



# Levee Analysis and Mapping Plan Ithaca Flood Protection Project

*City of Ithaca / Town of Ithaca, New York*

May 2018



**FEMA**

**RiskMAP**  
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## Acronyms

BF E	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
NYSDEC	New York State Department of Environmental Conservation
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 *Analysis and Mapping Procedures for Non-Accredited Levee Systems* (July 2013) in the Glossary of Levee Terms. This document is available from the FEMA Library at [https://www.fema.gov/media-library-data/20130726-1922-25045-4455/20130703\\_approachdocument\\_508.pdf](https://www.fema.gov/media-library-data/20130726-1922-25045-4455/20130703_approachdocument_508.pdf).

**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 *Analysis and Mapping Procedures for Non-Accredited Levee Systems* (July 2013).

**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 a levee, or levees, and associated structures, such as closures, pumps and drainage devices, 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 non-accredited levee system in a community or project area will be analyzed and the areas landward of the levee system will be mapped. The primary function of this group is to share information/data and identify options based on stakeholder roles and knowledge.

**Non-Accredited Levee System** – A levee system that does not meet the requirements spelled out 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 flood hazards posed by a 1-percent-annual-chance or greater flood.

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

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

\*All definitions on this page except for this one are from FEMA's *Analysis and Mapping Procedures for Non-Accredited Levee Systems* (July 2013).

## 0 Executive Summary

The Federal Emergency Management Agency’s (FEMA’s) Flood Insurance Study (FIS) report and Flood Insurance Rate Map (FIRM) for the City of Ithaca (City) and Town of Ithaca (Town), Tompkins County, New York shows the Cayuga Inlet Right Bank Levee (part of the Ithaca Flood Damage Reduction Project) as providing reduced flood hazard from the 1-percent-annual-chance flood. No data has been 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 (44CFR§65.10) *Mapping of areas protected by levee systems*; therefore, the levee system is considered non-accredited.

FEMA’s guidance was revised in 2013 to incorporate new Analysis and Mapping Procedures for non-accredited levees which provides a suite of flexible procedures to perform flood hazard analysis and mapping for non-accredited levees (see Section 1 of this report). The City and Town of Ithaca has a levee discovery project where the levee system is being studied using the Levee Analysis and Mapping Procedures (see Section 2). This study will help identify potential options the levee owner (City of Ithaca) may have to show the flood hazard within the leveed area on a future FIRM.

In September of 2017, FEMA Region II partnered with stakeholders in the City and Town of Ithaca to form a collaborative Local Levee Partnership Team (LLPT) and worked to determine potential Levee Analysis and Mapping Procedures for the Cayuga Inlet Right Bank Levee (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 extensive coordination of the LLPT and the initial data analysis performed, supports the development of this document — a plan outlining potential reach analysis procedures. This document informs the potential paths forward for the City (see Section 6). The City has expressed interest in the levee accreditation process for the Cayuga Inlet Right Bank Levee to continue the flood hazard reduction currently depicted on the effective FIRMs dated September 30, 1981 (City of Ithaca) and June 19, 1985 (Town of Ithaca). If the levee system is not accredited, future FIRMs would depict much of the leveed area as high risk 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 it provided no protection during a base (1-percent-annual-chance) flood. This was known as the “without levee” approach.

Some 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 leveed areas.

FEMA, its Production and Technical Services contractor Strategic Alliance for Risk Reduction II (STARR II), and Community Engagement and Risk Communication contractor (CERC) initiated the Levee Analysis and Mapping Procedures process for the levee located in the City and Town. Recent technological advances in data collection methods and hydrologic and hydraulic modeling were leveraged as part of this process. FEMA's Levee Analysis and Mapping Procedures for non-accredited levees is a more refined approach to mapping flood hazards in leveed areas.

The Levee Analysis and Mapping Procedures 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 Cayuga Inlet Right Bank Levee in the City and Town of Ithaca is non-accredited. In coordination with the communities, FEMA is using the Levee Analysis and Mapping Procedures process to develop refined flood hazard mapping in leveed areas. This will inform the City's decision, as the levee owner, on how they would like to depict the levee-related flood hazards in the City and Town of Ithaca.

This report is the result of the collaboration between FEMA, the City and Town of Ithaca, Tompkins County, New York State Department of Environmental Conservation (NYSDEC), U.S. Army Corps of Engineers (USACE), and other stakeholders. This report documents the evaluation of data, initial data analysis, as well as the communities' preferred Levee Analysis and Mapping Procedure.

## **2 Levee System Description**

### **2.1 Flood Protection Measures in the City and Town of Ithaca**

The Cayuga Inlet Right Bank Levee is a component of the USACE designed and constructed Ithaca Flood Damage Reduction Project that was constructed around 1970. Upon completion, the project was turned over to the local sponsor, the New York State Department of Environmental Conservation (NYSDEC). The Cayuga Inlet Right Bank Levee system is comprised of approximately 3,000 feet of earthen levee designed to reduce the flood risk on the right bank of the Cayuga Inlet. The drainage area upstream of the flood control project is approximately 87 square miles. The levee system is located adjacent to the Cayuga Inlet between Elmira Road (State Route 13) and the railroad crossing near Ithaca Dispatch in the City and Town of Ithaca, Tompkins County, New York as shown in Figure 1. The Cayuga Inlet Right Bank Levee system was reinstated as "active" in the USACE Levee Safety program as of January 2016.

The Cayuga Inlet Left Bank Levees are not shown as reducing flood hazard on the Town of Ithaca FIRM and were not further evaluated as part of this levee study.

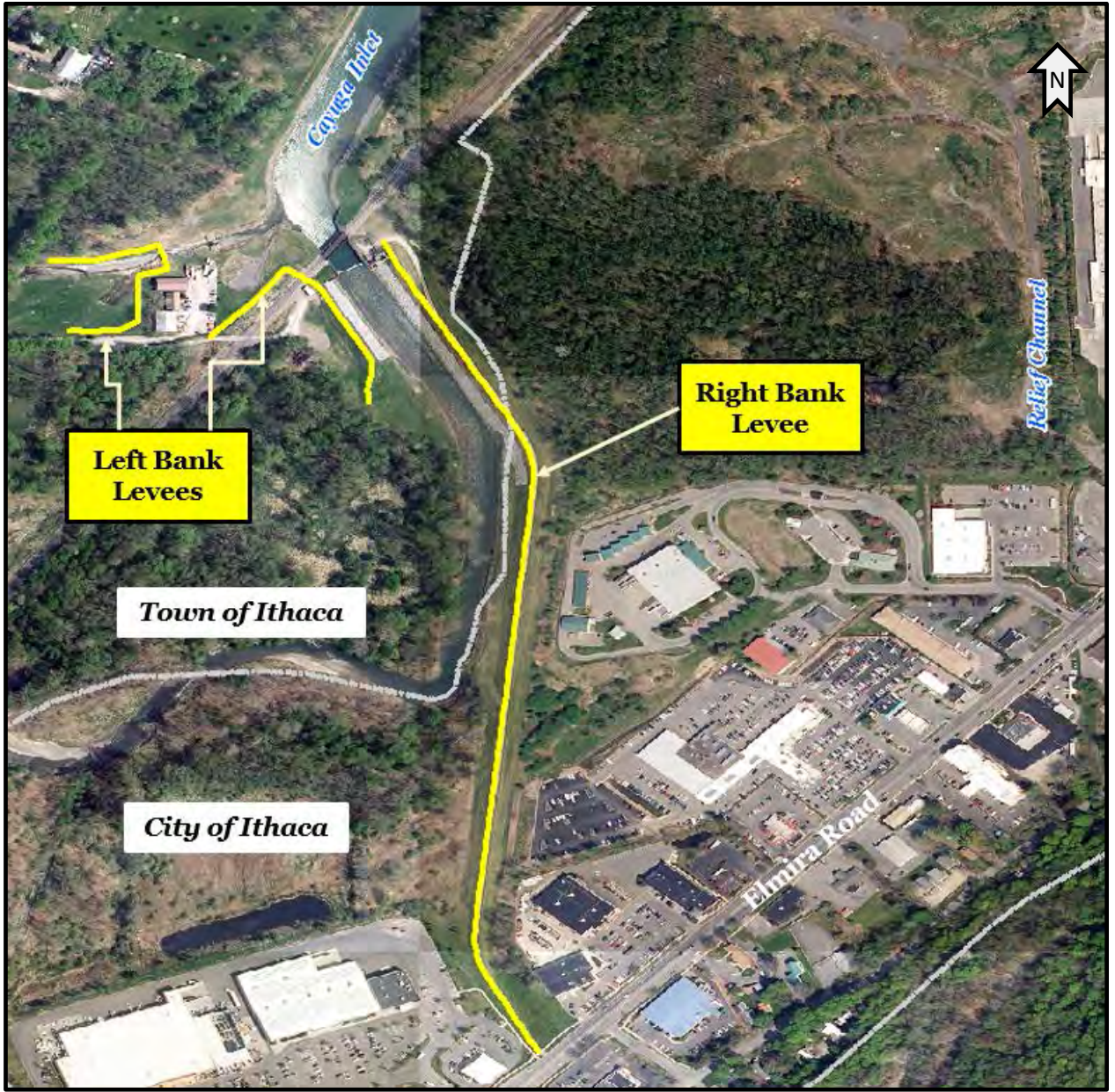


Figure 1: General Location Map

## 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 Leveed Area <sup>1</sup>
Tompkins County	City of Ithaca	Yes	N/A
Tompkins County	Town of Ithaca	Yes	

**Table 2. Community Map History**

Community	Initial Identification	Flood Hazard Boundary Map Revision Date(s)	FIRM Effective Date	FIRM Revision Date(s)
City of Ithaca	June 28, 1974	N/A	September 30, 1981	N/A
Town of Ithaca	June 4, 1976	April 4, 1980	June 19, 1985	N/A

A FIS report was issued for the City of Ithaca, Tompkins County, New York on March 30, 1981 and the Town of Ithaca, Tompkins County, New York on December 19, 1984. According to the FIS reports, the flood protection project, constructed in 1970, is believed to have reduced potential damages from flooding events due to “the improvement doubling the carrying capacity of the inlet.” The FIRMs show the levee as providing reduced flood hazard for the 1-percent annual-chance flood.

## 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.

<sup>1</sup> Special Flood Hazard Area (SFHA) in leveed area not identified on March 30, 1981 (Town of Ithaca) or December 19, 1984 (City of Ithaca) FIRMs. See Table 4 for additional information regarding potentially impacted structures.



**Table 3. LLPT Participants**

<b>LLPT Member</b>	<b>Contact Information</b>
Mike Thorne	City of Ithaca, Superintendent of Public Works mthorne@cityofithaca.org
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## 4 Stakeholder Engagement

### 4.1 LLPT Meeting 1

A FEMA-led project team engaged the Cayuga Inlet Right Bank Levee stakeholders at the LLPT Meeting 1 held at City Hall on September 18, 2017. 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 with respect to the levee system, and begin to establish the stakeholders who would like to participate in the LLPT.

