Levee Analysis and Mapping Plan
Moravia Flood Damage Reduction Project

Village of Moravia, New York

May 2018

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
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 are 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.

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

Levee 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 are 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 a 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 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 in the 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 undetermined but possible flood hazard.

*All definitions on this page except for these 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 Village of Moravia (Village), Cayuga County, New York depict the leveed area of the Dry Creek Right Bank Levee (part of the Moravia 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 mapping guidance was revised in 2013 to incorporate a new Analysis and Mapping Procedures for non-accredited levees which provides a suite of flexible procedures to perform flood hazard analysis and mapping (see Section 1 of this report). The Village 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 Village may have to show the flood hazard within the leveed area on a future FIRM.

In September of 2017, FEMA Region II collaborated with stakeholders in the Village to form a Local Levee Partnership Team (LLPT) and worked to determine potential Levee Analysis and Mapping Procedures for the Dry Creek 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 Village (see Section 6). The Village is currently weighing the benefits and costs of associated with the levee accreditation process for the Dry Creek Right Bank Levee. Accreditation of the levee system would continue to depict the flood hazard reduction within the leveed area currently shown on the effective FIRM included as Appendix C. Should the Village elect not to accredit the levee, future FIRMs may depict the leveed area as high risk Special Flood Hazard Area (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 flood hazard reduction during a base (1-percent-annual-chance) flood. This was called 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 (STARR II) and Community Engagement and Risk Communication contractor (CERC) initiated the Levee Analysis and Mapping Procedures process for the levee in the Village. Recent technological advances in data collection methods and hydrologic and hydraulic modeling were leveraged as part of this process. FEMA's Analysis and Mapping Procedures for non-accredited levees is a more refined approach to mapping flood hazards in leveed areas.

The Analysis and Mapping Procedures for non-accredited levees process also:

- Identifies and 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 Dry Creek Right Bank Levee in the Village is non-accredited. In coordination with the community, FEMA is using the Analysis and Mapping Procedures for non-accredited levees process to develop refined flood hazard mapping in leveed areas. This will inform the Village's decision on how they would like to proceed with depiction of the levee-related flood hazards.

This report is the result of the collaboration between FEMA, the Village, Cayuga 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 community's preferred Levee Analysis and Mapping Procedure.

2 Levee System Description

2.1 Flood Protection Measures in the Village of Moravia

The Dry Creek Right Bank Levee was built in 1948 by USACE as part of the Moravia Flood Damage Reduction Project. As part of the project, the Dry Creek channel was cleared of debris and a levee was constructed along the right descending bank from the Lehigh Valley Railroad bridge approximately 2,200 feet upstream to a point about 480 feet

upstream of Route 38. The Dry Creek Right Bank Levee system is owned and maintained by the NYSDEC. The Village of Moravia assists NYSDEC with maintenance of the levee system.

The alignment of the Dry Creek Right Bank Levee system is shown in Figure 1. The earthen embankment is approximately 0.4 miles in length along Dry Creek. The drainage area of Dry Creek at its confluence with Owasco Inlet is approximately 6.7 square miles.

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[1]
Cayuga County	Village of Moravia	Yes	N/A

[1] SFHA in leveed area not identified on August 2, 2007 FIRM. See Table 4 for additional information regarding potentially impacted structures with respect to the Natural Valley inundation area.

Table 2. Community Map History

Community	Initial Identification	Flood Hazard Boundary Map Revision Date(s)	FIRM Effective Date	FIRM Revision Date(s)
Village of Moravia	May 3, 1974	N/A	September 30, 1982	August 2, 2007

A countywide FIS report was issued for Cayuga County, New York on August 2, 2007. According to the FIS report, "In 1962, the USACE constructed a levee in the Village of Moravia along the northern bank of Dry Creek, from NYS Route 38 west to the railroad". While the levee system may provide some level of flood hazard reduction, the level of flood hazard reduction has not been identified with respect to the 1-percent-annual-chance flood. FEMA did not publish the section on levee risk 44CFR§65.10 until Vol. 51 Federal Register 30316, August 25, 1986.

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
Gary Mulvaney	Village of Moravia, Mayor mayorofmoravia@scccinternet.com
Patrick Doyle	Village of Moravia, Code Enforcement Officer jpdoyleiii@hotmail.com
Gary Fickeisen	Village of Moravia, Trustee gary@chronicleguidance.com
Bruce Natale	Cayuga County bnatale@cayugacounty.us
Tom Haag	Representative John Katko's Office, Field Representative Tom.haag@mail.house.gov
Paul Coca	USACE, H&H Engineering Team Lead Paul.a.coca@usace.army.mil
Jason Doktor	USACE, Civil Engineer Jason.p.doktor@usace.army.mil
Alan Fuchs	NYSDEC 518-402-8185; Alan.fuchs@dec.ny.gov
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Daniel Fuller	NYSDEC 607-775-2545; daniel.fuller@dec.ny.gov
Arvind Goswami	NYSDEC 518-402-8186; Arvind.goswami@dec.ny.gov

LLPT Member	Contact Information
Kevin Delaney	NYSDEC Kevin.delaney@dec.ny.gov
Alan Springett	FEMA Region II 26 Federal Plaza, New York NY 13820 212-680-8557; alan.springett@fema.dhs.gov
Shudipto Rahman	FEMA Region II, Project Monitor 26 Federal Plaza, New York NY 13820 202-702-4273; shudipto.rahman@fema.dhs.gov
Curtis Smith	FEMA Region II Regional Service Center Lead 646-490-3929; curtis.smith@stantec.com
Stephanie Nurre	STARR II, FEMA Mapping Consultant Project Manager 135 S. LaSalle Street, Suite 3100, Chicago, Ill 312-262-2284; stephanie.nurre@stantec.com
Nick Mueller	STARR II, FEMA Mapping Consultant 513-842-8200; nick.mueller@stantec.com
David Hayson	STARR II, FEMA Mapping Consultant 513-842-8200; david.hayson@stantec.com
Paige Mandy	CERC, FEMA Outreach Consultant 212-880-5295; paige.mandy@ogilvy.com
Thomas Song	CERC, FEMA Outreach Consultant 914-343-6696; thomas.song@mbakerintl.com
Sylvia Schmidt	CERC, FEMA Outreach Consultant Sylvia.schmidt@mbakerintl.com

4 Stakeholder Engagement

4.1 LLPT Meeting 1

A FEMA-led project team engaged the Dry Creek Levee stakeholders at the LLPT Meeting 1 held at the Village 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 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. Additional details regarding the LLPT 2 meeting are provided in Appendix B and information from the data collection are provided in Appendices D through I. The Initial Data Analysis is described in Section 5.

