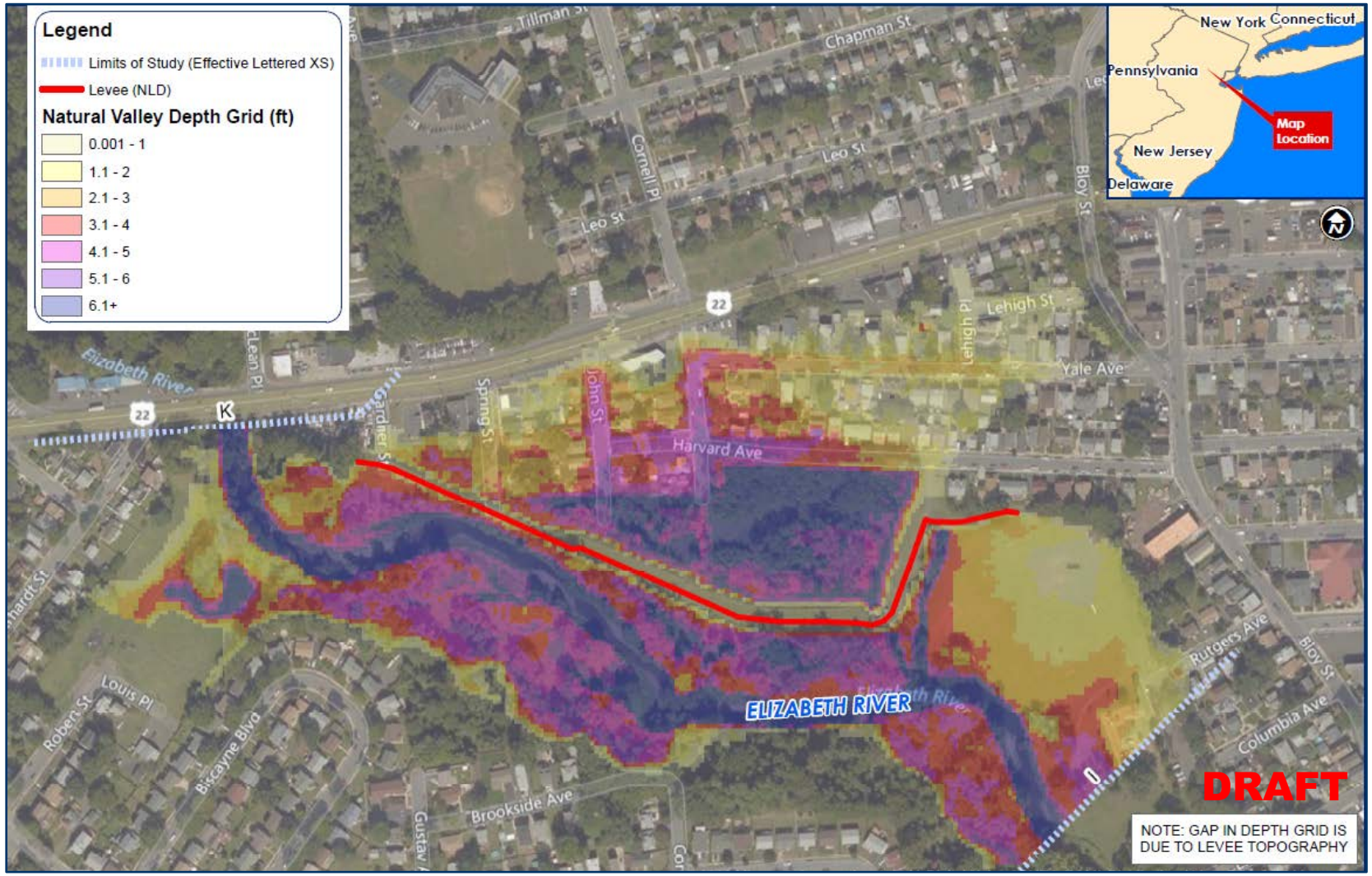
Natural Valley Procedure – Depth Grid



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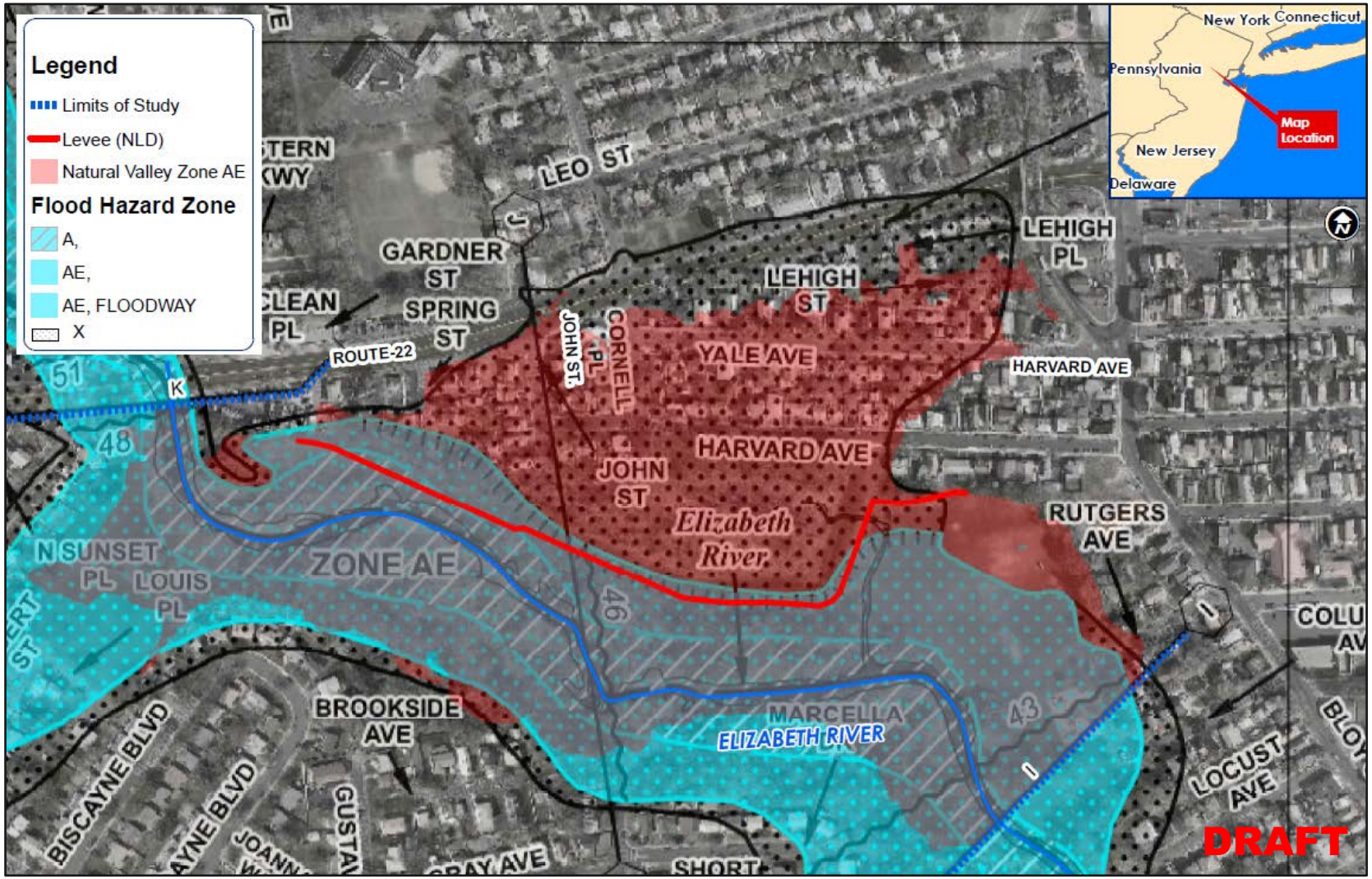
Natural Valley Procedure Compared to FIRM