An overview of the methods available to depict flood risks of leveed areas under current Levee Analysis and Mapping Procedures guidance was also discussed during the meeting along with a timeline for the levee project. Additional details regarding the LLPT 1 meeting are provided in Appendix A.

### 4.2 LLPT Meeting 2

On December 14, 2017, the LLPT Meeting 2 was held to review the Initial Data Analysis and discuss 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 Freeboard Deficient and Overtopping Procedures were not applicable due to the levee crest elevations being elevated above the BFE and minimum freeboard requirements expected to be met based on available data. The Sound Reach procedure was also not applied as noted in section 5.5. Additional details regarding the LLPT 2 meeting are provided in Appendix B and information from the data collection are provided in Appendices D through H. The Initial Data Analysis is described in Section 5.

### 4.3 LLPT Meeting 3

A LLPT Meeting 3 will be held to review the draft levee analysis and mapping plan with the LLPT prior to it being finalized. Notes from this meeting are provided in Appendix C.

## 5 Initial Data Analysis

FEMA project team members of STARR II developed an Initial Data Analysis, which is an approximate analysis using a relatively low level of detail, to approximate the floodplain boundary 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 reach analysis and application of reach analysis procedures are provided below. Supporting data is provided in Appendix H.

## 5.1 Reach Analysis

Topographic data and levee crest survey data from the USACE National Levee Database and as-built plans were reviewed to define the levee system and identify if the levee system should be evaluated as separate reaches for application of the reach analysis procedures. A levee reach is any continuous section of a levee system to which a single reach analysis procedure may be applied. Based on the review of the available levee crest data, the Cayuga Inlet Right Bank Levee appears to meet minimum freeboard requirements of 44CFR§65.10. The levee crest comparison is provided in Appendix D.

The Cayuga Inlet Right Bank Levee is located riverside of a low area in the topography. A breach or failure at any point along the levee could cause inundation of the low area landside of the levee. For hydraulic modeling purposes, there is no reason to evaluate the levee system as separate reaches because it would not refine the flood risk analysis of the leveed area.

It should be noted; however, that the Cayuga Inlet Right Bank Levee system ties-in to high ground at the upstream end near Elmira Road (State Route 13) and ties-in to a control/drop structure wall at the downstream end. The existing ground at the upstream end of the levee system near State Route 13 appears to be above the elevation of the 1-percent-annual-chance flood; however, it should be further investigated if the high ground is part of the roadway embankment or could be considered natural high ground. For the purposes of the reach analysis, the upstream end of the levee is considered to tie-in to natural high ground.

The downstream end of the levee system ties-in to the control/drop structure wall. The wall would be considered high ground as the area behind the designated levee has a protected area. No water from the Cayuga Inlet will have the capacity to flow upstream once passing through the control structure. For the purposes of the Initial Data Analysis, the control/drop structure wall was considered as existing high ground.

## 5.2 Natural Valley Procedure

The Natural Valley Procedure is completed for all levee systems to identify the potential leveed area associated with the 1-percent-annual-chance flood. This is completed through hydraulic modeling of the levee system as though it is not reducing flood risk by allowing flow to be conveyed on both sides of the levee.

## 5.3 Structural-Based Inundation Procedure

For the Structural-Based Inundation Procedure, a hypothetical breach analysis was completed using HEC-RAS 5.0.3 (2-Dimensional, unsteady flow) at three locations along the Cayuga Inlet Right Bank Levee (upstream, central, and downstream). The breach locations were developed for modeling purposes only and do not indicate historic or future breach development at these locations.

## 5.4 Freeboard Deficient Procedures

For the purposes of the initial data analysis of the Freeboard Deficient Procedure, the Cayuga Inlet Right Bank Levee crest elevations were estimated to be elevated at or above the BFE as noted in Section 5.1, therefore, the freeboard deficient procedure was not performed. The profile comparison is included in Appendix D.

## 5.5 Sound Reach Procedure

A Sound Reach can be described as a reach of a non-accredited levee system that meets minimum freeboard requirements in accordance with the standards in 44CFR§65.10 and has been designed, constructed, and maintained to withstand the flood hazards posed by a 1-percent-annual-chance flood. A Sound Reach is typically evaluated in conjunction with other reach analysis procedures to develop a composite snapshot of the landside flood risk of a levee system. A levee system comprised only of Sound Reaches would be considered an accredited levee system as each reach would meet all of the standards in 44CFR§65.10. Since the Cayuga Inlet Right Bank Levee system is considered a single reach, if 44CFR§65.10 compliant data can be provided to FEMA for the levee system it could be considered accredited.

## 5.6 Review of Initial Data Analyses

***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. 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 leveed area is also not depicted and would need to be evaluated in the future prior to updating the FIRM.***

The effective FIRMs do not show SFHA in the leveed area. The Natural Valley procedure results identify the potential flood risk if the levee system was not in place. Figure 2 illustrates the approximate inundation area for the 1-percent-annual-chance flood for the Natural Valley Procedure using HEC-RAS 5.0.3 (1-Dimensional / 2-Dimensional, unsteady-state flow). Figure 3 shows the approximate depth grid for the Natural Valley Procedure.

It should be noted that the Natural Valley analysis updated the effective HEC-2 hydraulic model based on available information. Future phases may warrant further evaluation of the modeling as a restudy of the reach of the Cayuga Inlet upstream of the control structure was outside of the scope of this levee study. Additional information regarding the methodology used in the Initial Data Analyses is provided in Appendix H.