4.3 LLPT Meeting 3

A LLPT Meeting 3 was held on April 20, 2018 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 identified as appropriate. This informed the discussions in LLPT Meeting 2 and the touchpoint call prior to LLPT Meeting 3. Details are provided below of the reach analysis and application of reach analysis procedures. Supporting data is provided in Appendix I.

5.1 Reach Analysis

Topographic data and levee crest survey data from the USACE National Levee Database 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.

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.

Based on the review of the available levee crest data, the Dry Creek Right Bank Levee appears to meet minimum freeboard requirements of 44CFR§65.10 except at the downstream end near the existing old railroad bridge; however, the levee is above the 1-percent-annual-chance flood elevation. This area could be further investigated to identify why the levee crest is lower; however, LLPT members indicated that a small section of the levee might have been modified to accommodate snowmobile access to the stream crossing. The levee crest comparison is provided in Appendix E.

It should be noted that the downstream end of the levee system ties-in to high ground near the old railroad embankment. The old railroad embankment may be considered a non-levee reach, as it was not originally designed as a levee, but may serve as an extension of the levee if the levee ties-into it. Typically, non-levee reaches are not recognized as levees and, therefore, cannot be mapped as reducing flood risk on a FIRM.

A non-levee reach could be recognized as a levee by FEMA (subject to accreditation or reach analysis procedures) if it can be certified to meet the minimum requirements of

44CFR§65.10, including that it is operated and maintained as a levee. The burden of proof falls on the stakeholder seeking recognition of the old railroad embankment as a levee. This may be feasible; however, the status of the high ground at the downstream end of the levee system could be further evaluated to verify it can be certified and recognized as part of the levee system.

For the purposes of the Initial Data Analysis, the high ground at the downstream tie-in of the levee system was recognized as part of the levee system for the application of reach analysis procedures.

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 was completed through hydraulic modeling of the levee system by allowing flow to be conveyed on both sides of the levee. This is used to set a baseline area of inundation against which other procedures can be evaluated. For the Moravia Levee System, the hydraulic modeling analysis was completed using HEC-RAS 5.0.3 (2-Dimensional, unsteady flow).

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 Dry Creek Right Bank Levee (upstream, central, and downstream). The breach locations were developed for modeling and informational purposes only and do not indicate historic or future breach development at these locations.

5.4 Freeboard Deficient Procedure

The Dry Creek Levee crest elevations were noted to be elevated at or above the BFE except at the downstream end at the old railroad bridge as noted in Section 5.1; therefore, the freeboard deficient procedure was deemed applicable. As noted in Section 5.1, the tie-in to high ground at the downstream end of the levee system should be further investigated.

5.5 Sound Reach Procedure

For the Dry Creek Right Bank Levee system, since initial review indicated that this levee system is subject to single reach analysis, the Sound Reach Procedure would not be applicable. The 44CFR§65.10-compliant data required to obtain a Sound Reach designation for a single levee reach would result in accreditation of the levee system.

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.

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 (2-Dimensional, unsteady-state flow). The effective Zone A SFHA for Morse Creek and Zone AE SFHA for Owasco Inlet are also shown on Figure 2 for reference purposes. Figure 3 shows the approximate depth grid for the Natural Valley Procedure.