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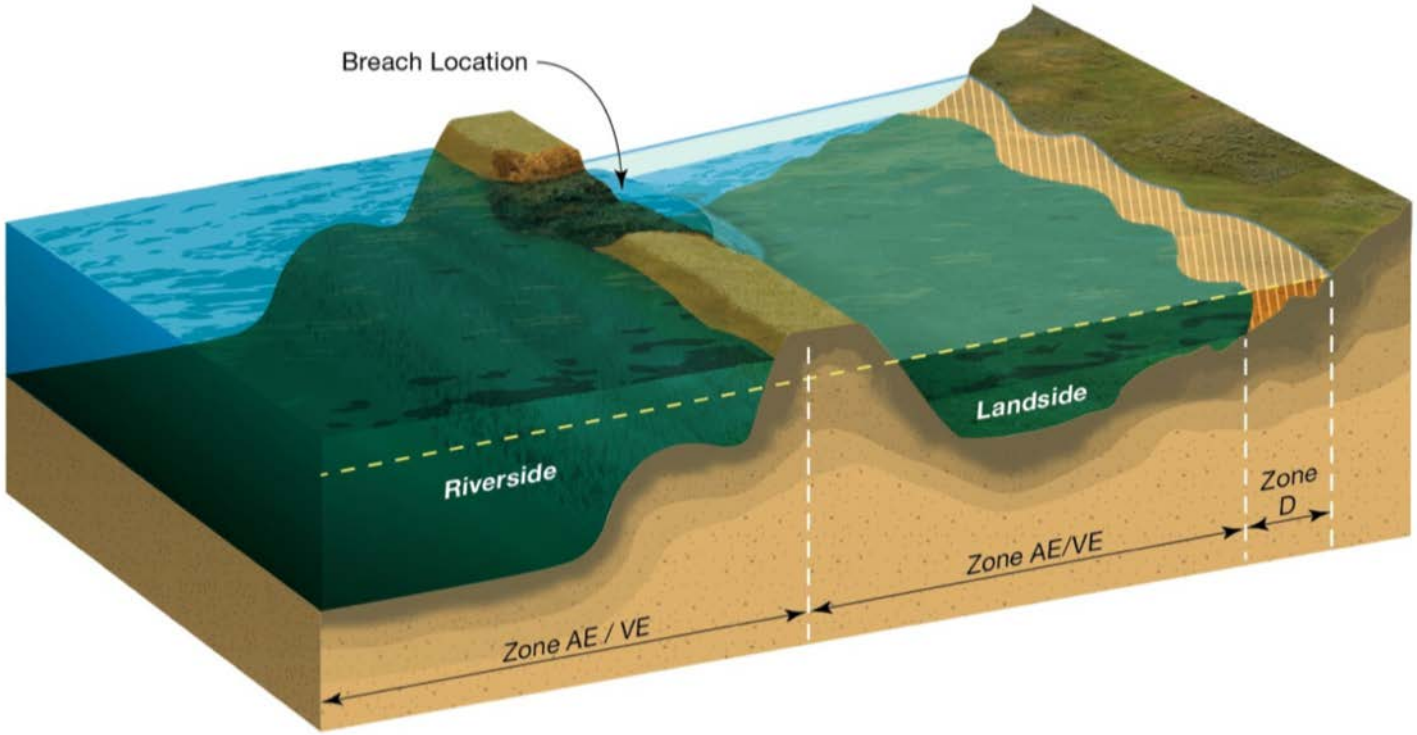
Structural-Based Inundation Procedure

This analysis identifies the landside flood risk by estimate of hypothetical breach analyses.