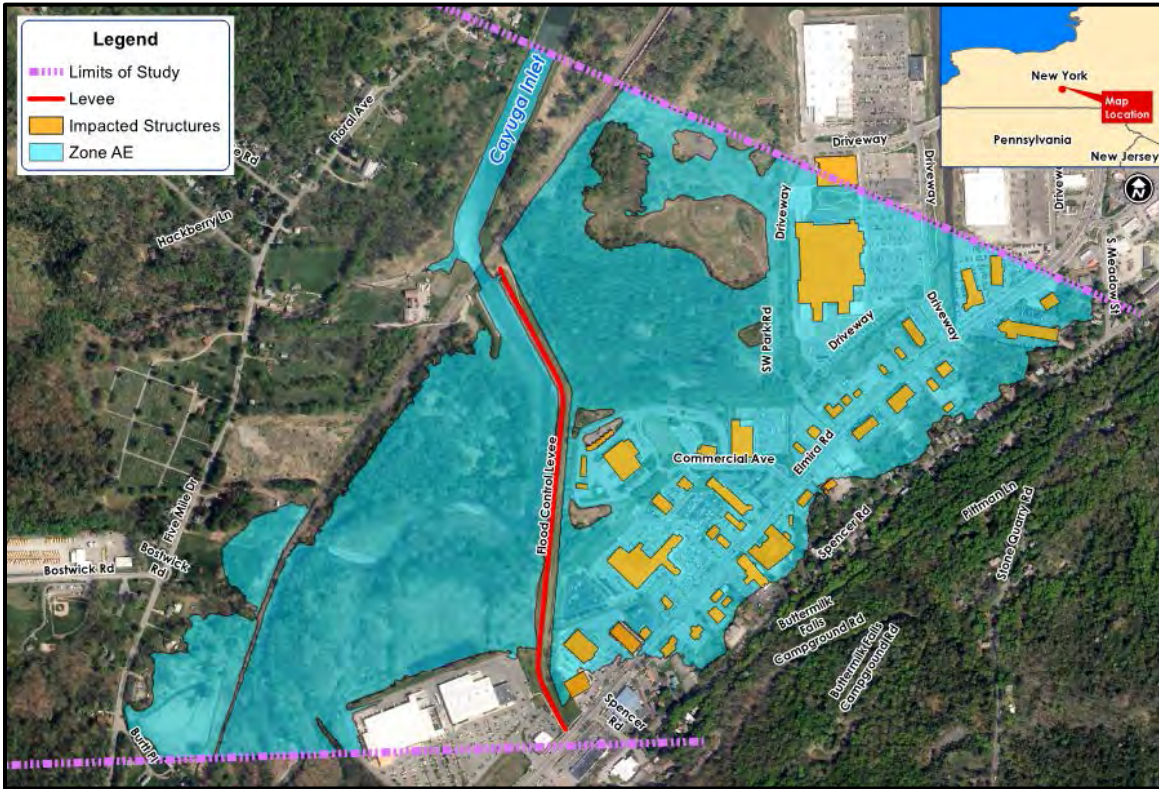


Figure 2: Natural Valley Procedure

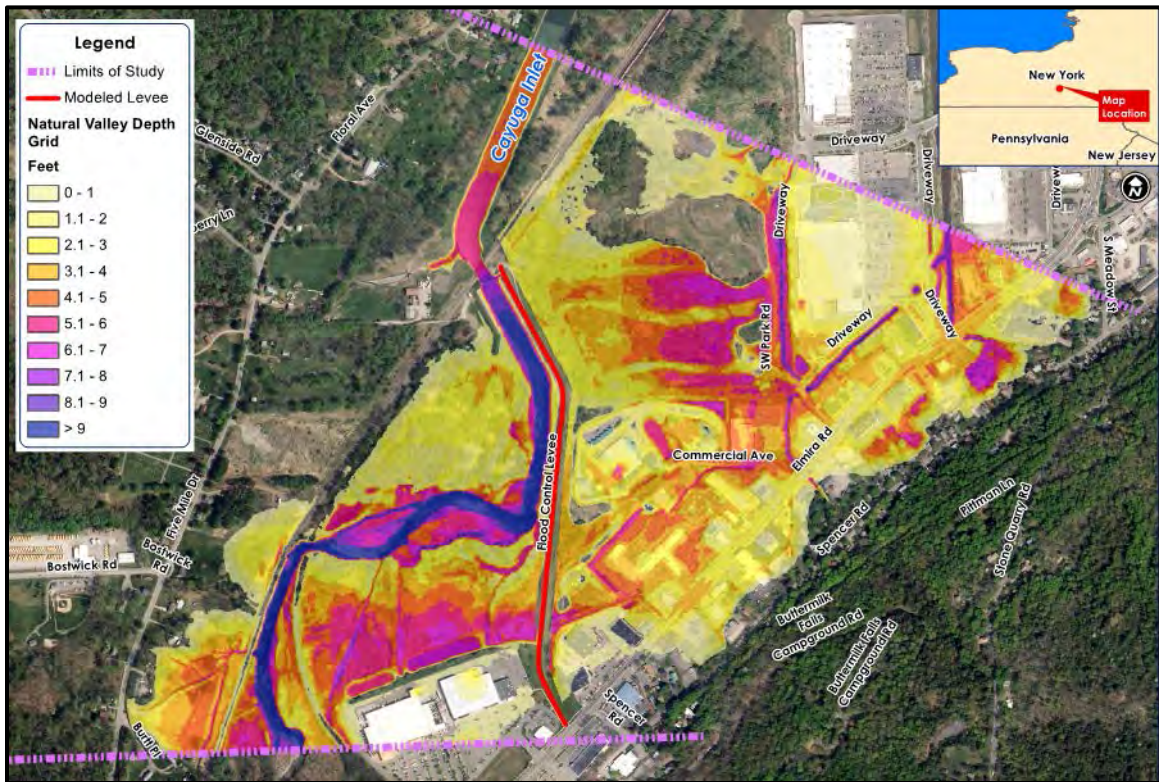
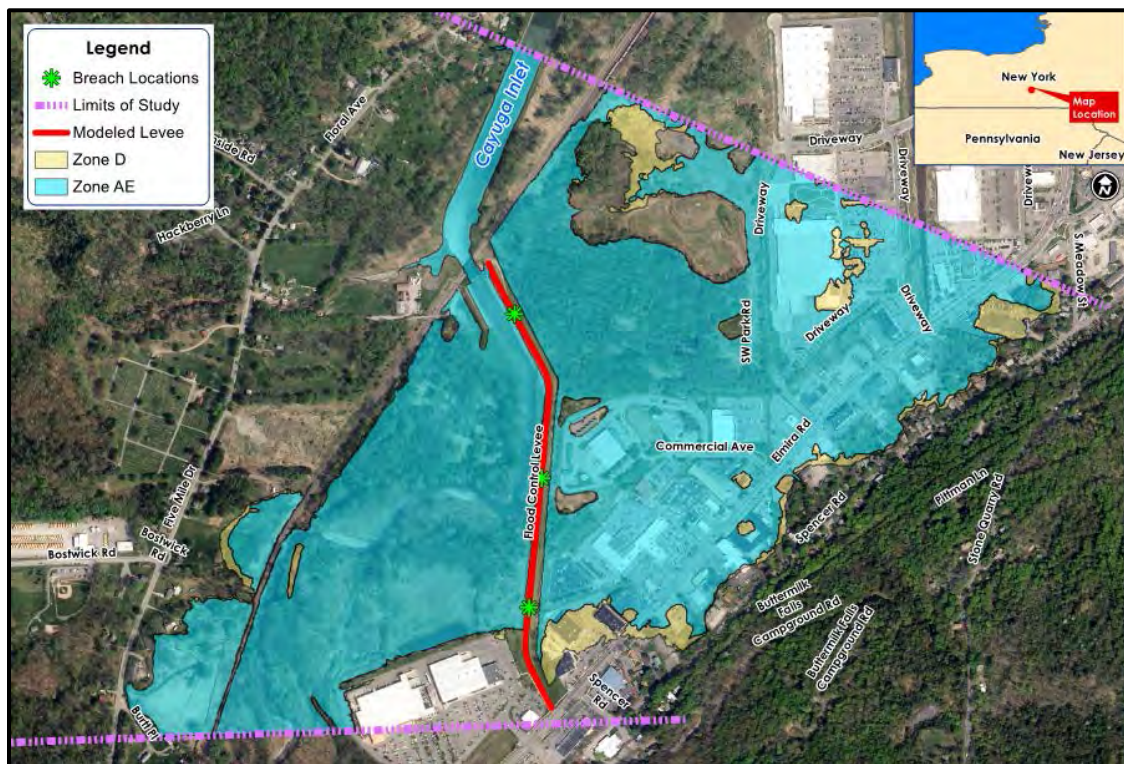


Figure 3: Natural Valley Procedure Flood Depth Grid

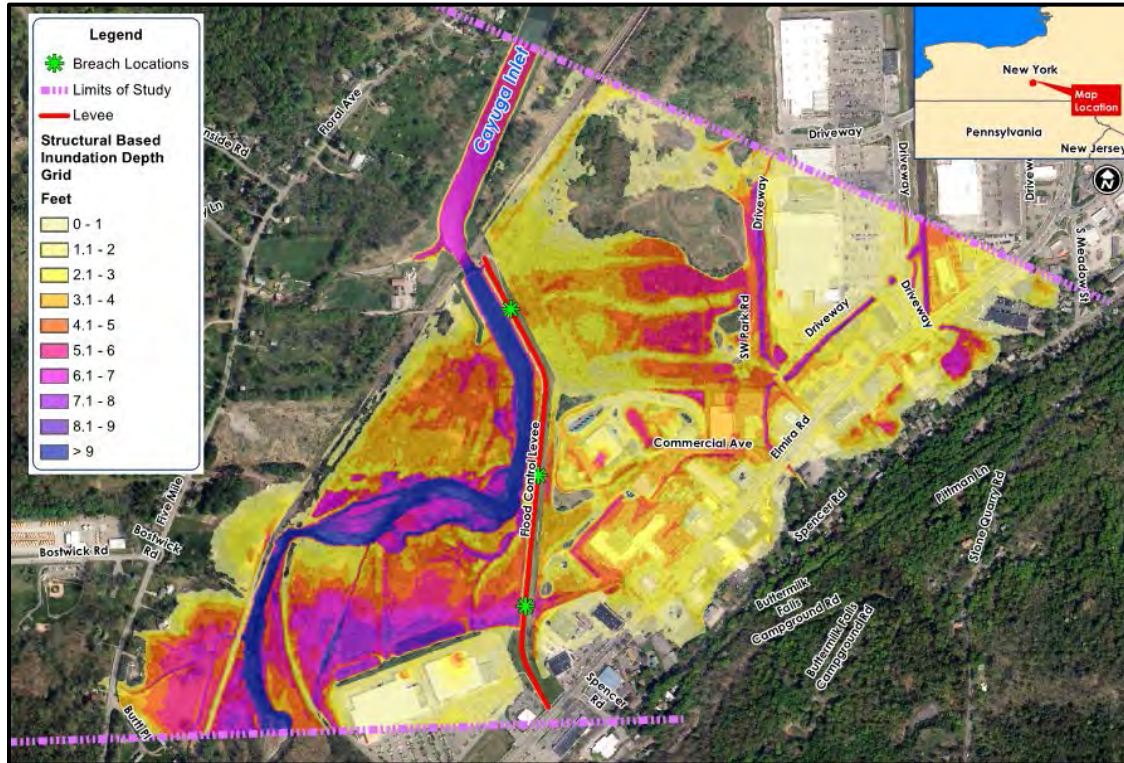
The Structural-Based Inundation Procedure yields a slightly smaller inundation area compared to the Natural Valley Procedure. As shown in Figure 4, the resulting inundation area from the Structural-Based Inundation Procedure could be mapped as Zone AE SFHA. The remaining flood risk between the Structural-Based Inundation Procedure and Natural Valley Procedure could be mapped as Zone D.

Zone D is defined by FEMA as unidentified, but possible flood risk and could require flood insurance at rates estimated to be similar to Zone A. Zone D, however, is not considered SFHA and does not have mandatory flood insurance purchase for federally back mortgages and has minimal floodplain management requirements.

Figure 5 shows the approximate depth grid for the Structural-Based Inundation Procedure.



**Figure 4: Structural-Based Inundation Procedure**



**Figure 5: Structural-Based Inundation Procedure Flood Depth Grid**

As noted above, the levee embankment was evaluated as a single reach under two reach analysis procedures: Natural Valley and Structural-Based Inundation Procedures. Summary results from the Initial Data Analysis are included in Table 4.

**Table 4. Results from the Initial Data Analysis**

Approximate Length of Levee Segment (ft)	Approximate # Structures Impacted	Comments: Natural Valley Procedure <sup>2</sup> (Figure 2)	Comments: Structural-Based Inundation Procedure <sup>3</sup> (Figure 4)	Comments: Freeboard Deficient Procedures <sup>4</sup>	Comments: Sound Reach Procedure <sup>5</sup>
3,000	49 Commercial Structures	<ul style="list-style-type: none"> <li>Results from updated hydraulic model (2D). Estimates potential inundation/leveed area if levee system not mapped as reducing flood hazard.</li> </ul>	<ul style="list-style-type: none"> <li>Results in slightly less flood extents during the 1-percent-annual chance flood compared to the Natural Valley Procedure. May be utilized for emergency planning.</li> </ul>	<ul style="list-style-type: none"> <li>Not applicable. Sufficient freeboard available for the Cayuga Inlet Right Bank Levee.</li> </ul>	<ul style="list-style-type: none"> <li>Not applied. If 44CFR§65.10 compliant data is provided for the levee system, it may be accredited.</li> </ul>

<sup>2</sup> Depicts levee reach as not reducing flood risk. No additional data required to support future analysis or mapping.

<sup>3</sup> Hypothetical levee breach analysis. No additional data required to support future analysis or mapping.

<sup>4</sup> Freeboard requirement (44CFR§65.10(b)(1)) is not met, but the top of levee reach is above the 1-percent-annual-chance flood. Certified data compliant with 44§CFR 65.10 and Freeboard Deficient procedures required to support future analysis or mapping.

<sup>5</sup> All minimum requirements of 44CFR§65.10 are met for levee reach, including freeboard. Certified data compliant with 44CFR§65.10 required to support future analysis or mapping.



## 6 Path Forward

### 6.1 Levee Analysis and Mapping Procedures

The Cayuga Inlet Right Bank Levee included in this study is shown as providing reduced flood hazard on the effective FIRMs. As no data in support of the 44CFR§65.10 requirements has been provided to FEMA in support of the levee system, the levee system is considered non-accredited.

FEMA engaged the communities and other levee stakeholders through the Levee Analysis and Mapping Procedures process to help identify potential options to evaluate the flood risk of the leveed area. The communities are considering moving forward with the accreditation process that could continue to map the reduced flood hazard due to the levee system. FEMA's Levee Accreditation Checklist has been included in Appendix F for reference.

Should the communities be able to provide 44CFR§65.10-compliant data for the Cayuga Inlet Right Bank Levee including the levee crest is certified to meet minimum freeboard requirements, the flood risk of the leveed area could be shown as reducing flood hazard. If the communities do not provide 44CFR§65.10-compliant data, the effective FIRMs dated September 30, 1981 and June 19, 1985 would be revised to show updated flood risk once the FEMA Regional Office incorporates updates into future mapping studies.

Due to the flood hazard mapping efforts underway in Tompkins County, 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 the Countywide mapping project, it should be incorporated into the final Countywide 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 FIRMs. 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. Additionally, future phases of the Levee Analysis and Mapping Procedure may warrant further evaluation of the modeling of the Cayuga Inlet upstream of the control structure, which was outside of the scope of this levee study.

## **7 References**

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

USACE, National Levee Database (GeoDatabase Version 3.0 dated 07-28-2015), 2015.