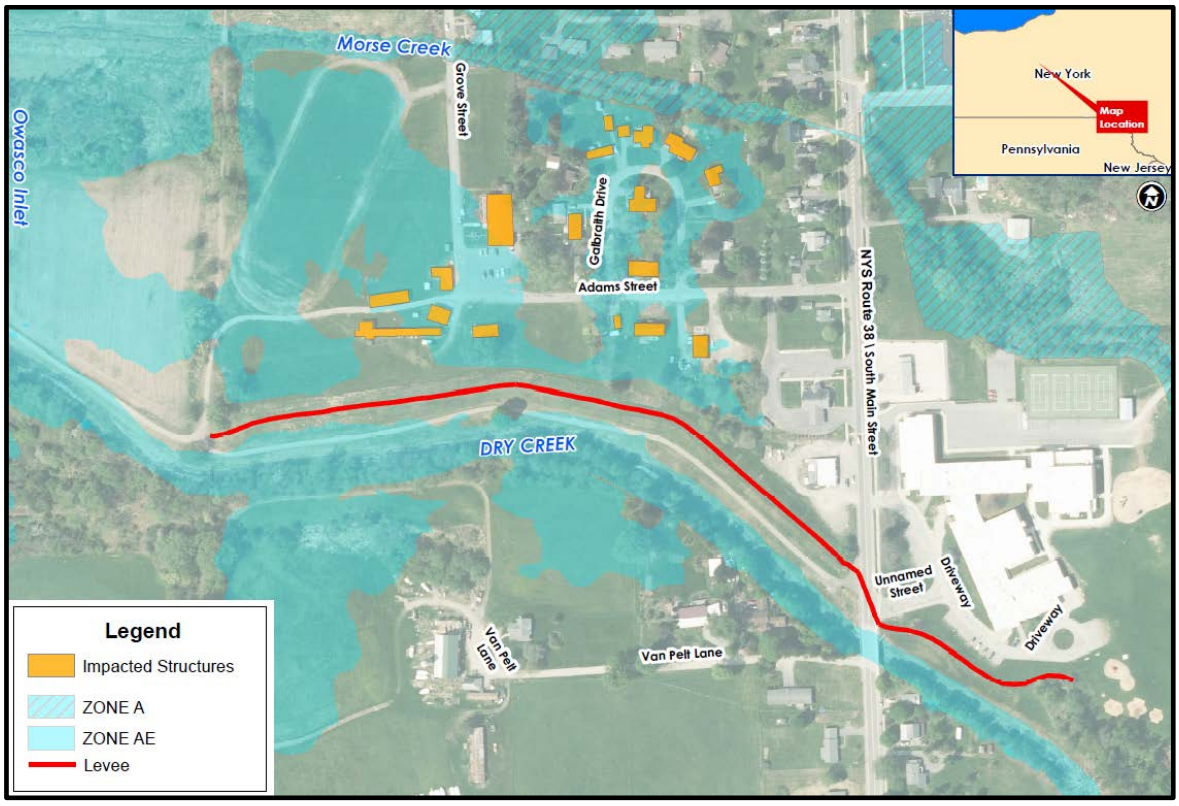

Figure 2: Natural Valley Procedure

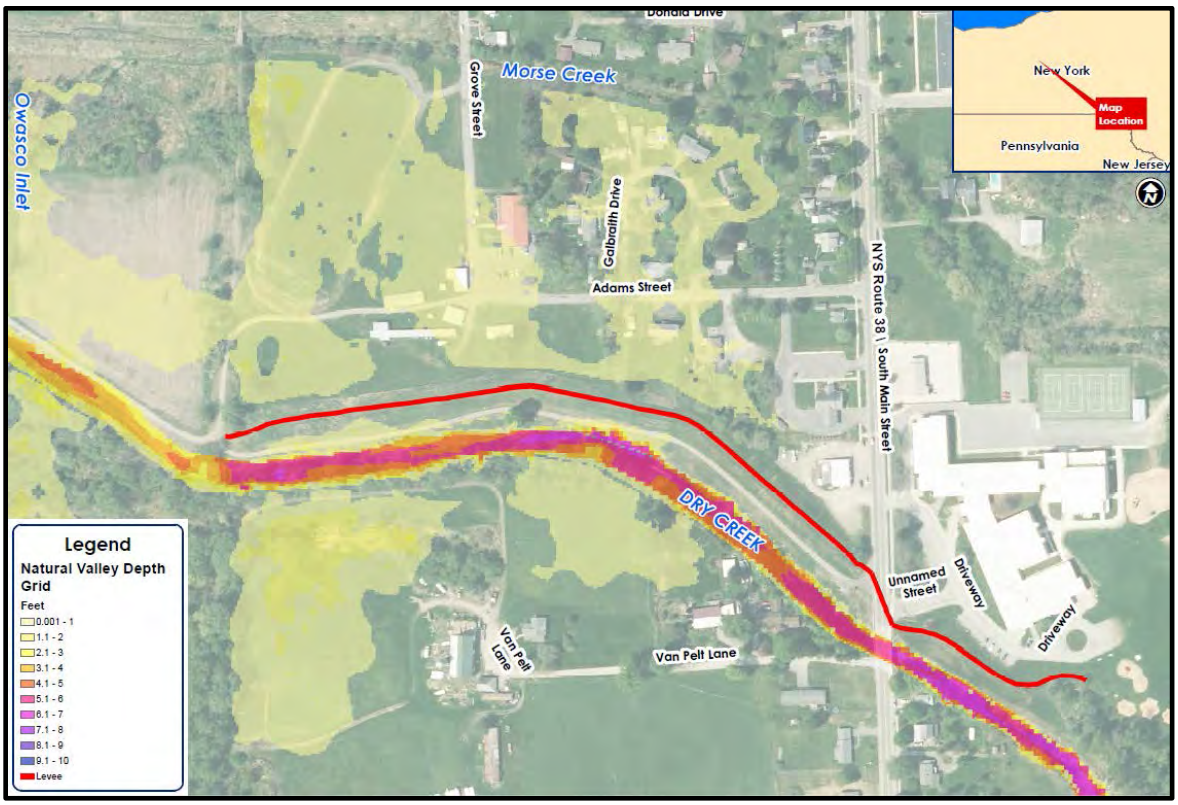

Figure 3: Natural Valley Procedure Flood Depth Grid[2]

The Structural-Based Inundation Procedure yields a slightly larger inundation area within compared to the Natural Valley analysis within the leveed area. This analysis is more conservative than the Natural Valley analysis and could be used by the community for emergency planning purposes. Figure 4 shows the composite inundation area resulting from these analyses completed using HEC-RAS 5.0.3 (2-Dimensional, unsteady flow). The effective Zone A SFHA for Morse Creek and Zone AE SFHA for Owasco Inlet are also shown on Figure 4 for reference purposes. Figure 5 shows the approximate depth grid for the Structural-Based Inundation Procedure.

[2] Depth grid shown for Natural Valley Procedure for Dry Creek only. Morse Creek and Owasco Inlet depth grid flood inundation data not shown.

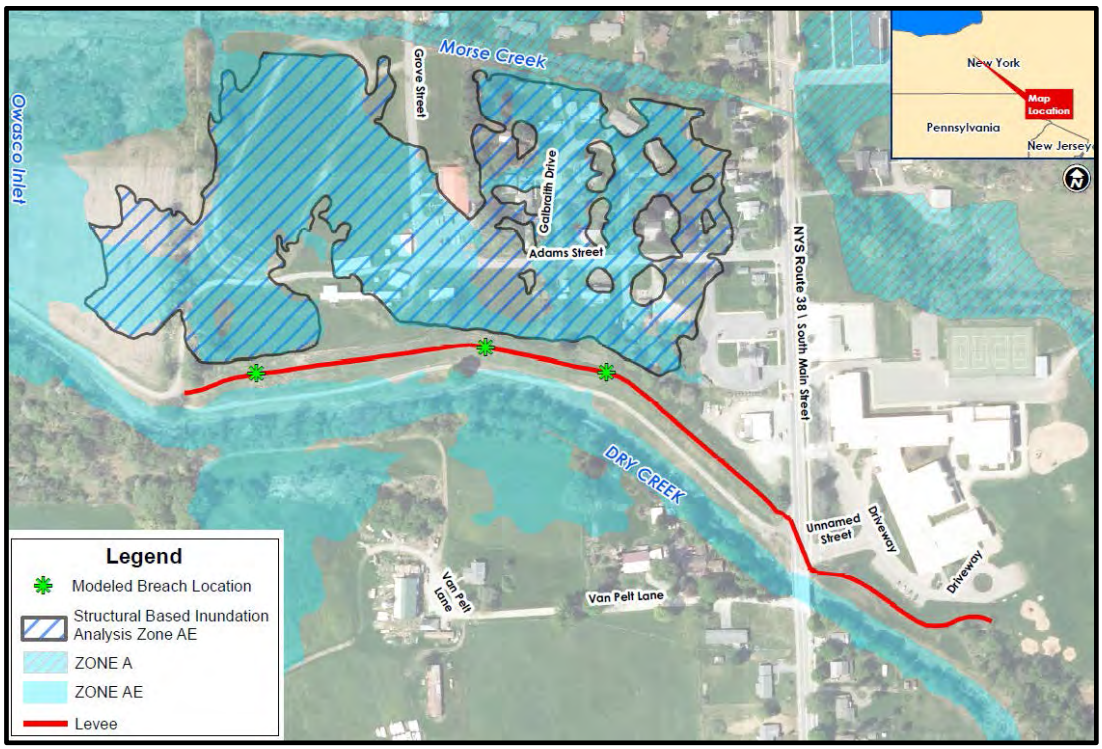

Figure 4: Structural-Based Inundation Procedure Compared to Natural Valley Procedure