Applications:

- Levee does not meet 44CFR65.10
  → Zone AE SFHA

- Emergency management applications



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Structural-Based Inundation (SBI) Procedure

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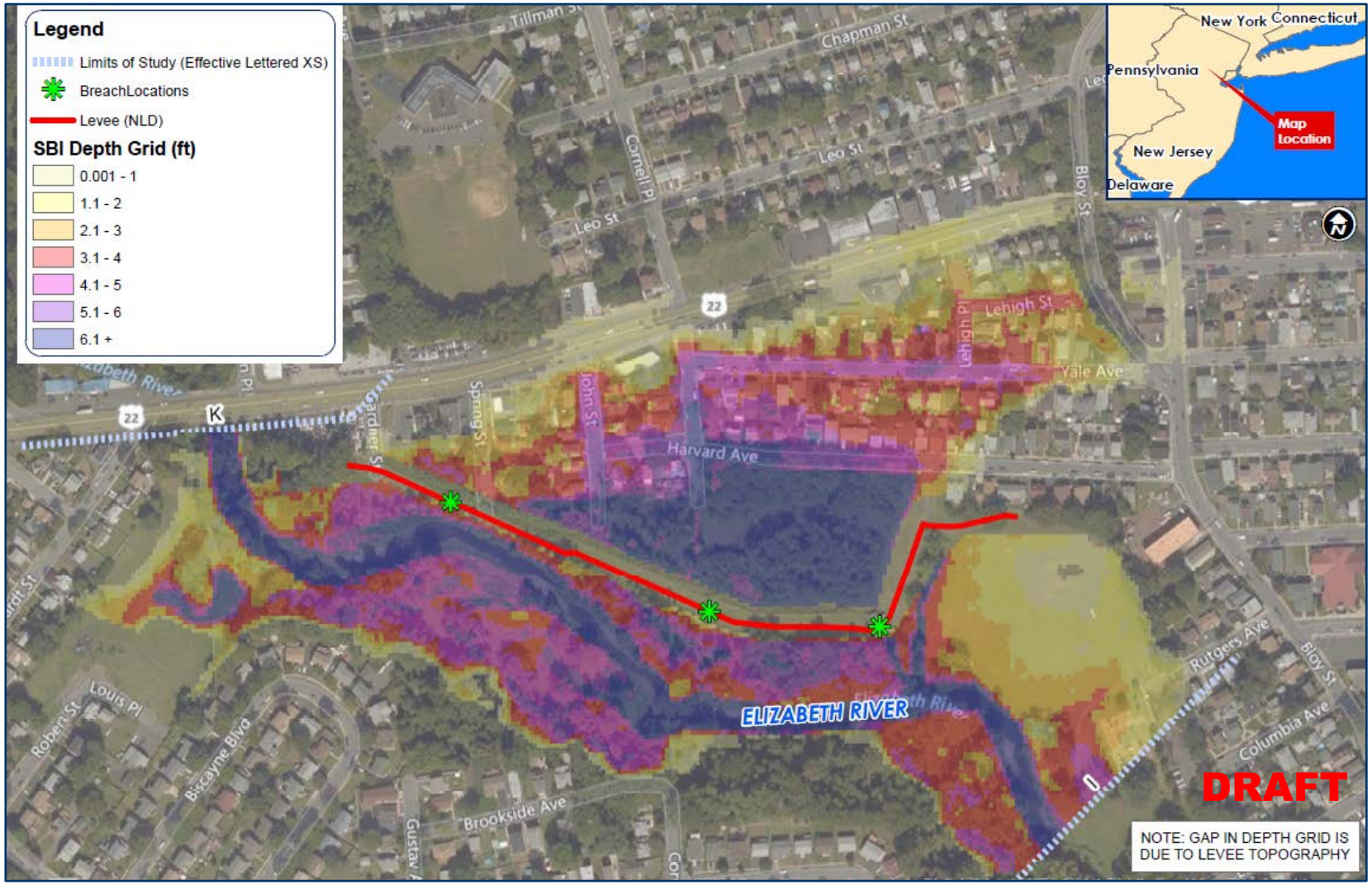
SBI Procedure Depth Grid



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SBI Compared to Natural Valley Procedure

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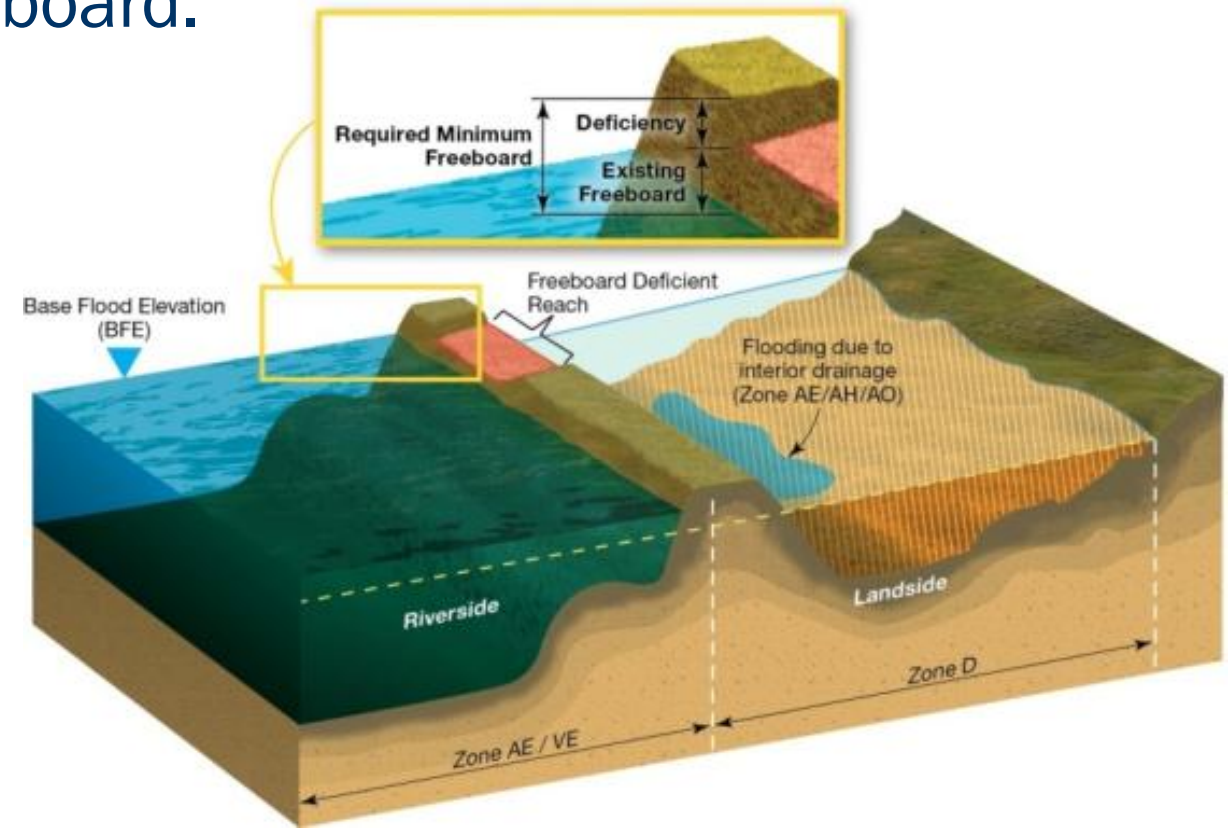
Freeboard Deficient Procedure