**Appendix A**  
**Stakeholder Engagement - LLPT Meeting 1 Information**

[Full Appendix Provided Separately](#)

# Meeting Notes

## ATTENDEES

**BILL GOODMAN**  
Town of Ithaca

**BRUCE BATES**  
Town of Ithaca

**DAN THAETE**  
Town of Ithaca

**JAMES WEBER**  
Town of Ithaca Department  
of Public Works

**JOANN CORNISH**  
City of Ithaca Department of  
Planning and Development

**MICHAEL THORNE**  
City of Ithaca Department of  
Public Works

**LISA NICHOLAS**  
City of Ithaca Department of  
Planning and Economic  
Development

**DAN COGAN**  
City of Ithaca

**SCOTT DOYLE**  
Tompkins County Planning  
Department

**WILLIAM COON**  
US Geological Survey

**DAN FULLER**  
NYS Department of  
Environmental Conservation

**PAUL COCCA**  
US Army Corps of Engineers

**JASON DOKTOR**  
U.S. Army Corps of  
Engineers

**ALAN SPRINGETT**  
FEMA

**SHUDIPTO RAHMAN**

## CITY AND TOWN OF ITHACA LEVEE ANALYSIS AND MAPPING PROCEDURES MEETING

September 18, 2017 4:00-6:00 PM (EST)

Location:

City Hall  
108 East Green Street  
Ithaca, NY 14850

Action Item	Owner
1. FEMA to provide more information on grant funding and contact the Village of Nichols to obtain background on their levee accreditation processes.	FEMA
2. FEMA will distribute meeting minutes to attendees.	FEMA
3. Community members to begin uploading data and relevant information to file transfer site and email Stephanie Nurre ( <a href="mailto:Stephanie.nurre@stantec.com">Stephanie.nurre@stantec.com</a> ) upon completion.	FEMA
<b>Login Information</b> <b>Browser link:</b> <a href="https://projsftp.stantec.com">https://projsftp.stantec.com</a> <b>FTP Client Hostname:</b> projsftp.stantec.com Port: 22 (can be used within an FTP client to view and transfer files and folder; e.g., FileZilla) <b>Login name:</b> LNYLAMPDP1559 <b>Password:</b> 3323987	
4. Community members to e-mail Paige Mandy ( <a href="mailto:paige.mandy@ogilvy.com">paige.mandy@ogilvy.com</a> ) to indicate if they are NOT interested in joining the Ithaca Local Levee Partnership Team (LLPT).	Ithaca

## AGENDA

- Provide an overview of levee systems
- Discuss levee flood hazard identification
- Discuss the LLPT members

# Meeting Notes

FEMA

**STEPHANIE NURRE**  
STARR II

**CURTIS SMITH**  
STARR II

**THOMAS SONG**  
FEMA Outreach Consultant

**PAIGE MANDY**  
FEMA Outreach Consultant

## OVERVIEW

The FEMA Region II levee team, U.S. Army Corps of Engineers (USACE), and New York State Department of Environmental Conservation (NYSDEC) engaged the City and Town of Ithaca to discuss the steps to identify flood hazards associated with the Cayuga Inlet Left and Right Bank Levees.

Detailed discussions covered potential analysis scenarios and the required technical data for each option. Attendees also discussed the participation of interested community, state, and federal officials and stakeholders in the Local Levee Partnership Team (LLPT). This group will share data and participate in discussions on the potential analysis and mapping options throughout the duration of the levee project. The LLPT will also be able to review the plan document summarizing the activities and outputs from the project. They will also weigh in on the path forward for identifying and mapping the flood risk associated with the levee.

Currently, the levees are shown on the 1981 Flood Insurance Rate Maps (FIRMs) as reducing flood risk identification for the landside of the levee system. The requirements for levees have changed since that date. FEMA does not have data to support that the levees meet minimum FEMA requirements. FEMA reiterated that the levee analysis and mapping approach will give the community a better understanding of how much the levee reduces the flood risk under current conditions.

## NOTES

During the meeting, the community and FEMA discussed in detail the different procedures that can be used for analysis. While more information would be useful, FEMA currently has all the information needed to perform the Natural Valley and Structural-Based Inundation procedures and will run these analyses to inform what the flood hazard associated with each levee/procedure will look like. Once complete, the community can decide which analysis provides enough information or if they would like to consider other options to better determine their risk and potentially accredit the levee.

The FEMA levee team informed the attendees the levee system is non-accredited, meaning FEMA does not have certified engineering data showing

# Meeting Notes

that the levee systems meets the minimum requirements of the Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44 CFR§65.10) to be recognized as removing the flood hazards posed by a base (1-percent-annual-chance) on a FIRM.

The FEMA levee team also elaborated that levees used to be categorized only as accredited or non-accredited. Now, with the analysis and mapping procedures for non-accredited levees, there is a suite of approaches that may be applied to assess the flood risk. A levee system can be evaluated as separate reaches, each analyzed based on its unique characteristics. Stephanie Nurre then reviewed each analysis procedure in detail along with the associated data requirements to map the flood risk on the FIRM in the future.

Stephanie clarified that, based on the available top of levee survey information from the USACE's National Levee Database (NLD), it appears that the crest of the levee system is above the Base Flood Elevation, and may meet minimum freeboard elevations. The NLD, however, contained limited surveyed data points. Additional information for the levee system would be valuable, such as record drawings. While more information would be useful, it was also noted that there is currently sufficient information available to perform the Natural Valley analysis to inform what the landside impact area will look like and also the Structural-Based Inundation (hypothetical breach) analysis.

The FEMA levee team, USACE, NYSDEC and the community stakeholders spent a portion of the meeting discussing available technical data. This included an update from the City of Ithaca indicating that several streams impacting the community are being restudied by the U.S. Geological Survey (USGS), including the Cayuga Inlet. The USGS indicated that the models reflect the natural valley condition; however, the upstream limit of the Cayuga Inlet restudy is at the control structure/weir located at the downstream end of the levee. There is an existing stream gage located just upstream of the flood control structure on the Cayuga River. Bathymetric data is also available for the Cayuga Inlet.

The USACE noted the railway embankment adjacent to the levee is being evaluated to see if it will be perceived as a non-project levee segment. The status of the potential impact on the levee analysis due to non-project levee segments (as referenced by the USACE) and non-levee features (as referenced by FEMA) should be addressed in future discussions. Additionally, the USACE confirmed that the levee system is active in the USACE PL 84-99 Rehabilitation Program.

# Meeting Notes

FEMA identified that the Village of Nichols certified their levee using New York Rising grant funding and is currently going through the accreditation process. FEMA will work to put the communities in contact with the Mayor of Nichols should this be of interest.

FEMA explained that the data collection and analysis of the non-accredited levees will be utilized to inform the community's mapping of flood risk on the landside of the levee system on future FIRMs and will be available to the community for emergency preparedness planning.

FEMA and the community discussed next steps in the LLPT process, which are to begin collecting additional data through a file transfer site. FEMA will contact the city and town about a touchpoint call prior to the next meeting (the LLPT 2 meeting), possibly late November, to review the draft analysis results with the community.

Regarding the timeline, FEMA anticipated a LLPT 2 meeting in the fall, but this is subject to change due to Hurricane Irma and Maria response.

## DISCUSSION

- QUESTION: Is the goal to rework the floodplain mapping?
  - ANSWER: This analysis will inform floodplain maps in the future when they are due for updates. The results can be used for floodplain management to guide the land use in areas with flood hazards. While this information will not have any insurance implications, residents and business owners should be encouraged to act by either developing mitigation projects or purchasing flood insurance on their own volition. Those who choose to purchase insurance would currently pay the preferred risk rate, which would be at the lowest cost available.
  
- QUESTION: The levee under discussion is non-accredited?
  - ANSWER: Yes, the Cayuga Inlet Left and Right Bank Levees are considered non-accredited. FEMA does not have any technical assurances the levees would operate as built and would perform at a level that met the minimum requirements that would lead to accreditation.
  
- QUESTION: What are the benefits of pursuing accreditation besides lowering flood insurance rates?

# Meeting Notes

- ANSWER: While it is understood that the insurance implications are important, the certification of the levees needed for accreditation would identify that they would perform adequately to keep people and properties in the levee impact areas safe from the 1-percent-annual-chance flood. Certifying the levees means engineering tests and analysis on the systems show they were fundamentally sound and should operate to design criteria without structural failures.



# Meeting Notes

Department of Homeland Security  
Federal Emergency Management Agency  
Region II – Mitigation Division

ITHACA T/C  
(1 OF 2)



#	Name - PLEASE PRINT	Title	Organization/Town	E-Mail
28	William Coon	Hydrologist	USGS	wcoon@usgs.gov
29	PAUL COCCA	H&H Engineering Town Lead	USACE	paul.a.cocca@usace.army.mil
30	JASON DOKTOR	Civil Engineer	USACE	Jason.P.Doktor@usace.army.mil
31	Curtis Smith	RSC	STARR II	
32	Don Thaele	Town Engineer Town of Ithaca	Town of Ithaca	dthaele@town.ithaca.ny.us
33	Janet	of Ithaca	Town of Ithaca	janet@town.ithaca.ny.us
34	Scott Doyle	Assoc. Planner	TOMPKINS COUNTY	sdoyle@tompkins-co.org
35	JOANN CORNISH	PLANNING DIRECTOR	CITY OF ITHACA	jcornish@cityofithaca.org
36	THOMAS SONG	CERC		
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# Meeting Notes

Department of Homeland Security  
Federal Emergency Management Agency  
Region II - Mitigation Division

1 ITHACA T/C  
(2 OF 2)



#	Name - PLEASE PRINT	Title	Organization/Town	E-Mail
28	Alan Springett	Senior Engineer	FEMA	Alan.Springett@sema.dhs.gov
29	DAN FULLER	Flood Protection Engineer	NYS DEC-Region 7	daniel.fuller@dec.ny.gov
30	MIKE THORNE	Sup. of Public Works	City of Ithaca	mthorne@cityofithaca.org
31	LIDA NICHOLS	Senior Planner	CITY OF ITHACA	lnicholas@cityofithaca.org
32	Bill Goodman	Supervisor	Town of Ithaca	BGoodman@town.ithaca.ny.us
33	Brian W. Bietes	Director Public Works	Town of Ithaca	bbietes@town.ithaca.ny.us
34	Dan Cogon	Chief of Staff	City of Ithaca	dcogon@cityofithaca.org
35				
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**Appendix B**  
**Stakeholder Engagement - LLPT Meeting 2 Information**

[Full Appendix Provided Separately](#)

# Meeting Notes

## ATTENDEES

### BRUCE BATES

Town of Ithaca

### JIM WEBER

Town of Ithaca Department of Public Works

### TIM LOGUE

City of Ithaca Department of Public Works

### MICHAEL THORNE

City of Ithaca Department of Public Works

### BILL COON

U.S. Geological Survey

### DAN FULLER

NYS Department of Environmental Conservation

### KELLI HIGGINS-ROCHE

NYS Department of Environmental Conservation

### BRAD WENSKOSKI

NYS Department of Environmental Conservation

### NADINE LITTLE

NYS Department of Environmental Conservation

### LAURA ORTIZ

U.S. Army Corps of Engineers

### JOSEPH KASPERSKI

U.S. Army Corps of Engineers

### ROBERT REMMERS

U.S. Army Corps of Engineers – Buffalo District

### MOLLY SAFREED

Office of Congressman Tom Reed

## CITY AND TOWN OF ITHACA LEVEE ANALYSIS AND MAPPING PROCEDURES MEETING 2

December 14, 2017, 3:00-5:00 PM (EST)