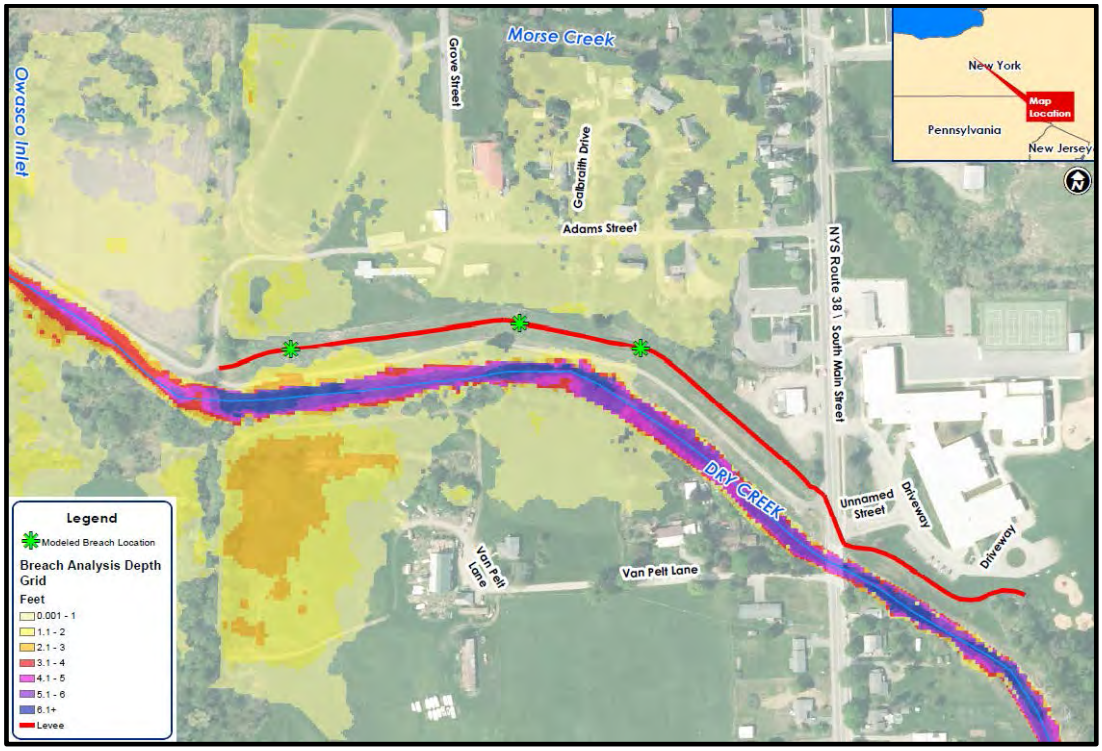

Figure 5: Structural-Based Inundation Procedure Flood Depth Grid[3]

[3] Depth grid shown for Structural-Based Inundation Procedure and Dry Creek only. Morse Creek and Owasco Inlet depth grid or flood inundation data not shown.

To revise the FIRM to reflect the Freeboard Deficient Procedure for the Dry Creek Right Bank Levee reach, 44CFR§65.10-compliant data would need to be received and accepted by FEMA for the entire levee system (including the downstream tie-in); however, the minimum levee crest elevations would be at or above the BFE for Dry Creek along the entire length of the levee, but below minimum freeboard requirements.

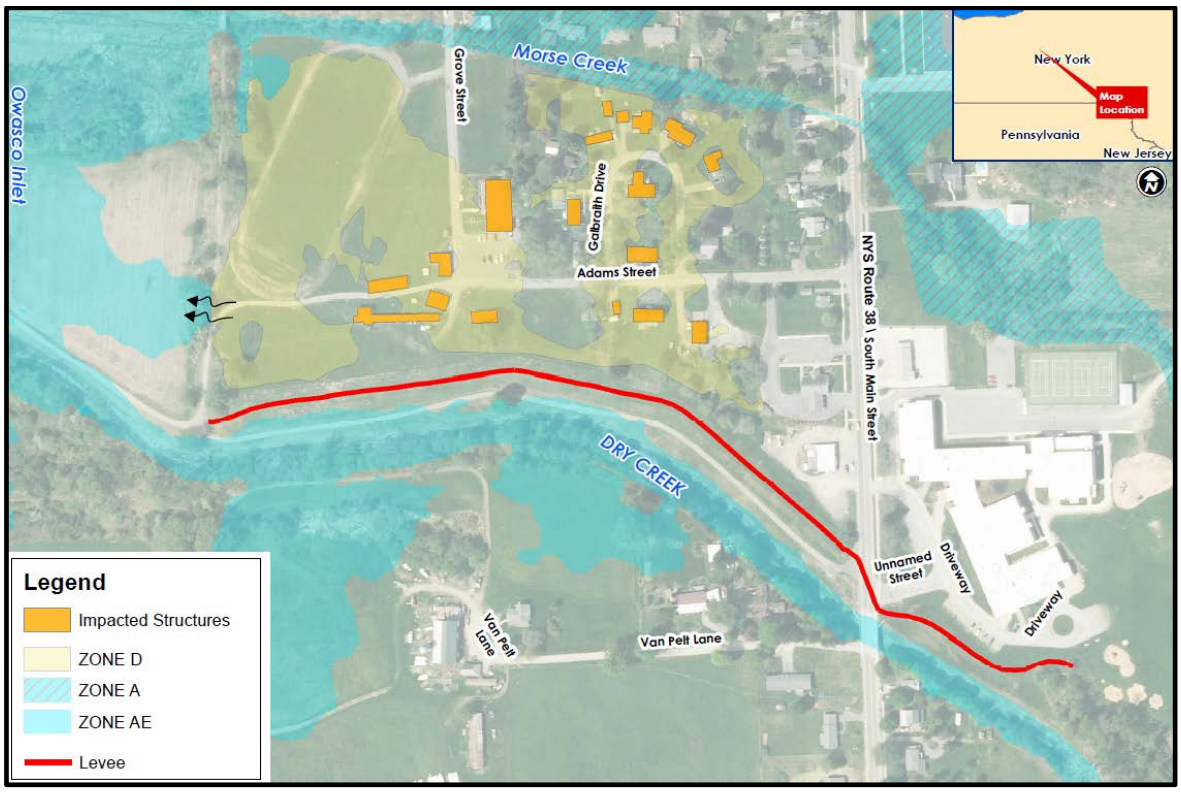

Figure 6: Freeboard Deficient Procedure

Figure 6 shows the approximate flood risk if the Dry Creek Right Bank Levee system could be certified as Freeboard Deficient. The flood risk of the leveed area was conservatively estimated to be equal to that of the Natural Valley Procedure; however, a more detailed analysis could be part of future studies. The resulting flood risk of the leveed area could be depicted as Zone D. The effective Zone A SFHA for Morse Creek and Zone AE SFHA for Owasco Inlet are also shown on Figure 6 for reference purposes.