This analysis identifies the landside flood risk if levee crest is elevated above the 1-percent-annual chance (100-year) water surface elevation but does not meet minimum freeboard.

Applications:

- Levee meets 44CFR65.10 except for freeboard
- Levee crest above 1% annual chance wsel
  → Zone D
  → Areas of Zone AE ponding areas may remain



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Freeboard Deficient Procedure

FEMA

Zone D

- Defined as “undetermined, but possible, flood hazards”
- No federal mandatory purchase requirement
- Insurance rates are similar to approximate Zone A
- Minimal NFIP-required floodplain management, but possible to use for floodplain management purposes

Mapping Path Forward Based on Data

	Reach Procedures				
	Sound **	Freeboard Deficient **	Overtopping **	Structural-Based Inundation *	Natural Valley *
Elevation Information for the Levee Crest and Toe	✓	✓	✓	✓	
BFE + Freeboard Less than Levee Crest	✓				
BFE Less than Levee Crest	✓	✓			
Operations and Maintenance Plan	✓	✓	✓	Recommended	
Structural Design Requirements	✓	✓	✓		
Inspection Reports	✓	✓	✓	Recommended	
Evaluation of Overtopping Erosion Potential			✓		

* - No cost to community

** - Potential additional cost to community

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Path Forward & Next Steps

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Township of Hillside
Local Levee Partnership Team (LLPT)

Group of stakeholders participating in the discussion of levee flood risk and providing feedback and local levee data to FEMA relating to the levee system.

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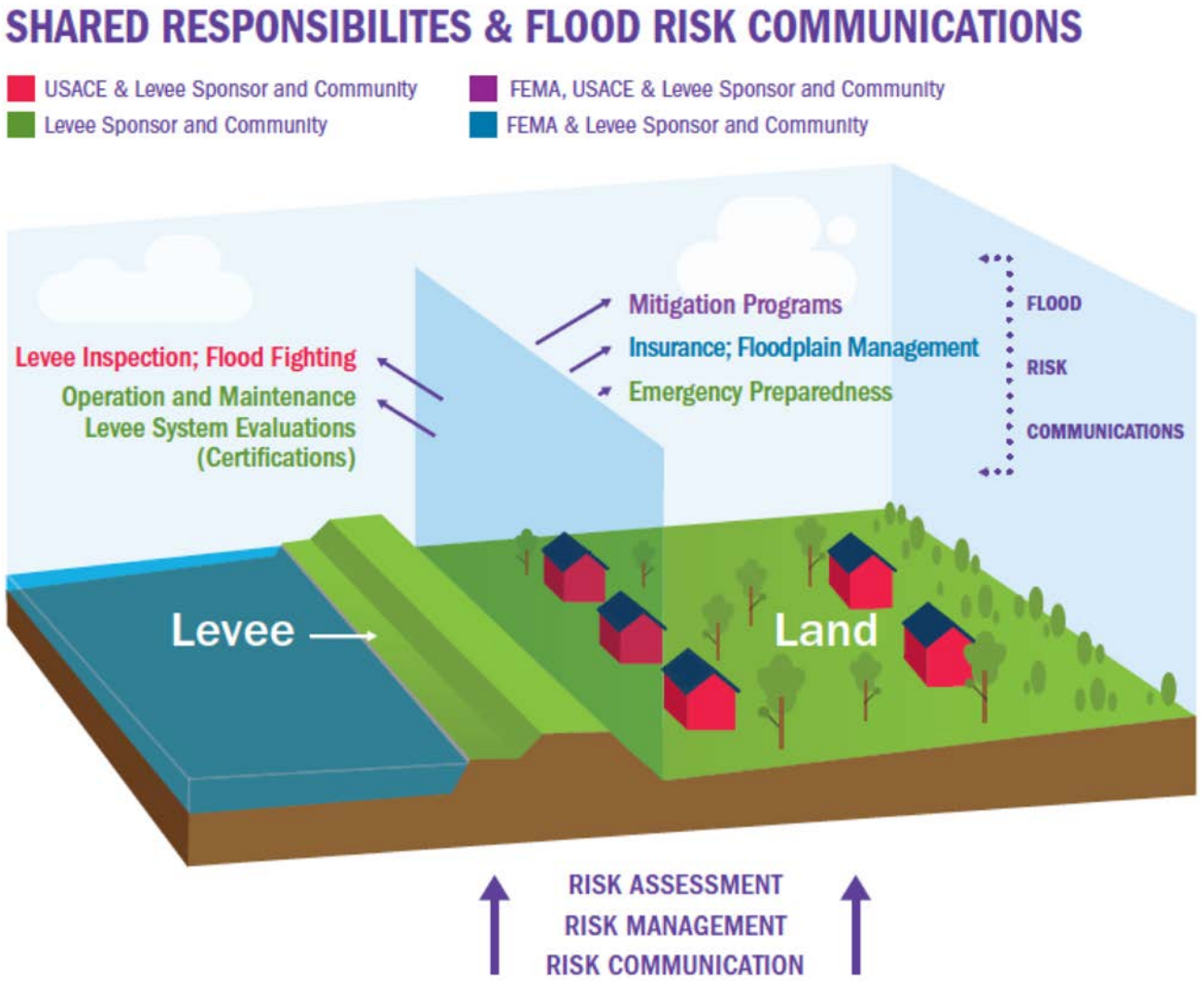
Shared Levee Responsibilities