Location:

City Hall  
108 East Green Street  
Ithaca, NY 14850

Action Item	Owner
1. LLPT members to upload any additional data and relevant information to FEMA's file transfer site and email Stephanie Nurre at <a href="mailto:stephanie.nurre@stantec.com">stephanie.nurre@stantec.com</a> upon completion.	Ithaca
<b>Login Information</b> <b>Browser link:</b> <a href="https://projsftp.stantec.com">https://projsftp.stantec.com</a> <b>FTP Client Hostname:</b> projsftp.stantec.com Port: 22 (can be used within an FTP client to view and transfer files and folder; e.g., FileZilla) <b>Login name:</b> LNYLAMPDP1559 <b>Password:</b> 3323987	
2. FEMA to refine the analyses as necessary and draft a levee analysis and mapping plan to be shared during the LLPT 3 meeting.	FEMA

## AGENDA

- Review Levee Flood Hazard
  - Cayuga Inlet Right Bank Levee System
- Review Results of Initial Data Analysis
- Discuss Application of Reach Study Procedures
- Discuss Next Steps in the Process

## OVERVIEW

The Federal Emergency Management Agency (FEMA) Region II levee team (FEMA levee team), the U.S. Army Corps of Engineers (USACE), and the New York State Department of Environmental Conservation (NYSDEC) engaged the City of Ithaca to identify flood hazards for non-accredited levees

# Meeting Notes

**ALAN SPRINGETT**  
FEMA

**SHUDIPTO RAHMAN**  
FEMA

**STEPHANIE NURRE**  
STARR II

**DAVID HAYSON**  
STARR II

**NECOLLE  
MACCHERONE**  
FEMA Outreach Consultant

**TOM SMITH**  
FEMA Outreach Consultant

as they relate to the Cayuga Inlet Right Bank Levee System. The first Local Levee Partnership Team (LLPT) meeting was held on September 18, 2017. The LLPT 2 meeting focused on reviewing the results of the Initial Data Analysis.

During the meeting, Alan Springett discussed the general flood risk in the U.S. and FEMA's perspective on accredited vs. non-accredited levees.

Stephanie Nurre and David Hayson provided a summary of the Initial Data Analysis for the Cayuga Inlet Right Bank Levee System.

## NOTES

As currently shown on the Flood Insurance Rate Map (FIRM), the levee system is shown as reducing flood risk as there is no Special Flood Hazard Area (SFHA) depicted in the leveed area.

FEMA considers this levee system as non-accredited as no data has been received in support of 44 CFR 65.10 levee accreditation requirements, which includes freeboard and other design criteria.

FEMA anticipates future mapping in Tompkins County to be part of the Seneca Watershed Study. Significant local effort has already been invested in this study area as the City of Ithaca has collaborated with the U.S. Geological Survey (USGS), which is restudying many streams in the area. Some details of this study differ from what FEMA typically uses for the FIRMs. For example, they are using peak flow on the four sub-watersheds and using a more conservative model than FEMA would to identify potential flood risk. The City plans to use the USGS maps as a tool for mitigation, but not to replace the regulatory requirements of the FEMA maps. FEMA may be able to leverage the USGS data to support future mapping of the 1-percent-annual-chance flood. USGS is using an older model, but it could be refined. The study areas may also differ between the FEMA study and the USGS study.

Community Rating System (CRS) discussions followed. The CRS is a voluntary program for recognizing and encouraging community floodplain management activities exceeding the National Flood Insurance Program's minimum standards. Flood insurance premium rates for residents within a CRS community are discounted to reward community actions that meet the goals of the CRS. Regulating to higher standards (as noted above) is one area that is eligible for CRS points. The City or Town may want to consider joining the CRS. Neither the City nor the Town of Ithaca are currently CRS communities.

# Meeting Notes

During the meeting, dates of the upcoming Tompkins County study were requested. Specific dates of the study have not been determined yet. FEMA will follow up with the community when this information is available. The Cayuga Inlet Right Bank levee is being evaluated as one reach.

The STARR II team conducting the Initial Data Analysis received as-built plans from 1967 and 1977 from the USACE for the two small levees on the left bank. These two levees were not looked at for this analysis because they are not protecting structures. A USACE periodic inspection report, a shoaling report, and a historic watershed report for Cayuga inlet and vicinities were also received.

The FEMA levee team asked whether there was any other information pertaining to the levee that may be available for the study. Local members of the LLPT indicated that the 1-percent-annual-chance stream flow data is higher than what was used in 1981, so the effective flow rates in the Flood Insurance Study and hydraulic models are lower than actual current conditions.

## **Results of Initial Data Analysis:**

Natural Valley Procedure – flow is shown on both sides of the levee. The effective HEC-2 hydraulic model on microfiche was converted to a digital HEC-RAS hydraulic model. A few modifications were made such as removing a railroad that is no longer a stream crossing, updating the control weir elevation based on as-built conditions, and extending the cross sections to the east and incorporating them. The Natural Valley scenario shows the result of an unconstrained flood zone. The inundation area is wider than effective “with-levee” condition, but the Base Flood Elevations are lower. It essentially shows what was there before the levee was constructed.

For this analysis, 1-dimensional modeling was used that reflected the water surface in the stream channel as extending to the overbank areas. Refining the 1-D model to a 2-dimensional hydraulic model is being considered to better reflect the potential flood risk in the leveed area.

The hydrograph for the 2-D analysis scaled up a recent storm hydrograph at the nearby stream gage to be consistent with the effective 1-percent-annual-chance peak flow rate.

The model may be refined in the future if scope allows, to refine the hydrology and hydraulics in the study area.

# Meeting Notes

## **Freeboard analysis:**

The levee crest elevations were taken from the National Levee Database (NLD). The levee continues upstream and downstream where it's possible that it could meet the freeboard minimums though not recorded in the NLD. If there is any effort that goes into surveying the top of the levee to get more information, this data could be added to this analysis to fill in some of the gaps. Currently, the analysis includes only the three points in the NLD.

## **Structural-Based Inundation:**

Three hypothetical breach locations were chosen based on FEMA's guidelines. The peak is when the breach begins to occur and generally spills out to the east. A breach width of 300 feet and a formation time of 15 minutes was used in the analysis. The composite inundation area resulting from the three breach analyses is not very different from the results of the Natural Valley analysis; however, the depth of the Structural-Based Inundation area was less.

Potential flood zones, including Zone AE and Zone D and their possible flood insurance implications were discussed.

A member of the LLPT identified an inconsistency on a mapped area between the various exhibits (see slide 11 and 12). The project team will check to verify that the same shapefile is being used in both examples.

A member of the LLPT asked whether the shoaling area would impact the analysis, as there is significant shoaling in the channel. A potential solution was to run an analysis both with and without dredging the channel. A study was conducted showing approximate consequences and amount to be dredged upwards of 600,00 cubic yards. This amount was confirmed by local team members. The team agreed to look at how we can use the shoaling report as part of this analysis. HEC-RAS version 5 could include the 1-D channel flow and show 2-D in the overbank. However, another team member pointed out that shoaling likely does not impact the study area because it occurs downstream of the flood control weir. It was suggested that issues from shoaling can be placed in FEMA's Coordinated Needs Management Strategy for consideration to help prioritize where areas of future study are needed.

## **ADDITIONAL DISCUSSION**

The Village of Nichols has recently completed the first levee accreditation in New York State. The Mayor of Nichols can share details on their experience and the work needed to meet FEMA's standards for accreditation. The Village used New York

# Meeting Notes

Rising funding to complete some of the effort. The process cost roughly \$125,000 per mile.

FEMA encouraged community officials to submit CLOMRs for any planned projects that might impact the level of flooding.

There is an operation and maintenance plan already in place. A warning system and an evacuation plan would also be needed; these may already be in place under an emergency management plan.

The City would like to consider moving forward with accreditation, due to the potential impacts in the leveed area if the Natural Valley SFHA were to be mapped in the future. The stream analysis may need to be enhanced. The data collection and Initial Data Analyses associated with this levee project will be shared with the LLPT.

FEMA reiterated that the purpose of the levee analysis and mapping approach is to give the community a better understanding of how much the levee reduces the flood risk under current conditions. In turn, this will allow the community to not only better understand their risk, but also take the appropriate steps to reduce that risk.



# Meeting Notes

Department of Homeland Security  
Federal Emergency Management Agency  
Region II – Mitigation Division



**ITHACA MEETING SIGN-IN SHEET**

Meeting Date/Time: Thursday, December 14, 2017  
3:00 PM – 5:00 PM

#	Name – PLEASE PRINT	Title	Organization/Town	E-Mail
1	Molly Safreed	Field Representative	Congressman Tom Reed	molly.safreed@mail.house.gov
2	Bruce Bstes	Director of Code Enforcement	Town of Ithaca	bkstes@townofithaca.ny.us
3	Jim Weber	Director of Public Works	Town of Ithaca	jweber@townofithaca.ny.us
4	Bill Coon	Hydrologist	U.S.G.S.	wcoon@usgs.gov
5	DAN FULLER	Flood Protection Engineer	NYS DEC - Kirkwood	daniel.fuller@dec.ny.gov
6	Mike Thorne	Asst of Public Works	City of Ithaca	mthorne@cityofithaca.org
7	Necolle Maccherone	CTP Lead	CERC - FEMA consultant	necolle.maccherone@mbakerintl.com
8	Alan Springett	Senior Engineer	FEMA	Alan.Springett@fema.dhs.gov
9	David Hayson	Project Engineer	Starr II	david.hayson@stantec.com
10	Stephanie Nurve	Project Mgr	STARR II	stephanie.nurve@stantec.com
11				
12				

**Appendix C**  
**Stakeholder Engagement - LLPT Meeting 3 Information**

[full Appendix Provided Separately](#)

# Meeting Notes

## ATTENDEES

**MICHAEL THORNE**  
City of Ithaca

**RAY BENJAMIN**  
City of Ithaca

**BRANDON MCGEE**  
Town of Enfield

**BUDDY ROLLINS**  
Town of Enfield

**ELIZABETH THOMAS**  
Town of Ulysses

**BILL COON**  
Town of Ulysses

**JAMES WEBER**  
Town of Ithaca

**C.J. RANDALL**  
Town of Danby

**MICHAEL MURPHY**  
Village of Dryden

**ANDREW SCIARABBA**  
T.G. Miller P.C.

**DAVID HERRICK**  
T.G. Miller P.C.

**MICHAEL HALL**  
Tompkins County Soil and  
Water Conservation District

**KEVIN DELANEY**  
NYS Department of  
Environmental Conservation

**BRAD WENSKOSKI**  
NYS Department of  
Environmental Conservation

**DAN FULLER**  
NYS Department of  
Environmental Conservation

**ARVIND GOSWAMI**  
NYS Department of  
Environmental Conservation

## CITY OF ITHACA LOCAL LEVEE PARTNERSHIP TEAM (LLPT) MEETING III

April 18, 2018 2:00-4:00 PM (EST)

### Location:

Common Council Chambers  
108 East Green Street  
Ithaca, NY 14850

Action Item	Owner
1. Send City a link to the recording and webinar notes on Nichols: the Road to Accreditation.	FEMA

## SUMMARY

The Federal Emergency Management Agency (FEMA) reviewed the Cayuga Inlet Right Bank Levee system with the City of Ithaca and other levee stakeholders comprising the LLPT for this levee project. The discussion agenda included review of the levee flood hazard, discussion of the draft levee plan, comments received regarding the draft plan, previously discussed levee topics, future analysis refinements and map updates, and an open forum.