Zone D is defined by FEMA as "an area of undetermined but possible flood hazards" 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.

As noted above, the levee embankment was evaluated as a single reach under three reach analysis procedures: Natural Valley, Structural-Based Inundation, and Freeboard Deficient. 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[2]	Comments: Structural-Based Inundation Procedure[3]	Comments: Freeboard Deficient Procedures[4]	Comments: Sound Reach Procedure[5]
2,210	18 Total Structures; including 2 commercial businesses and 8 residential homes	• Results from 2D hydraulic model. Estimates potential inundation/leveed area if levee system not mapped as reducing flood hazard.	• More conservative results than Natural Valley Procedure. May be utilized for emergency planning.	• There is insufficient freeboard for the levee at the old railroad bridge. • The downstream end of the levee system may tie-in to existing high ground (recognized as a levee) or the old railroad embankment (not recognized as a levee). If the downstream ties-in to the old railroad embankment, it could be considered a non-levee feature and could mapped using the Natural Valley procedure. For the old railroad embankment to be recognized as part of the levee, it would need to be owned, operated, and maintained as a levee in accordance with 44CFR§65.10.	• Not applied. If 44CFR§65.10 compliant data is provided for the entire levee system, it may be accredited.

[2] Depicts levee reach as not reducing flood risk. No additional data required to support future analysis or mapping.
[3] Hypothetical levee breach analysis. No additional data required to support future analysis or mapping.
[4] Freeboard requirement (44CFR§65.10(b)(1)) is not met, but apparent crest elevation for levee reach is above the 1-percent-annual-chance flood. Certified data compliant with 44§CFR 65.10 required to support future analysis or mapping; however, Freeboard Deficient procedures may be used to address freeboard requirement of 44CFR§65.10(b)(1).
[5] Freeboard requirement (44CFR§65.10(b)(1)) appears met for levee reach. 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 Dry Creek Levee system included in this study is shown as providing reduced flood hazard on the effective FIRM. As no data in support of the 44CFR§65.10 requirements have been provided to FEMA in support of the levee system, the levee system is considered non-accredited.

FEMA engaged the community and other levee stakeholders through the Analysis and Mapping Procedures for non-accredited levees process to help identify potential options to evaluate the flood risk of the leveed area. The community is considering the costs and benefits of moving forward with the accreditation process that could maintain identification of the reduced flood hazard in the leveed area. FEMA's Levee Accreditation Checklist has been included in Appendix G for reference.

Should the community be able to provide 44CFR§65.10 compliant data for the Dry Creek Right Bank Levee system, including the levee crest and downstream tie-in are certified to meet minimum freeboard requirements, the flood risk of the leveed area could be shown as reducing flood hazard. If the community does not provide 44CFR§65.10 compliant data, the effective FIRM dated August 2, 2007 would be revised to show updated flood risk once the FEMA Regional Office incorporates updates into future mapping studies.

Should the community be able to provide 44CFR§65.10 compliant data for the Dry Creek Right Bank Levee system showing the levee crest and downstream tie-in are at or above the 1-percent-annual-chance flood; however, the entire levee system does not meet minimum freeboard requirements, the leveed area could be mapped as Zone D.

FEMA does not anticipate updating the flood risk maps in the near future; however, the 44CFR§65.10-compliant levee data in support of the Freeboard Deficient Procedure or accreditation 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 and to allow for input on the process.

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

GARY MULVANEY
Mayor of Village of Moravia

GARY FICKEISEN
Village of Moravia

PATRICK DOYLE
Village of Moravia

SETH JENSEN
City of Auburn

BRUCE NATALE
Cayuga County

MICHAEL FANDRICH
U.S. Rep John Katko

DAN FULLER
NYS Department of Environmental Conservation

ARVIND GOSWAMI
NYS Department of Environmental Conservation

BRAD WENSKOSKI
NYS Department of Environmental Conservation

PAUL COCCA
U.S. Army Corps of Engineers

JASON DOKTOR
U.S. Army Corps of Engineers

ALAN SPRINGETT
FEMA

VILLAGE OF MORAVIA
LEVEE ANALYSIS AND MAPPING PROCEDURES MEETING

September 18, 2017 1:00-3:00 PM (ET)

Location:

Village Hall
22 Central Street
Moravia, NY 13118

Action Item	Owner
1. FEMA to provide more information on grant funding and contact the Village of Nichols to obtain background information on their levee accreditation processes. FEMA will also introduce a contact to Moravia.	FEMA
2. Community members to begin uploading data and relevant information to the project file transfer (FTP) site and email Stephanie Nurre (Stephanie.nurre@stantec.com) upon completion. **Project FTP Site - Login Information** **Browser link**: https://projsftp.stantec.com **FTP Client Hostname**: projsftp.stantec.com Port: 22 (can be used within an FTP client to view and transfer files and folder; e.g., FileZilla) **Login name:** MORAVIA1433 **Password:** 4070234	Moravia
3. Community members to e-mail Paige Mandy at paige.mandy@ogilvy.com to indicate if they are NOT interested in becoming a member of the Lisle Local Levee Partnership Team (LLPT).	Moravia

AGENDA

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

Meeting Notes

SHUDIPTO RAHMAN
FEMA

CURTIS SMITH
STARR II

DAVID HAYSON
STARR II

STEPHANIE NURRE
STARR II

THOMAS SONG
FEMA Outreach Consultant

PAIGE MANDY
FEMA Outreach Consultant

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 Village of Moravia to identify flood hazards for non-accredited levees as they relate to the Dry Creek.

Detailed discussions covered potential analysis scenarios and the required technical data for each option. Also discussed was 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 levee is shown on the August 2007 Flood Insurance Rate Map (FIRM) as reducing flood risk identification on the landside of the levee system. However, FEMA does not have data to show that the levee meets the minimum FEMA requirements [Title 44 Code of Federal Regulations (CFR)§65.10] to provide such protection.