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Levee Analysis and Mapping Procedure

1 LLPT 1: STAKEHOLDER COORDINATION AND DATA COLLECTION MEETING

Identify Local Levee Partnership Team (LLPT) members with FEMA and begin data collection

2 INITIAL LEVEE DATA ANALYSIS

FEMA performs the initial levee data analysis based on collected information from the LLPT

The reach analysis procedures that will be reviewed include the following:

- Natural Valley
- Freeboard Deficient
- Overtopping
- Structural-Based Inundation
- Sound Reach

3 LLPT 2: MEETING TO REVIEW INITIAL DATA ANALYSIS

Technical review of initial levee data analysis results with LLPT members

4 LLPT 3: REVIEW LEVEE ANALYSIS AND MAPPING PLAN

Discuss the draft levee analysis and mapping plan and ways to convey risk and mitigation information to citizens

FEMA

Levee System Data & Documentation Needed

Identify other community information, resources, developments in the community, and current mitigation projects currently underway

- Elevation Information for the Levee System (Toe & Crest)
- Design Base Flood Elevation (BFE)
- Structural Design Information
- Geotechnical Evaluation
- Interior Drainage Analysis
- Operation and Maintenance Plans
- As-built Plans
- Levee Inspection Reports

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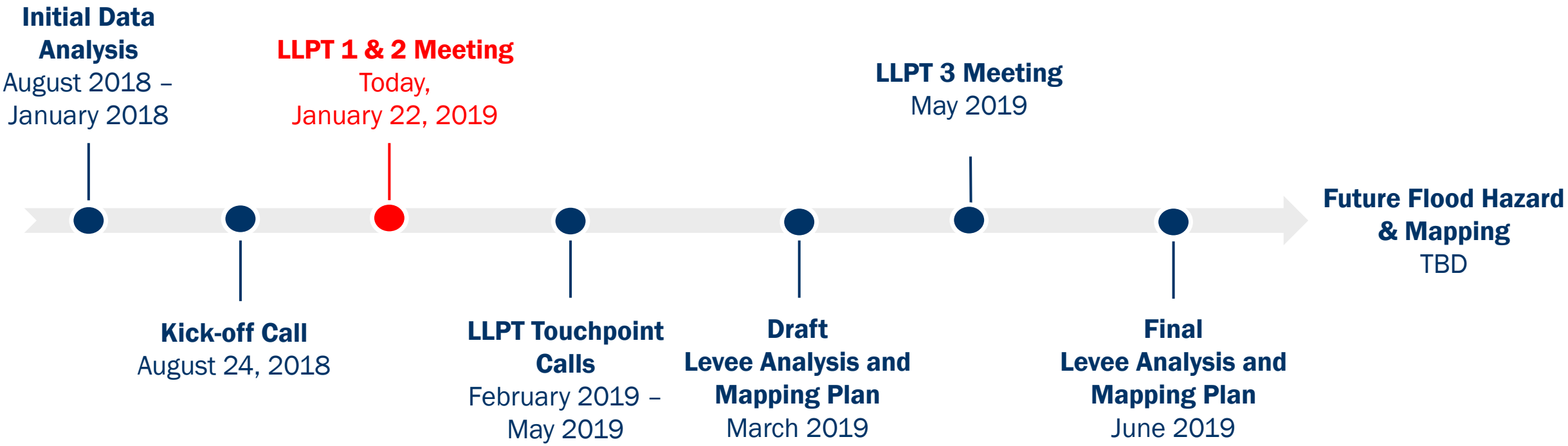
Township of Hillside LLPT Timeline



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QUESTIONS?

Contact:
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shudipto.rahman@fema.dhs.gov

Stephanie Nurre, Senior Mitigation Planner - STARR II
Phone: 312-474-1158
E-mail:
stephanie.nurre@stantec.com

FEMA

Contacts

	Title	Employee	Phone Number
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		Alan Springett, Alternative Project Monitor alan.springett@fema.dhs.gov	(212) 680-8557
Production and Tech. Services	Project Engineers, Floodplain Analysis and Mapping – STARR II	Stephanie Nurre, STARR II stephanie.nurre@stantec.com	(312) 262-2284
		Curtis Smith, STARR II curtis.smith@stantec.com	(646) 842-8239
Outreach	Community Engagement and Risk Communication (CERC) – Resilience Action Partners	Matt Kroneberger matt.kroneberger@ogilvy.com	(212) 237-6373

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Thank You

Challenges, Innovation, The way forward

Appendix

44 CFR§65.10:
"Mapping of areas protected by levee systems"

- 65.10(a) – General Requirements
- 65.10(b) – Design Requirements
- 65.10(c) – Operations Plans
- 65.10(d) – Maintenance Plans
- 65.10(e) – Certification Requirements

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65.10(b) Design Requirements

- 65.10(b)(1) – Freeboard
- 65.10(b)(2) – Closures
- 65.10(b)(3) – Embankment Protection
- 65.10(b)(4) – Embankment and foundation stability
- 65.10(b)(5) – Settlement Analysis
- 65.10(b)(6) – Interior Drainage
- 65.10(b)(7) – Other Design Criteria