Attendees discussed the fact that the draft levee plan includes an overview of the levee profile, LLPT and stakeholder engagement, freeboard profile comparison, initial data analysis and findings, and supporting data such as meeting notes, collected data, and further analyses.

Stephanie Nurre addressed the levee plan comments received from the City of Ithaca. Additionally, FEMA shared plans for a detailed flood study of the Cayuga Inlet in the future. The study will refine the effective analysis and provide the City with more data on flood risks in the area of the levee system and may affect the hazard data related to the levee. Additional outreach will take place to update the City on the project, once initiated.

## DISCUSSION

The landward side of levee is developed; however, the levee crest appears to be elevated above freeboard based on U.S. Army Corps of Engineers' (USACE) National

# Meeting Notes

**THOMAS BROWN**  
United States Army Corps of  
Engineers

**STEPHANIE NURRE**  
STARR II

**SHUDIPTO RAHMAN**  
FEMA

**ALAN SPRINGETT**  
FEMA

**JOHN DROMSKY-REED**  
COMPASS

**MUNJED BADWAN**  
COMPASS

**THOMAS SONG**  
CERC

**SYLVIA SCHMIDT**  
CERC

Levee Database survey points. Shudipto Rahman noted that the National Levee Database (NLD) only contained three survey points along the levee crest.

The as-built plans and available digital terrain data also indicate that levee crest is elevated above minimum freeboard requirements.

The planned detail flood study might change the Base Flood Elevation affecting the results of the levee analysis completed.

**Q:** U.S. Geological Survey (USGS) conducted a flood study for stream segments nearby. Could this be used for FEMA's project?

**A:** FEMA looks at all available data when undertaking a project. USGS uses different standards when conducting studies. FEMA will contact USGS to obtain the results and will anticipate how the data can be incorporated into our analysis.

Information regarding additional projects on channels in the area should be shared with FEMA and New York State Department of Environmental Conservation (NYSDEC). This information can be reviewed as part of a future flood study.

**Q:** The city expressed an interest in levee accreditation. Has there been any further discussions?

**Mike Thorne:** It is a matter of cost and getting more information about the process and work needed.

FEMA held a webinar that enabled the Village of Nichols to share their experience with levee accreditation. FEMA will be distributing the notes and the recording soon.

If the City is interested in joining the Community Rating System (CRS) program, FEMA and NYSDEC can help. CRS is a great way to help build resilience and save money on flood insurance. Communities who participate in the CRS program have higher floodplain management standards, which results in residents of the community having a lower flood risk. To reflect the reduced risk, flood insurance costs are lower in CRS communities.

## CLOSING

FEMA thanked everyone for attending and encouraged attendees to contact FEMA and NYSDEC in the future.

# Meeting Notes

USACE welcomed questions or concerns, and their contact information is included in the presentation.

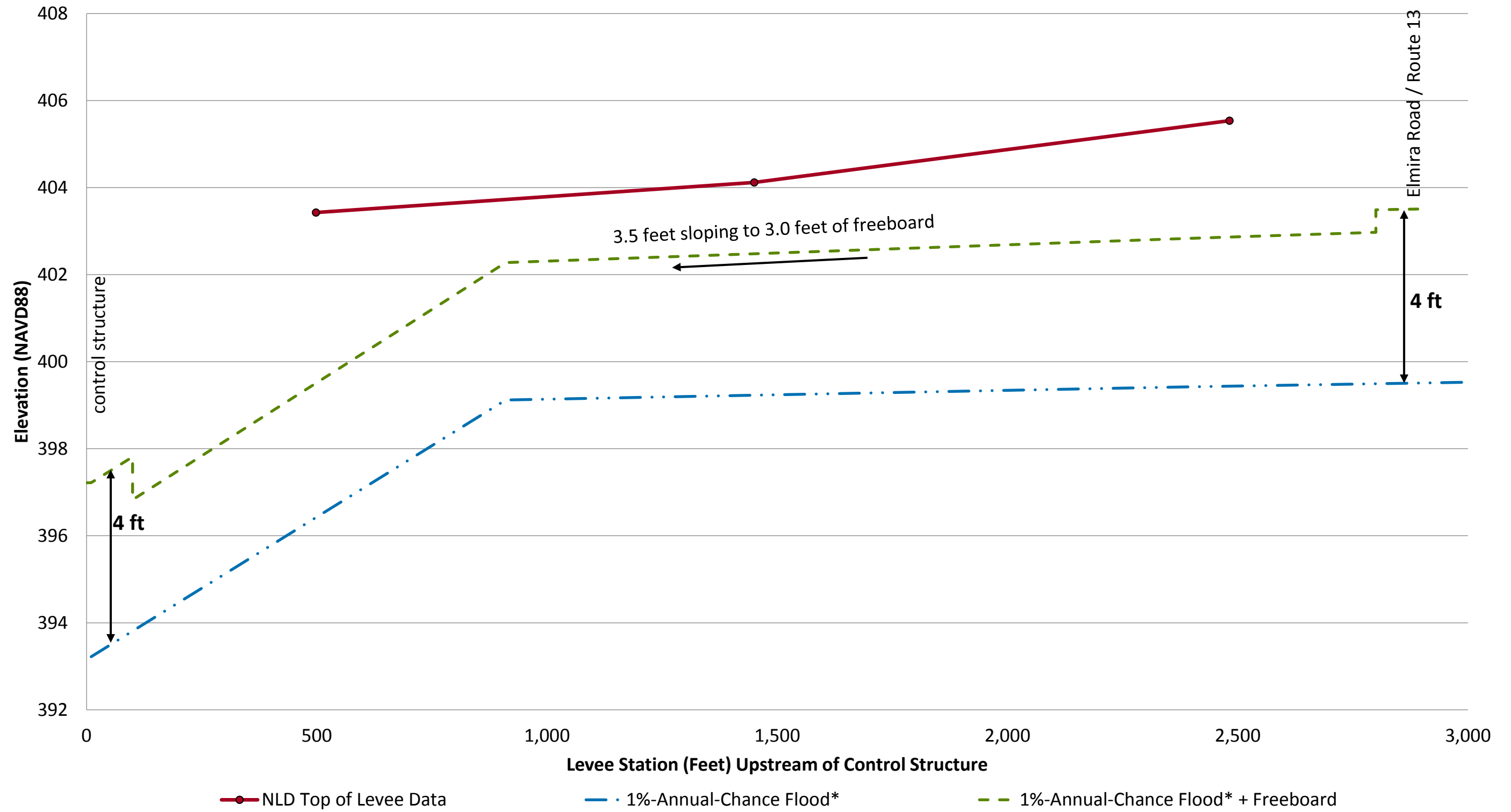


FEMA

**RiskMAP**  
Increasing Resilience Together

**Appendix D**  
**Freeboard Profile Comparison**

### Cayuga Inlet (Ithaca) Right Bank Levee Profile vs. 1%-Annual-Chance Flood



\*FEMA Effective HEC-2 Model for Cayuga Inlet

## **Appendix E**

### **Site Photographs**

[Appendix Provided Separately](#)



**Appendix F**  
**Levee Accreditation Checklist**

# Meeting the Criteria for Accrediting Levee Systems on NFIP Flood Maps

## How-to-Guide for Floodplain Managers and Engineers

A levee system is a flood protection 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. 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 Department of Homeland Security, Federal Emergency Management Agency (FEMA) and its State and local mapping partners review levee system data and documentation.

It is the levee owner's or community's responsibility to provide data and documentation to demonstrate that a levee system meets National Flood Insurance Program (NFIP) requirements as described in Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44 CFR Section 65.10), which you may view on the FEMA Web site at [www.fema.gov/plan/prevent/fhm/lv\\_fpm.shtm](http://www.fema.gov/plan/prevent/fhm/lv_fpm.shtm).

To be recognized as providing a 1-percent-annual-chance level of flood protection on the modernized NFIP maps, called Digital Flood Insurance Rate Maps (DFIRMs), levee systems must meet *and continue to meet* the minimum

design, operation, and maintenance standards (44 CFR Section 65.10)..

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 issued Procedure Memorandum No. 34 (PM 34), *Interim Guidance for Studies Including Levees*, on August 22, 2005. PM 34 provided clarification of the procedures provided in Appendix H of FEMA's *Guidelines and Specifications for Flood Hazard Mapping Partners*.

FEMA issued Revised Procedure Memorandum No. 43, *Guidelines for Identifying Provisionally Accredited Levees*, on March 16, 2007, which allows issuance of preliminary and, in some cases, effective DFIRMs while communities/levee owners compile and submit required data and documentation. FEMA issued Procedure Memorandum No. 45, *Revisions to Accredited Levee and Provisionally Accredited Levee Notations*, in April 2008 to clarify map notes for accredited and provisionally accredited levee systems.

This document provides information regarding the types of data and documentation that must be submitted for levee systems to be accredited on DFIRMs, including a checklist and an index of further resources you may wish to consult.

### COMMUNITIES WITH LEVEE SYSTEMS SHOULD KNOW:

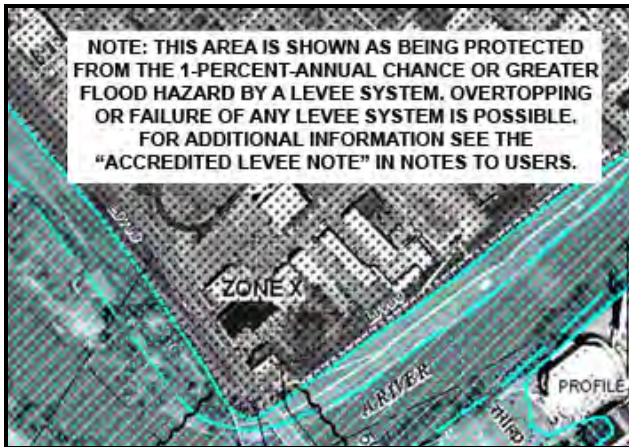
- The community and/or other party seeking recognition or continued recognition of a levee system must provide data and documentation showing that the levee system provides base (1-percent-annual-chance) flood protection for FEMA to credit the levee system with flood protection on a FIRM or DFIRM.
- Communities *must* actively participate in the levee system documentation process.
- Levee systems without sufficient data and documentation will not be credited with providing base flood protection.
- Some levee systems may qualify for the Provisionally Accredited Levee (PAL) designation.
- Guidance regarding the PAL designation and other levee issues is available at:

[www.fema.gov/plan/prevent/fhm/lv\\_fpm.shtm](http://www.fema.gov/plan/prevent/fhm/lv_fpm.shtm)



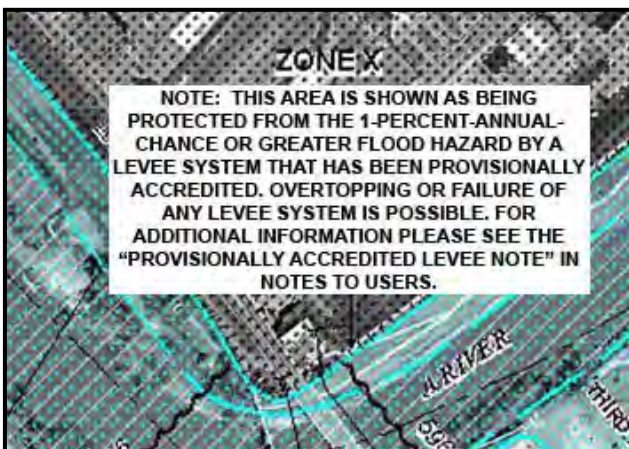
## HOW FEMA WILL MAP LEVEE SYSTEMS

FEMA mapping requirements are designed to provide the people living and working behind levee systems with accurate, up-to-date flood hazard and risk information so that they may make wise decisions to minimize damage and loss of life. 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 DFIRMs.