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

Thomas Song opened the meeting and facilitated introductions of attendees. Shudipto Rahman then provided an overview of the FEMA focus on levee hazard identification and risk communication. Shudipto also provided an overview of the Dry Creek Right Bank Levee, along with Stephanie Nurre.

Stephanie then discussed the levee's non-accredited status. The levee system is considered non-accredited because FEMA does not have certified engineering data showing 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 the flood hazards posed by a 1-percent-annual-chance or greater flood.

The FEMA levee team elaborated on FEMA's previous identification of levees 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. However, for this small levee, the entire system will likely be evaluated as one reach/entity. Stephanie then reviewed each analysis procedure in detail along with the associated data requirements to map the flood risk on a future FIRM.

Stephanie clarified that, based on the available top of levee survey information from the USACE's National Levee Database (NLD), it appears that the levee crest is elevated above the Base Flood Elevation (BFE) except for a point at the downstream end. Additional information for the levee system would be valuable, such as record drawings, to better understand the levee system. 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 flood hazard would look like in the levee impact area., as well as the Structural-Based Inundation (hypothetical breach) analysis.

The USACE noted that there is a separate non-project levee segment. The USACE levee system ends where the trees/wooded area begins. Additionally, USACE is completing screenings of these types of levee segments and recently conducted a survey of this area. The impact of the non-project levee segment on the levee identification and analysis will be part of future discussions.

The FEMA levee team, USACE, NYSDEC, and the community discussed the levee certification and accreditation process in accordance with minimum FEMA requirements (44 CFR§65.10). Currently, FEMA does not have data on this levee to support it being accredited and mapped on the FIRM as providing reduced flood hazard. FEMA noted that the Village of Nichols certified their levee through New York Rising grant funding and is currently going through the accreditation process. FEMA can work to put the community in touch with the Mayor of Nichols, should this be of interest.

While the community's FIRM was issued in 2007, requirements have changed since then. FEMA explained that this analysis will be utilized to help identify the path forward to map the flood hazard on the landside of the levee system in the future (no earlier than a few years). Additionally, FEMA discussed how this

data will be given to the community and can be used in emergency preparedness and hazard mitigation planning.

Additionally, the community discussed local flooding and how it is getting worse in the community as well as around the country. FEMA explained that if a presidential declaration is issued, homeowners in the Special Hazard Area, who accept government help to pay for recovery will be forced to carry flood insurance going forward, which the community thought was important to share with residents. Additionally, the USACE explained that if the levee is damaged by a storm event and it's in good standing in the USACE's PL 84-99 Rehabilitation Program, the levee would be eligible for Federal assistance to make repairs.

FEMA and the community discussed next steps in the LLPT process, which are to begin collecting additional data through a file transfer site. Once the initial data analysis has been conducted, FEMA will then coordinate the LLPT 2 meeting to review the preliminary results with the community. FEMA offered to organize a touchpoint call with the community before this meeting to give them a preview of the results, possibly late November.

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

DISCUSSION

- QUESTION: For non-project levee segments, who would be responsible for the data?
    - ANSWER: For this project, FEMA will try and uncover more information on this embankment.

- QUESTION: Will this study lead to accreditation?
    - ANSWER: No, accreditation needs to be pursued by the community.

Meeting Notes

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

MORAVIA (1 OF 2)

FEMA

#	Name – PLEASE PRINT	Title	Organization/Town	E-Mail
13	[illegible]	[illegible]	[illegible]	[illegible]@SCCCINTHNAT-FEMA
14	Gary Fichelson	Trustee	" "	Gary@ChronicleGuidance.com
15	PAUL COCCA	H&H Engineering Team Leader	USACE	paul.a.cocca@usace.army.mil
16	JASON Doktor	Civil Engineer	USACE	JASON.P.Doktor@USACE.Army.mil
17	Alan Springett	Sr. Engineer	FEMA	alan.Springett@fema.dhs.gov
18	Curtis Smith	RSC	STARR II	
19	Bruce Natale	Flood HAZMIT Engr	CAYUGA COUNTY	bnatale@cayugacounty.us
20	PATRICK DOYLE	CODE ENFORCEMENT OFFICER	VILLAGE OF MORAVIA	jpdoyleiii@hotmail.com
21	SHU PATHMAN	CIVIL ENGINEER	FEMA	shudipto.rahman@fema.dhs.gov
22	STEPHANIE NURRE	PROJECT MGR STARR II	STARR II	stephanie.nurre@stantec.com
23	THOMAS SONG	CERC		
24	BRAD W.		NYSDEC	
25	Arvind Goswami		NYSDEC	
26	Paige Mandy		NYSDEC	
27	David Hayson	PROJECT ENGINEER	STARR II	

Meeting Notes

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

MORAVIA (2 OF 2)

FEMA

#	Name – PLEASE PRINT	Title	Organization/Town	E-Mail
28	DAN FULLER	Flood Protection Engineer	NYS DEC - Region 7	daniel.fuller@dec.ny.gov
29	Seth Jensen	Director of Municipal Utilities	C/o Auburn	sjensen@auburnny.gov
30	MIKE FANDRICH	DEP. DISTRICT DIRECTOR	U.S. REP. JOHN KATKO	MICHAEL.FANDRICH@MAIL.HOUSE.GOV
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Appendix B
Stakeholder Engagement - LLPT Meeting 2 Information

Full Appendix Provided Separately

Meeting Notes

ATTENDEES

GARY MULVANEY
Mayor of the Village of Moravia

GARY FICKEISEN
Village of Moravia

PATRICK DOYLE
Village of Moravia

BRUCE NATALE
Cayuga County

TOM HAAG
Office of U.S. Representative John Katko

BRAD WENSKOSKI
NYS Department of Environmental Conservation

NADINE LITTLE
NYS Department of Environmental Conservation

KEVIN DELANEY
NYS Department of Environmental Conservation

DAN FULLER
NYS Department of Environmental Conservation

ALAN SPRINGETT
FEMA Region II

SHUDIPTO RAHMAN
FEMA Region II

VILLAGE OF MORAVIA

LEVEE ANALYSIS AND MAPPING PROCEDURES MEETING 2

December 14, 2017, 10:00 AM-12:00 PM (ET)

Location:
Village Hall
22 Central Street
Moravia, NY 13118

Action Item	Owner
1. Include the Village of Moravia in the future coordination call planned with the Village of Nichols to get background on their levee accreditation processes.	FEMA
2. Community members to begin uploading data and relevant information to FEMA's file transfer site and email Stephanie Nurre (Stephanie.nurre@stantec.com) upon completion. **Project FTP Site - Login Information** **Browser link:** https://projsftp.stantec.com **FTP Client Hostname:** projsftp.stantec.com Port: 22 (can be used within an FTP client to view and transfer files and folder; e.g., FileZilla) **Login name:** MORAVIA1433 **Password:** 4070234	Moravia
3. Provide community general information regarding Flood Insurance	FEMA