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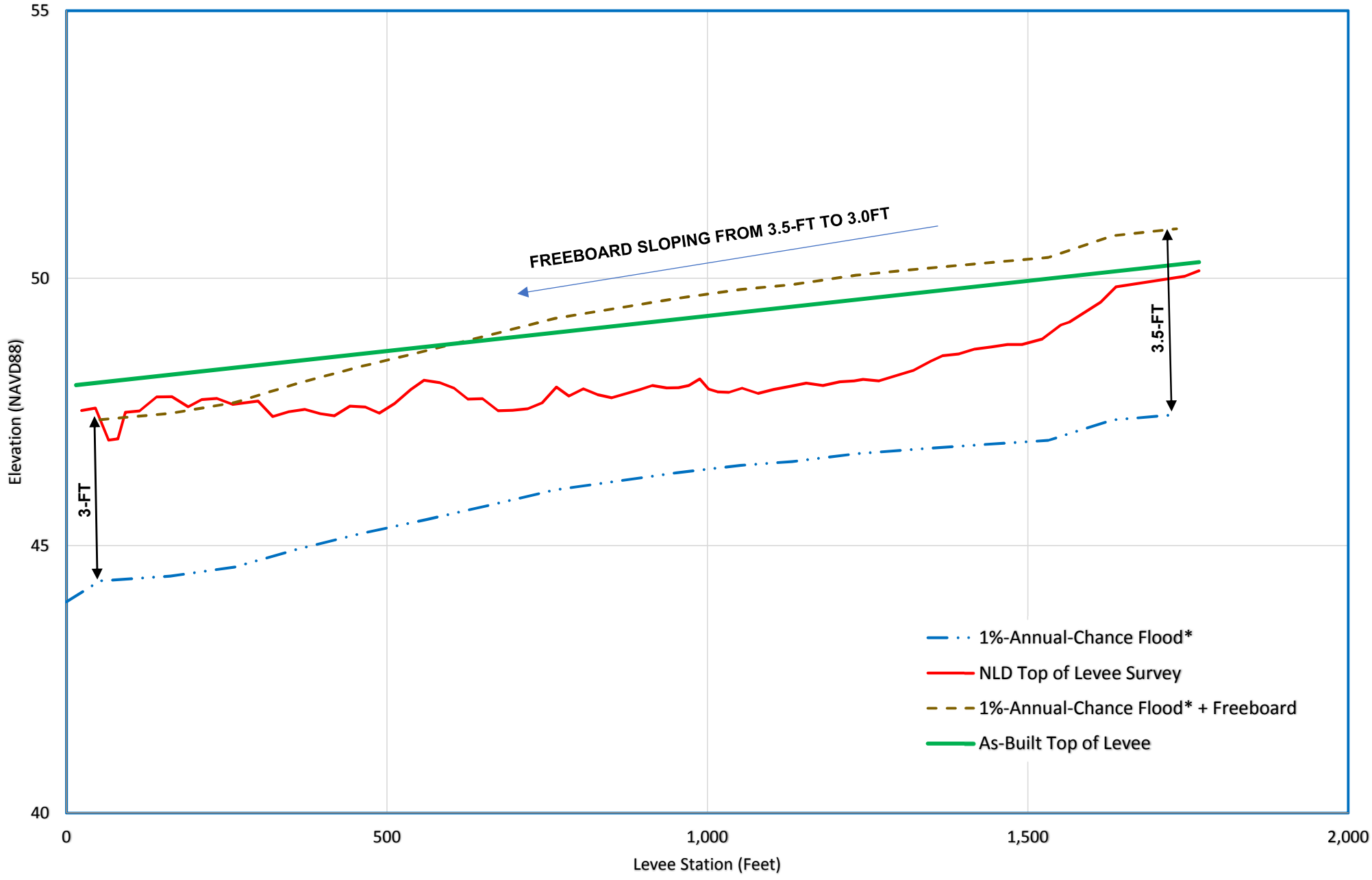
Appendix B
Freeboard Profile Comparison

Elizabeth River (Hillside, NJ)
Left Bank Levee Profile vs.
1%-Annual-Chance Flood



*FEMA Effective Model for Elizabeth River, NJ

Appendix C
Levee Accreditation Checklist

Meeting the Criteria for Accrediting Levee Systems on Flood Insurance Rate Maps:
How-To Guide for Floodplain Managers and Engineers

The National Flood Insurance Program (NFIP) defines a levee system in Title 44, Chapter 1,Section 59.1 of the Code of Federal Regulations (44 CFR 59.1) as a flood risk reduction system that consists of a levee, or levees, and associated structures, such as closure and drainage devices, which are constructed and operated in accordance with sound engineering practices to protect a hydraulically distinct area. Within the NFIP, a levee is a manmade structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.

As part of the flood mapping process, the Federal Emergency Management Agency (FEMA), and its State and local mapping partners, review and evaluate levee system data and documentation. Any community and/or other party seeking recognition or continued recognition of a levee system on a Flood Insurance Rate Map (FIRM) must provide FEMA with data and documentation, certified by a registered professional engineer, showing that the levee system is expected to provide 1-percent-annual-chance (base) flood risk reduction.

To be mapped on a FIRM as providing base flood risk reduction, levee systems must meet and continue to meet the NFIP minimum design, operation, and maintenance requirements described in Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44 CFR 65.10). FEMA has posted several guidance documents related to levee accreditation, mapping, and other topics. Please access the Levee Resources Library for updated guidance documents. To help clarify the responsibilities of community officials, levee owners, or other parties seeking recognition of a levee system identified during a study/mapping project, FEMA has posted several guidance documents related to levee accreditation, mapping, and other related topics. This document provides information regarding how FEMA maps levee systems, a checklist of the types of data and documentation that must be submitted for levee systems to be accredited on FIRMs, and an index of further resources.

A NOTE ABOUT FLOOD RISK AND FLOOD INSURANCE

Levee systems are designed to provide a specific level of protection. They can be overtopped or fail during flood events larger than those for which the system was designed. Levee systems also decay over time, which may increase the likelihood of failure. They require regular maintenance and periodic upgrades to retain their level of protection. When levees do fail, the resulting damage, including loss of life, may be much greater than if the levee system had not been built.