### Accredited Levee System

An accredited levee system is a system that FEMA has determined can be shown on a DFIRM as providing a 1-percent-annual-chance or greater level of flood protection. This determination is based on the submittal of data and documentation required by 44 CFR Section 65.10. The area landward of an accredited levee system is shown as a moderate-risk area, labeled Zone X (shaded), on the DFIRM except for areas of residual flooding, such as ponding areas, which will be shown as high-risk areas, called Special Flood Hazard Areas (SFHAs). Flood insurance is not mandatory in Zone X (shaded) areas, but is mandatory in SFHAs. FEMA strongly encourages flood insurance for all structures in levee-impacted areas.



### Provisionally Accredited Levee (PAL) System







The PAL designation may be used for a levee system that FEMA has previously accredited with providing 1-percent-annual-chance flood protection on an effective FIRM/DFIRM, and for which FEMA is awaiting data and/or documentation that will show the levee system is compliant with 44 CFR Section 65.10. Before FEMA will apply the PAL designation to a levee system, the community or levee owner will need to sign and return an agreement indicating the data and documentation required for compliance with 44 CFR Section 65.10 will be provided within a specified timeframe. The impacted area landward of a PAL system also is shown as a moderate-risk area, labeled Zone X (shaded). Therefore, flood insurance is not mandatory for insurable structures in the levee-impacted area; however, it is strongly encouraged by FEMA as are other protective measures.



### Levee System Not Accredited or De-accredited

If the levee system is not shown as providing 1-percent-annual-chance flood protection on an effective FIRM, the system is considered “not accredited” and the levee-impacted area is mapped as Zone AE or Zone A on a DFIRM, depending on the type of study performed for the area. If the levee system was previously shown as providing 1-percent-annual-chance flood protection on an effective FIRM or DFIRM, but does not meet the PAL requirements or is no longer eligible for the PAL designation, FEMA will de-accredit the levee system and re-map the levee-impacted area as an SFHA, labeled Zone AE or Zone A depending on the type of study performed. Flood insurance will be required for insurable structures with federally backed mortgages in SFHAs.



Design Criteria*	Section of the NFIP Regulations: 65.10(b)
<p><b>Description:</b> 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. The following requirements must be met:</p>	
<p><b>Checklist for Design Criteria:</b></p>	
	<p><b>Freeboard.</b> Minimum freeboard required 3 feet above the Base Flood Elevation (BFE) all along length, and an additional 1 foot within 100 feet of structures (such as bridges) or wherever the flow is restricted. Additional 0.5 foot at the upstream end of a levee. Coastal levees have special freeboard requirements (see Paragraphs 65.10(b)(1)(iii) and (iv)).</p>
	<p><b>Closures.</b> All openings must be provided with closure devices that are structural parts of the system during operation and designed according to sound engineering practice.</p>
	<p><b>Embankment Protection.</b> 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.</p>
	<p><b>Embankment and Foundation Stability Analyses.</b> 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, <i>Design and Construction of Levees</i>, (Chapter 6, Section II), may be used.</p>
	<p><b>Settlement Analyses.</b> 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, <i>Soil Mechanics Design— Settlement Analysis</i>, must be submitted.</p>
	<p><b>Interior Drainage.</b> 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.</p>



<b>Operation Plan*</b>	<b>Paragraph 65.10(c)(1) of the NFIP Regulations</b>
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**Description:** For a levee system to be recognized (i.e., accredited), the operational criteria must be as described below. 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.

<b>Checklist for Operation Plan:</b>	
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<input type="checkbox"/>	<b>Flood Warning System.</b> 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.
<input type="checkbox"/>	<b>Plan of Operation.</b> A formal plan of operation including specific actions and assignments of responsibility by individual name or title.
<input type="checkbox"/>	<b>Periodic Operation of Closures.</b> Provisions for periodic operation, at not less than one-year intervals, of the closure structure for testing and training purposes.
<input type="checkbox"/>	<b>Interior Drainage Plan.</b> See below.



<b>Interior Drainage Plan</b>	<b>Paragraph 65.10(c)(2) of the NFIP Regulations</b>
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**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 protection purposes only if the following minimum criteria are included in the operation plan.

<b>Checklist for Interior Drainage Plan:</b>	
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<input type="checkbox"/>	<b>Flood Warning System.</b> 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.
<input type="checkbox"/>	<b>Plan of Operation.</b> A formal plan of operation including specific actions and assignments of responsibility by individual name or title.



	<b>Manual Backup.</b> Provision for manual backup for the activation of automatic systems.
	<b>Periodic Inspection.</b> 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.
<b>Maintenance Plan</b>	<b>Paragraph 65.10(d) of the NFIP Regulations</b>

**Description:** For levee systems to be recognized as providing protection from the base flood (i.e., 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 being 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 that 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. Also, certified “as-built” plans of the levee must be submitted. 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 Professional Engineer or certified by a Federal agency.
	Certified as-built levee plans are included in the submittal.

## 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 larger flood events.

Levee systems also decay over time. They require regular maintenance and periodic upgrades to retain their level of protection. When levees do fail, they often fail catastrophically. 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 protection, by floodproofing, or by taking other protective measures.

## CHECKLIST INFORMATION

The checklist provided in this fact sheet is meant to assist local community officials and levee owners in gathering the data and documentation that will be required for FEMA to show a levee system as providing 1-percent-annual-chance flood protection on the community's DFIRM. Where possible, text from the actual NFIP regulations (44 CFR Section 65.10) was used.

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

Design Criteria*	Section of the NFIP Regulations: 65.10(b)
	<b>Description:</b> 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.

For a comprehensive description of each item in this checklist, please see Appendix H of the *Guidelines and Specifications for Flood Hazard Mapping Partners*. Locations of this resource, and other useful resources, are provided below.

## INDEX OF RESOURCES

This fact sheet is accessible, along with an assortment of other levee-related resources, through a dedicated portion of the FEMA Web site. The gateway to the FEMA-provided levee information, which is organized by stakeholder group to assist levee owners, community officials, and other stakeholders, is [www.fema.gov/plan/prevent/fhm/lv\\_intro.shtm](http://www.fema.gov/plan/prevent/fhm/lv_intro.shtm). The FEMA resources referenced in this fact sheet, listed below, are directly accessible through [www.fema.gov/plan/prevent/fhm/lv\\_fpm.shtm](http://www.fema.gov/plan/prevent/fhm/lv_fpm.shtm).

- Procedure Memorandum No. 34, *Interim Guidance for Studies Including Levees*
- Revised Procedure Memorandum No. 43, *Guidelines for Identifying Provisionally Accredited Levees*.
- Procedure Memorandum No. 45, *Revisions to Accredited Levee and Provisionally Accredited Levee Notations*
- Appendix H, "Mapping of Areas Protected by Levee Systems," of *Guidelines and Specifications for Flood Hazard Mapping Partners*.
- Section 65.10. *Mapping of Areas Protected by Levee Systems* of the NFIP regulations.

Flood insurance information can be found at [www.fema.gov/business/nfip](http://www.fema.gov/business/nfip) or on the NFIP's consumer Web site, [www.FloodSmart.gov](http://www.FloodSmart.gov).

Links to the USACE Web site also are provided on the levee-dedicated pages; the resources discussed in this fact sheet are accessible through the USACE Web page at [www.usace.army.mil/publications/eng-manuals](http://www.usace.army.mil/publications/eng-manuals).

## **Appendix G Collected Data**

[Appendix Provided Separately](#)



## **Appendix H**

### **Initial Data Analysis**

[Full Appendix Provided Separately](#)



## MEMORANDUM

**To:** Shudipto Rahman, Alan Springett

**From:** Stephanie Nurre, David Hayson

**Cc:** Srikanth Koka

**Date:** February 8, 2018

**Subject:** Analysis and Mapping Procedures for Non-Accredited Levees - Initial Data Analysis  
City of Ithaca, Town of Ithaca, Tompkins County, NY

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### Purpose

This memorandum summarizes the application of Natural Valley (NV) and Structure-Based Inundation (SBI) procedures for developing flood hazard data for the Cayuga Inlet Right Bank Levee system adjacent to the Cayuga Inlet in the City of Ithaca and Town of Ithaca, Tompkins County, New York (Figure 1). The Cayuga Inlet Right Bank Levee system is part of the Ithaca Flood Damage Reduction Project. The Cayuga Inlet Left Bank Levee systems were not addressed through the Analysis and Mapping Procedures for Non-Accredited Levees Process at the discretion of the Town of Ithaca.

The hydrologic and hydraulic assumptions, approaches, and methodology applied to develop NV and SBI floodplains for the 1-percent-annual-chance flood are summarized in the sections that follow. Details on the general guidance for these procedures are available in "[Analysis and Mapping Procedures for Non-Accredited Levee Systems](#)". Details regarding specific attributes of the levee system and available data will be included in the Analyses and Mapping Plan.