AGENDA

- Review Dry Creek Right Bank Levee Flood Hazard
  - Local Levee System
  - Analysis and Mapping Procedures for Non-Accredited Levees
- Application of Reach Study Procedures
- Review Results of Initial Data Analysis
- Discuss Next Steps in the Process

FEMA

RiskMAP
Increasing Resilience Together

Meeting Notes

CURTIS SMITH
STAR II

NICK MUELLER
STARR II

DAVID HAYSON
STARR II

STEPHANIE NURRE
STARR II

SYLVIA SCHMIDT
FEMA Outreach Consultant

TOM SMITH
FEMA Outreach Consultant

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 Village of Moravia to identify flood hazards for non-accredited levees as they relate to the levee system located on the right descending bank of Dry Creek. The first Local Levee Partnership Team (LLPT) meeting (LLPT 1) was held on September 18, 2017. The LLPT 2 meeting focused on reviewing the results of the Initial Data Analysis. It was emphasized that coordination will provide the best results for the village. With increased understanding of flood hazards, the village can better prepare by allocating resources appropriately, understanding future needs, and planning procedures in response to flood events.

Stephanie Nurre and David Hayson provided a summary of the Initial Data Analysis for the Dry Creek Right Bank Levee system.

NOTES

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

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

FEMA does not currently have a mapping project funded to update the Cayuga County FIRMs for Dry Creek.

The FEMA levee team asked whether there was any other information pertaining to the levee that may be available for the study. Bruce Natale of Cayuga County noted that Cayuga County was one of the first counties in the State to obtain LiDAR data. New LiDAR data processed with newer techniques may be available in the future to refine the terrain data in the area for future mapping projects.

Results of the Initial Data Analysis:

Natural Valley Procedure – flow is being conveyed on both sides of the levee and shows the potential area of inundation without the levee reducing the flood risk. For the Natural Valley Analysis, the effective 1-Dimensional HEC-RAS analysis was

refined to a 2-Dimensional hydraulic model to better reflect the potential flood risk in the leveed area. Approximately 18 structures were estimated to be within the Natural Valley inundation area; however, a LLPT member clarified that the estimated number of potentially impacted structures should be closer to 8 residential structures and 2 commercial structures (10 structures total).

Freeboard Analysis:
The levee crest elevations were taken from the National Levee Database (NLD). The levee continues upstream of Main Street; however, the 1-percent-annual-chance flood stays in the channel and does not inundate overbank areas. The levee crest is shown as meeting the minimum freeboard requirements, except at the downstream end near the existing stream crossing. This area could be further investigated to identify why the levee crest is lower; however, LLPT members indicated that a small section of the levee might have been modified to accommodate access to the stream crossing. Additionally, the Freeboard Analysis will be revised to include the additional 1 foot of freeboard within 100 feet of Main Street.

Structural-Based Inundation:
Three hypothetical breach locations were chosen along the levee system based on FEMA's guidelines for the analysis. However, the levee could breach at any point along the levee system. The composite inundation area resulting from the three breach analyses is not significantly different from the results of the Natural Valley analysis; however, the depth of the Structural-Based Inundation area was greater.

Application of Reach Study Procedures – what are the data requirements?

- Natural Valley – no additional data are needed.
- Structural-Based Inundation – more data could be provided, but mapping is possible based on what was available.
- Sound Reach Procedure – all minimum requirements of 44 CFR 65.10 must be certified by a Professional Engineer and provided to FEMA for a completeness check.

ADDITIONAL DISCUSSION

There are multiple flood sources (Morse Creek, Dry Creek, etc.) in the vicinity of the levee; however, moving forward the discussion will focus on the streams that impact the levee system.

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. They used New York Rising funding to

complete some of the effort. The process cost roughly $125,000 per mile. The Village of Moravia expressed interest in participating in this discussion. Curtis Smith of the FEMA Region 2 Regional Service Center (RSC) can provide information on the accreditation process, as the RSC performs the completeness checks on submitted accreditation packages.

The County will be updating their Hazard Mitigation Plan in 2018-2019. The levee system should be included in the Hazard Mitigation Plan to potentially be eligible for future funding.

- **QUESTION:** Has the bridge at the downstream end of the levee system on Dry Creek changed? How is it reflected in the hydraulic model?
  - **ANSWER**: The data available for the bridge can be shared with the group. We have the ftp site as a repository for data collection associated with the project.

- **QUESTION**: Will the sound reach analysis help with accreditation?
  - **ANSWER**: Sound reach meets all needs for accreditation, but other information could come from another source. Another creek could overlap a portion of the levee that we see is protected from flooding. Sound reach analysis will reduce your accreditation by the impacts.

- **QUESTION**: The levee extends east of Route 38. Do you have information on what is going on in that area for the Natural Valley Analysis?
  - **ANSWER**: Upstream of Route 38/Main Street, the current analysis shows that the 1-percent-annual-chance flood would be contained in the channel; however, less frequent/larger storm events could potentially impact the area.

- **QUESTION**: Could we request that the Structural-Based Inundation be mapped as the flood hazard on the future FIRMs**?**
  - **ANSWER**: Yes, the community could request that; however, many communities would be ok with the lesser of the two (floodplain elevations between the Natural Valley and Structural-Based Inundation Analyses) and would supplement their emergency management procedures and/or floodplain management criteria with the more conservative information.

- **QUESTION**: How does the FEMA Region manage/allocate funding?
  - **ANSWER**: The Region manages the funding that FEMA Headquarters provides them. It looks to maintain funding for projects, but there is always additional funding with any disaster or hazard.

Meeting Notes

- **QUESTION**: If something happens and the levee is at risk, how can the community determine what should be done?
  - **ANSWER**: Because the NYSDEC is involved with the levee system, they will have a good idea of what should be done if damage were to occur.

- **QUESTION**: What will be the most beneficial thing for the Village to do?
  - **ANSWER**: FEMA will move forward and update the FIRMs; however, the community will be advised in advance of the map update. Discussing the levee system and the potential flooding impact scenarios in advance of any mapping project allows time for the community to consider its options, potential benefits, and costs.

    The Village emphasized retaining minimal flood risks in order to retain commercial investment in the community.