For all these reasons, FEMA strongly encourages people in levee-impacted areas to understand their flood risk, know and follow evacuation procedures, and protect their property by purchasing flood insurance, floodproofing their structure, or taking other precautionary measures. For more information on flood insurance, please visit FloodSmart.gov.

RISK MAPPING, ASSESSMENT, AND PLANNING PROGRAM (RISK MAP)

The Federal Emergency Management Agency's Risk MAP Program delivers quality data that increases public awareness and leads to action to reduce risk to life and property. Risk MAP is a nationwide program that works in collaboration with States, Tribes, and Local communities using best available science, rigorously vetted standards, and expert analysis to identify risk and promote mitigation action, resulting in safer, more resilient communities.

RiskMAP
Increasing Resilience Together

FEMA

HOW FEMA MAPS LEVEE SYSTEMS

FEMA mapping requirements are designed to provide accurate, up-to-date flood hazard and risk information to people living and working landward of levee systems so that they may make wise decisions to minimize loss of life and damage to property due to flooding. FEMA does not evaluate the performance of a levee system—this is the responsibility of the levee owner. FEMA is responsible for establishing levee system evaluation and mapping standards, determining flood insurance risk zones, and reflecting these determinations on FIRMs.

Figure 1. Accredited Levee System

Accredited Levee System

An accredited levee system is a system that FEMA has determined to meet the design, data, and documentation requirements of 44 CFR 65.10; it therefore can be shown on a FIRM as reducing the base flood hazard. This determination is based on a submittal, by or on behalf of a community, which includes 44 CFR 65.10—compliant data and documentation, certified by a registered professional engineer. The area landward of an accredited levee system is shown on the FIRM as a moderate-hazard area, labeled Zone X (shaded), except for areas of interior drainage flooding such as ponding areas, which will be shown as high-hazard areas, called Special Flood Hazard Areas (SFHAs). Flood insurance is not mandatory in Zone X (shaded) areas, but it is mandatory in SFHAs. FEMA strongly encourages flood insurance for all structures in floodplains and especially in areas landward of levees.

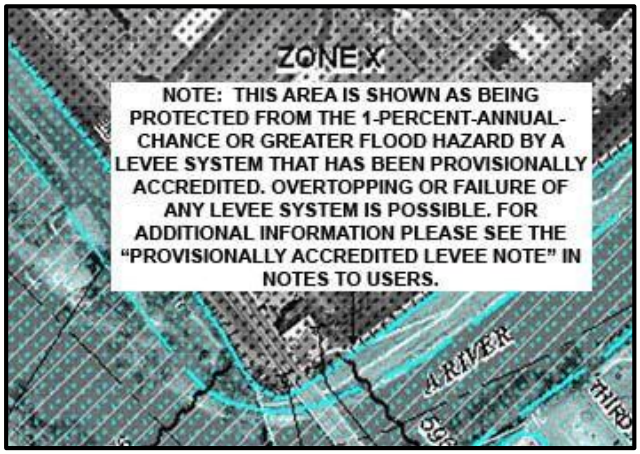


Figure 2. Provisionally Accredited Levee System

Provisionally Accredited Levee (PAL) System

The Provisionally Accredited Levee (PAL) designation may be used for a levee system that FEMA has previously accredited as providing base flood hazard reduction on an effective FIRM, and for which FEMA is awaiting data and/or documentation that will show the levee system is compliant with 44 CFR 65.10. Before FEMA will apply the PAL designation to a levee system, the community or levee owner needs to sign and return an agreement indicating that the data and documentation required for compliance with 44 CFR 65.10 will be provided within a specified timeframe. Where PAL requirements are met, the impacted area landward of a PAL system on the updated FIRM is shown as a moderate-hazard area, labeled Zone X (shaded) and a PAL note is added. Therefore, flood insurance is not mandatory for

insurable structures in the area landward of a levee system with a PAL designation; however, flood insurance and other protective measures are strongly encouraged by FEMA. A community is eligible to receive a PAL designation for a levee system only once.

Levee System: Non-Accredited or De-accredited

If the levee system is not shown as providing base flood hazard reduction on an effective FIRM, the system is considered to be non-accredited and the levee-impacted area is mapped as Zone AE or Zone A on a FIRM following implementation of analysis and mapping procedures depending on approaches and type of study performed for the area. If the levee system was previously shown as providing base flood protection on an effective FIRM but does not meet PAL requirements, FEMA will perform analysis procedures to effectively remove accreditation or "de-accredit" the levee system and will re-map the affected area landward of the levee as an SFHA, labeled Zone AE or Zone A depending on the type of study performed. Flood insurance is required for insurable structures in SFHAs, if they have with federally backed mortgages.

Figure 3. Levee System: Non-Accredited or De-accredited

The checklist provided on the following pages is meant to assist local community officials and levee owners in gathering the 44 CFR 65.10—compliant data and documentation required for FEMA to recognize a levee system with 1-percent-annual-chance flood hazard reduction on the community's FIRM (accreditation). Where possible, text from the actual NFIP regulations (44 CFR 65.10) was used in the following table.

The checklist is set up according to the appropriate paragraph of 44 CFR 65.10. For example, Design Criteria can be found in Paragraph 65.10(b):

Design Criteria*	Section of the NFIP Regulations: 65.10(b)
	Description: For levee systems to be recognized (i.e., accredited) by FEMA, evidence that adequate design and operation and maintenance systems are in place to provide reasonable assurance that protection from the base flood exists must be provided.