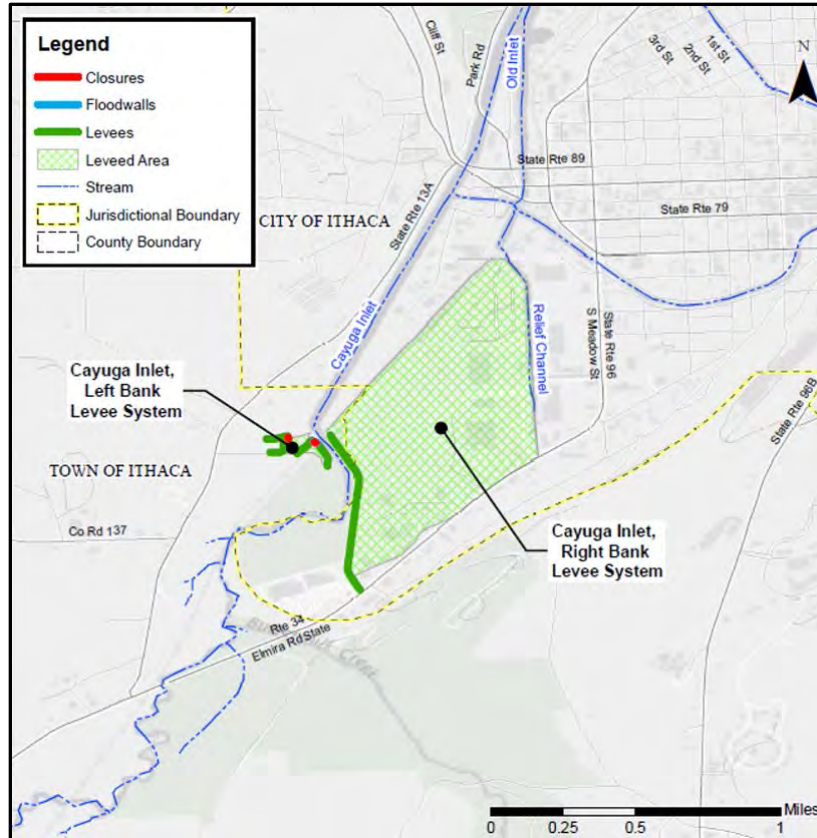


Figure 1: Levee Systems at the City of Ithaca and Town of Ithaca, NY

## Hydrology: Methodology

This section summarizes methods and source data used for the development of 1-percent-annual-chance flow hydrographs used in the two-dimensional (2-D) unsteady-state model of the NV and SBI Procedures. The effective City of Ithaca and Town of Ithaca, Tompkins County, New York Flood Insurance Study (FIS) report flowrates were used for the one-dimensional (1-D) steady-state models leveraged to develop the 2-D unsteady-state model of the Cayuga Inlet.

Because the effective hydrologic model was not available for Cayuga Inlet, a hydrograph was developed for the stream to simulate the peak 1-percent-annual-chance flood in the effective FIS report of 11,600 cfs using data from the U.S. Geological Survey (USGS) stream gage site 04233255 along Cayuga Inlet at Ithaca, New York. Figure 2 shows the location of the stream gage which is located near the drop structure near the downstream end of the Cayuga Inlet Right Bank Levee system.

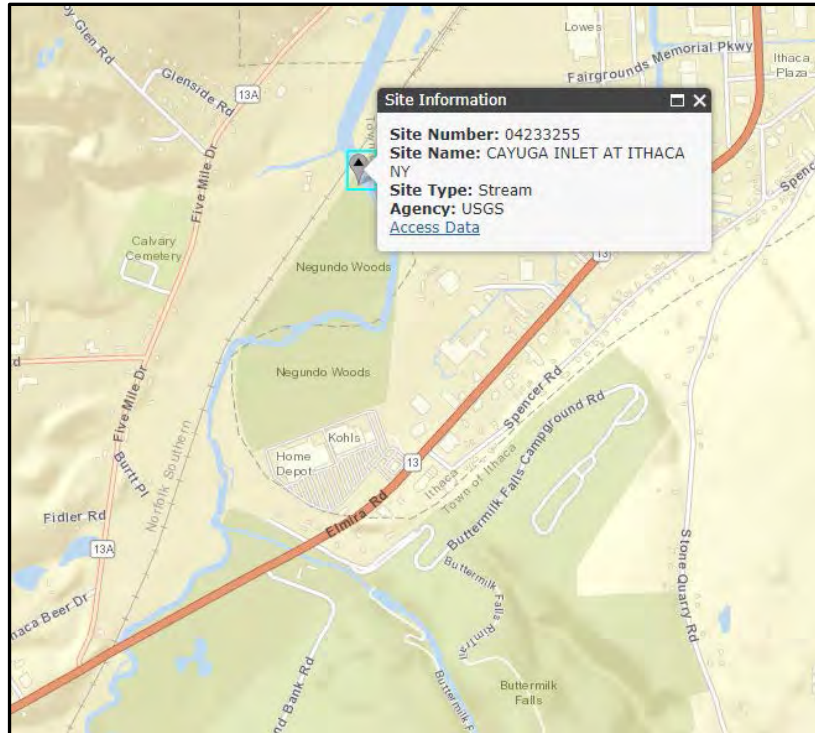


Figure 2 – Cayuga Inlet Stream Gage at Ithaca, New York

Historical, instantaneous discharge data was available after 2012 at the Cayuga Inlet at Ithaca USGS stream gage. A historic event recorded on June 14, 2015 resulted in a peak discharge of 9,760 cfs. This hydrograph was scaled up to achieve the effective peak of 11,600 cfs and was used in the 2-D unsteady-state analyses. These two hydrographs were plotted together for reference purposes in Figure 3.

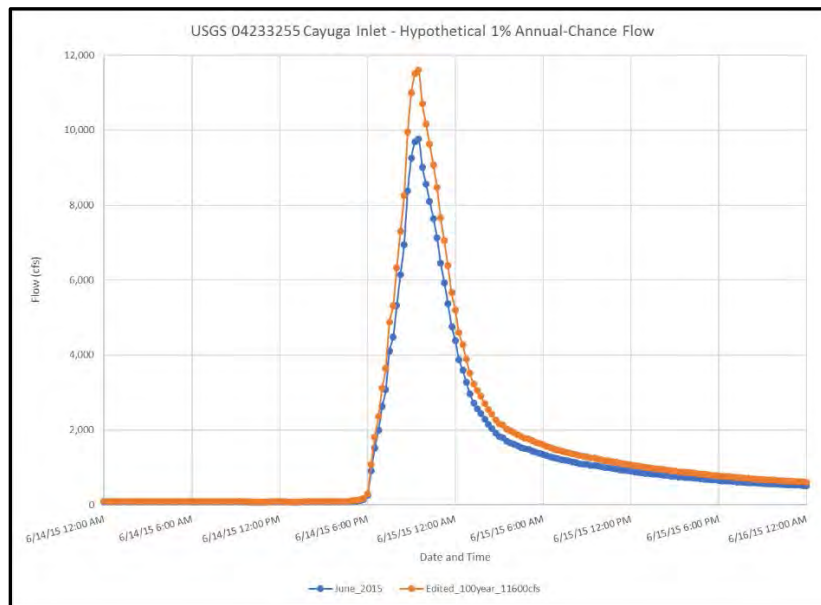


Figure 3 – Peak Discharge Comparison Plot

## **Hydraulics: Methodology**

This section summarizes hydraulic methods and assumptions used to model NV and SBI Procedures for the Cayuga Inlet Right Bank Levee system. Models used for this analysis were adapted and refined from the scanned image files of the effective HEC-2 model for the Cayuga Inlet.

### **Natural Valley Procedure**

A selected reach of the HEC-2 model within the study area was converted into the HEC-RAS format, version 5.0.3 and NAVD88 datum. The converted model extended from about 1,500 feet downstream of a railroad bridge at river station 3148000 (HEC-2 lettered section "H") at the downstream end to about 2,600 feet downstream of Elmira Road/State Route 13 at river station 3152000 at the upstream end. The water surface elevations in the converted HEC-RAS hydraulic model were typically within 0.5 feet of the HEC-2 model at most locations.

To provide the best available modeling for the Initial Data Analyses, the converted HEC-RAS model was refined to update the river centerline and reach lengths to match recent aerial imagery. Effective HEC-2 cross sections were spatially georeferenced and extended for mapping purposes. Several new cross sections were added for the analysis to generate better mapping. The control structure dimensions and elevations were modified based on as-built construction drawings. Levee stations and ineffective flow stations were also added.

The results of the 1-D steady-state NV Procedure yielded notably higher water surface elevations than the 2-D unsteady-state SBI analysis; therefore, a 2-D analysis of the NV Procedure was developed. For this unique levee system analysis, development a 2-D unsteady-state analysis for the NV Procedure yielded a more consistent comparison to the SBI Procedure, also typically evaluated using a 2-D unsteady-state analysis.

The channel Manning's "n" roughness coefficients were adjusted to "calibrate" the water surface elevations observed in the 2-D unsteady-state model to compare to the 1-D steady-state effective model. A 2-D mesh flow area was developed on the right overbank of the Cayuga Inlet parallel to Elmira Road (State Route 13) and the Cayuga Inlet. For the purposes of this Initial Data Analysis, the 2-D mesh area was stopped at the downstream end parallel to the lettered "Cross Section H". The floodplain extents are likely to extend beyond the area mapped and included in the study area. A 2-D boundary condition was applied utilizing normal depth at this location.

The 2-D HEC-RAS model utilizes a mesh (based on a DEM downloaded from NYSGIS Clearinghouse), that controls the movement of water through the 2-D flow area, to evaluate and plot the inundation area resulting from the NV analysis or a hypothetical breach. A Manning's "n" land cover layer was generated based on aerial imagery to simulate the approximate roughness coefficients experienced by overland flow.

The Natural Valley Procedure was modeled for the Cayuga Inlet Right Bank Levee system by removing the topographic features of the levee from the 2-D model and connecting the cross sections to the 2-D mesh, and allowing the discharge to flow from the Cayuga Inlet naturally as if the levee was not in place.

### **Structural-Based Inundation Procedure**

The georeferenced, steady-state, converted HEC-RAS model was also used to develop an unsteady-state, 2-D model for the SBI Procedure. For the SBI Procedure, hypothetical breaches of the levee system were simulated at three locations to evaluate the potential flood risk to the area east of the levee within the NV inundation area for the 1-percent-annual-chance flood. No locations of levee impairment or historic breaches were reported along the levee system to assist in the selection of the modeled breach locations.

The existing levee system is earthen levee. Engineering judgement was used to select the breach parameters used in this analysis and were based on values recommended in FEMA Operating Guidance 12-13. The parameters used for the breach analyses are presented in the table below. Each breach shape was trapezoidal with a breach weir coefficient of 2.6. The failure mode used was piping with a piping coefficient of 0.6 and a linear breach progression with 1:1 side slopes.

<b>Breach ID</b>	<b>Modeled Station</b>	<b>Final Bottom Width (feet)</b>	<b>Initial Piping /Final Bottom Elevation (feet)</b>	<b>Breach Formation Time (hours)</b>
1	675	300	393.93	0.25
2	1500	300	390.95	0.25
3	2600	300	390.60	0.25

Table 1 - Breach Parameters

Each breach model run produced slightly different inundation extents. The simulated volume of water leaving Cayuga Inlet during a breach was not a significant fraction of the total hydrograph volume. The volume transfer between the Cayuga Inlet and the breach area occurs rapidly (over about two hours) while the peak of the inflow hydrograph within the Cayuga Inlet occurs over a couple of hours. Reasonable variation to the breach parameters is not expected to significantly change the results of the Structural-Based Inundation Procedure.

### **Results**

Results for all modeling scenarios were presented at the LLPT 2 meeting and follow-up touchpoint call. Summary results are available in the presentation slides, and will be included in Analysis and Mapping Plan.