Design Criteria	Section of the NFIP Regulations: 65.10(b)
Description: For levee systems to be accredited by FEMA, communities and/or levee owners must submit data and documentation to show that adequate design and operations and maintenance systems are in place to provide reasonable assurance that the levee has, and will continue to have, base flood risk reduction capability.	
Checklist for Design Criteria:	
☐	**Freeboard.** The minimum freeboard required is 3 feet above the Base Flood Elevation (BFE) all along the length of the levee, with an additional 1 foot within 100 feet of structures (such as bridges) or wherever the flow is restricted, and an additional 0.5 foot at the upstream end of a levee. Levees impacted by coastal flooding have special freeboard requirements (see Paragraphs 65.10(b)(1)(iii) and (iv)).
☐	**Closures.** All openings must be provided with closure devices that are structural parts of the system during operation and designed according to sound engineering practice.
☐	**Embankment Protection**. Engineering analyses must be submitted that demonstrate that no appreciable erosion of the levee embankment can be expected during the base flood, as a result of either currents or waves, and that anticipated erosion will not result in failure of the levee embankment or foundation directly or indirectly through reduction of the seepage path and subsequent instability.
☐	**Embankment and Foundation Stability Analyses.** Engineering analyses that evaluate levee embankment stability must be submitted. The analyses provided must evaluate expected seepage during loading conditions associated with the base flood and must demonstrate that seepage into or through the levee foundation and embankment will not jeopardize embankment or foundation stability. An alternative analysis demonstrating that the levee is designed and constructed for stability against loading conditions for Case IV as defined in the U.S. Army Corps of Engineers (USACE) Engineer Manual 1110–2–1913, *Design and Construction of Levees*, (Chapter 6, Section II), may be used.
☐	**Settlement Analyses.** Engineering analyses must be submitted that assess the potential and magnitude of future losses of freeboard as a result of levee settlement and demonstrate that freeboard will be maintained. This analysis must address embankment loads, compressibility of embankment soils, compressibility of foundation soils, age of the levee system, and construction compaction methods. In addition, detailed settlement analysis using procedures such as those described in USACE Engineer Manual 1110–1–1904, *Soil Mechanics Design— Settlement Analysis*, must be submitted.

☐	**Interior Drainage.** An analysis must be submitted that identifies the source(s) of such flooding, the extent of the flooded area, and, if the average depth is greater than 1 foot, the water-surface elevation(s) of the base flood. This analysis must be based on the joint probability of interior and exterior flooding and the capacity of facilities (such as drainage lines and pumps) for evacuating interior floodwaters, as described in USACE Engineer Manual 1110-2-1914, *Hydrologic Analysis of Interior Areas.*
Operation Plan	**Paragraph 65.10(c)(1) of the NFIP Regulations**
Description: For a levee system to be accredited, the operational criteria described below must be provided. All closure devices or mechanical systems for internal drainage, whether manual or automatic, must be operated in accordance with an officially adopted operation manual, a copy of which must be provided to FEMA by the operator when levee or drainage system recognition is being sought or when the manual for a previously recognized system is revised in any manner. All operations must be under the jurisdiction of a Federal or State agency, an agency created by Federal or State law, or an agency of a community participating in the NFIP.	
Checklist for Operation Plan:	
☐	**Flood Warning System.** Documentation of the flood warning system, under the jurisdiction of Federal, State, or community officials that will be used to trigger emergency operation activities; and demonstration that sufficient flood warning time exists for the completed operation of all closure structures, including necessary sealing, before floodwaters reach the base of the closure.
☐	**Plan of Operation**. A formal plan of operation including specific actions and assignments of responsibility by individual name or title.
☐	**Periodic Operation of Closures.** Provisions for periodic operation, at not less than 1-year intervals, of the closure structure for testing and training purposes.
Interior Drainage Plan	**Paragraph 65.10(c)(2) of the NFIP Regulations**
Description: Interior drainage systems associated with levee systems usually include storage areas, gravity outlets, pumping stations, or a combination thereof. These drainage systems will be recognized by FEMA on NFIP maps for flood risk reduction purposes only if the following minimum criteria are included in the operation plan.	
Checklist for Interior Drainage Plan:	

☐	**Flood Warning System.** Documentation of the flood warning system, under the jurisdiction of Federal, State, or community officials that will be used to trigger emergency operation activities; and demonstration that sufficient flood warning time exists to permit activation of mechanized portions of the drainage system.
☐	**Plan of Operation.** A formal plan of operation including specific actions and assignments of responsibility by individual name or title.
☐	**Manual Backup.** Provision for manual backup for the activation of automatic systems.
☐	**Periodic Inspection.** Provisions for periodic inspection of interior drainage systems and periodic operation of any mechanized portions for testing and training purposes. No more than 1 year shall elapse between either the inspections or the operations.
Maintenance Plan	**Paragraph 65.10(d) of the NFIP Regulations**
Description: For levee systems to be recognized as accredited by FEMA, the maintenance criteria must be as described herein.	
Checklist for Maintenance Plan:	
☐	Levee systems must be maintained in accordance with an officially adopted maintenance plan, and a copy of this plan must be provided to FEMA by the owner of the levee system when recognition is sought or when the plan for a previously recognized system is revised in any manner.
☐	All maintenance activities must be under the jurisdiction of a Federal or State agency, an agency created by Federal or State law, or an agency of a community participating in the NFIP which must assume ultimate responsibility for maintenance.
☐	This plan must document the formal procedure that ensures that the stability, height, and overall integrity of the levee and its associated structures and systems are maintained. At a minimum, the plan shall specify the maintenance activities to be performed, the frequency of their performance, and the person by name or title responsible for their performance.
Certification	**Paragraph 65.10(e) of the NFIP Regulations**

Description: Data submitted to support that a given levee system complies with the structural requirements set forth in "Design Criteria" (Paragraphs 65.10(b)(1) through (7) of the regulations) must be certified by a Registered Professional Engineer. Certifications are subject to the definition given in Section 65.2 of the NFIP regulations. In lieu of these structural requirements, a Federal agency with responsibility for levee design may certify that the levee has been adequately designed and constructed to provide protection from the base flood.

Checklist for Certification Requirement:	
☐	All data submitted is certified by a Professional Engineer or by a Federal agency**.**
☐	Certified as-built levee plans are included in the submittal.

Appendix D
Collected Data

(full appendix provided separately)

Appendix E
Initial Data Analysis

(full appendix provided separately)