- **QUESTION**: Would participation in the Community Rating System (CRS) lower rates for everyone in the village?
  - **ANSWER**: Yes, it would offer higher standards of floodplain management as well, which would ensure your community is more resilient to flood risks. The village currently has a CRS rating of 7 or 8.

- **QUESTION**: Is the Village interested in finding out more about accreditation?
  - **ANSWER**: Yes, if it would make a difference to their flood risk and funding is available.

Meeting Notes

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

FEMA

MORAVIA MEETING SIGN-IN SHEET

Meeting Date/Time: Thursday, December 14, 2017
10:00 AM – 12:00 PM

#	Name – PLEASE PRINT	Title	Organization/Town	E-Mail
1	Gary Fichelsen	Trustee	V. Moravia	Gary@Chronicle Guidance.com
2	PATRICK DOYLE	CODE ENFORCEMENT OFFICER	VILLAGE OF MORAVIA	jpdoyleiii@hotmail.com
3	GARY MULVANY	MAYOR	VILLAGE MORAVIA	village of moravia@scc.intervalicom
4	David Hayson	Project Engineer	STARR II	david.hayson@stantec.com
5	Stephanie Nurre	Proj. Mgr	STARR II	stephanie.nurre@stantec.com
6	Kevin Delaney	~~NYSDEC~~ Engineer	NYSDEC	Kevin.delaney@dec.ny.gov
7	Tom Haag	Field Rep.	Rep. John Katko	Tom.Haag@mail.house.gov
8	Bruce Natale	Flood Engr.	CAYUGA COUNTY	bnatale@cayugacounty.us
9	Alan Springett	Senior Engineer	FEMA	Alan.Springett@fema.dhs.gov
10				
11				
12				

FEMA

RiskMAP
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Appendix C
Stakeholder Engagement - LLPT Meeting 3 Information

Meeting Notes

ATTENDEES

MAYOR GARY MULVANEY
Village of Moravia

PATRICK DOYLE
Village of Moravia

BRUCE NATALE
Cayuga County

NADINE LITTLE
NYS Department of Environmental Conservation

KEVIN DELANEY
NYS Department of Environmental Conservation

ARVIND GOSWAMI
NYS Department of Environmental Conservation

BRAD WENSKOSKI
NYS Department of Environmental Conservation

THOMAS BROWN
United States Army Corps of Engineers

JIM ROGERS
United States Army Corps of Engineers

STEPHANIE NURRE
STARR II Mapping Team

ALAN SPRINGETT
FEMA

SHUDIPTO RAHMAN
FEMA

THOMAS SONG
FEMA CERC

AMBER GREENE
FEMA CERC

SYLVIA SCHMIDT
FEMA CERC

VILLAGE OF MORAVIA LOCAL LEVEE PARTNERSHIP TEAM (LLPT) MEETING III

April 20, 2018 10:00-11:00 AM (EST)

Location:
Village Hall
22 Central Street
Moravia, NY 13118

Action Item	Owner
1. Brad, Arvind, Nadine, and LLPT member contact information will be added to presentation slides before they are shared with attendees.	FEMA

SUMMARY

The Federal Emergency Management Agency (FEMA) reviewed the Dry Creek Right Bank Levee system with the Village of Moravia 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 map updates, and an open forum.

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.

Discussions also included additional uses for the data produced from this project and how the Village could use it for planning purposes as well as the how the depth grids can be useful for emergency action planning.

NOTES

The downstream end of the levee near the railroad bridge was found to not meet freeboard requirements. This could be an area to examine the levee freeboard and is something for future consideration.

Meeting Notes

The Village of Nichols recently hosted a webinar on their experience with getting their levee accredited. They used funds received through New York Rising to pay for the certification of levee documents. If a levee is accredited, flood insurance rates are lowered for affected structures.

The depth of flooding shown on the landside of the levee system is mostly shallow, around a foot of depth, which will affect structures in the area of the levee. The precise elevation of ground where structures are located is not available; however, if elevation data becomes available, the structures may be able to be shown as outside the high-risk floodplain if the homeowner obtains an elevation certificate.

If the Village is remapped, which is not slated to happen in the next couple of years, insurance costs may increase. When FEMA is ready to update the Flood Insurance Rate Map (FIRM), it will schedule multiple meetings between the beginning and the end of the mapping project.

Having discussions now, in advance of a future mapping project, provides perspective on potential options for mapping the flood risk associated with the levee system.

If levee-related flood hazards are identified as Zone D in the future, there will be no federal requirements associated with building in floodplain or mandatory purchase of flood insurance. It was stressed that mortgage companies may still require flood insurance, which is outside the jurisdiction of FEMA and the State.

DISCUSSION

Q: Would the county be open to having the levee analysis mapping plan accessible through their website?

- **Bruce:** The county should be able to do that, but not sure where on the website it could be hosted and will check with IT.

Q: FEMA also develops Geographic Information System (GIS) shapefiles and data – would the county be interested in having that too?

- **Bruce:** Yes, I think our GIS department would be interested.
- **Patrick Doyle:** Our website is hosted by the county, but we could host information on our building website as well.

Q: Was the freeboard determined to be deficient, Stephanie?

- **Stephanie:** The profile of the levee shows that it is elevated above Base Flood Elevation (BFE).

- She referenced the levee profile slide in the presentation and noted that the downstream end of the levee appears to not meet the minimum freeboard requirement. Further investigation would be needed if the Village is interested in levee accreditation.

Q: Bruce, are you involved in the Hazard Mitigation Plan development for Cayuga County?

- **Bruce:** Yes. The Planning Department will lead it along with emergency management. Funds were applied for the plan in the fall and I believe we have been awarded the funds since.

  Thomas: We held a webinar on maximizing Community Rating System (CRS) credit for Hazard Mitigation Plans previously. We can share the notes and recording to people involved in the county plan. The webinar covered how to maximize the number of CRS points that can be earned when incorporating certain elements into the Hazard Mitigation Plan.

Q: People in town commonly worry about flood insurance costs. Does this affect any issues with new housing?

- **Mayor Mulvaney:** I don't see much new development in the area shown to have flooding. A lot of buildings along the levee are owned by the Veterans of Foreign Wars' organization.

Q: Is there an official comment period on the draft?

- **Shudipto:** FEMA sent the draft out a month and a half ago. There is still time to submit comments, there is no solid deadline. Any comments in the next 2-3 weeks will likely be able to be incorporated.

  Thomas: The official mapping we discussed is years away. When the time comes, issues involving the levee will be revisited, as well as the plan. Revising the plan may be made down the road, but that will be up to the Village.

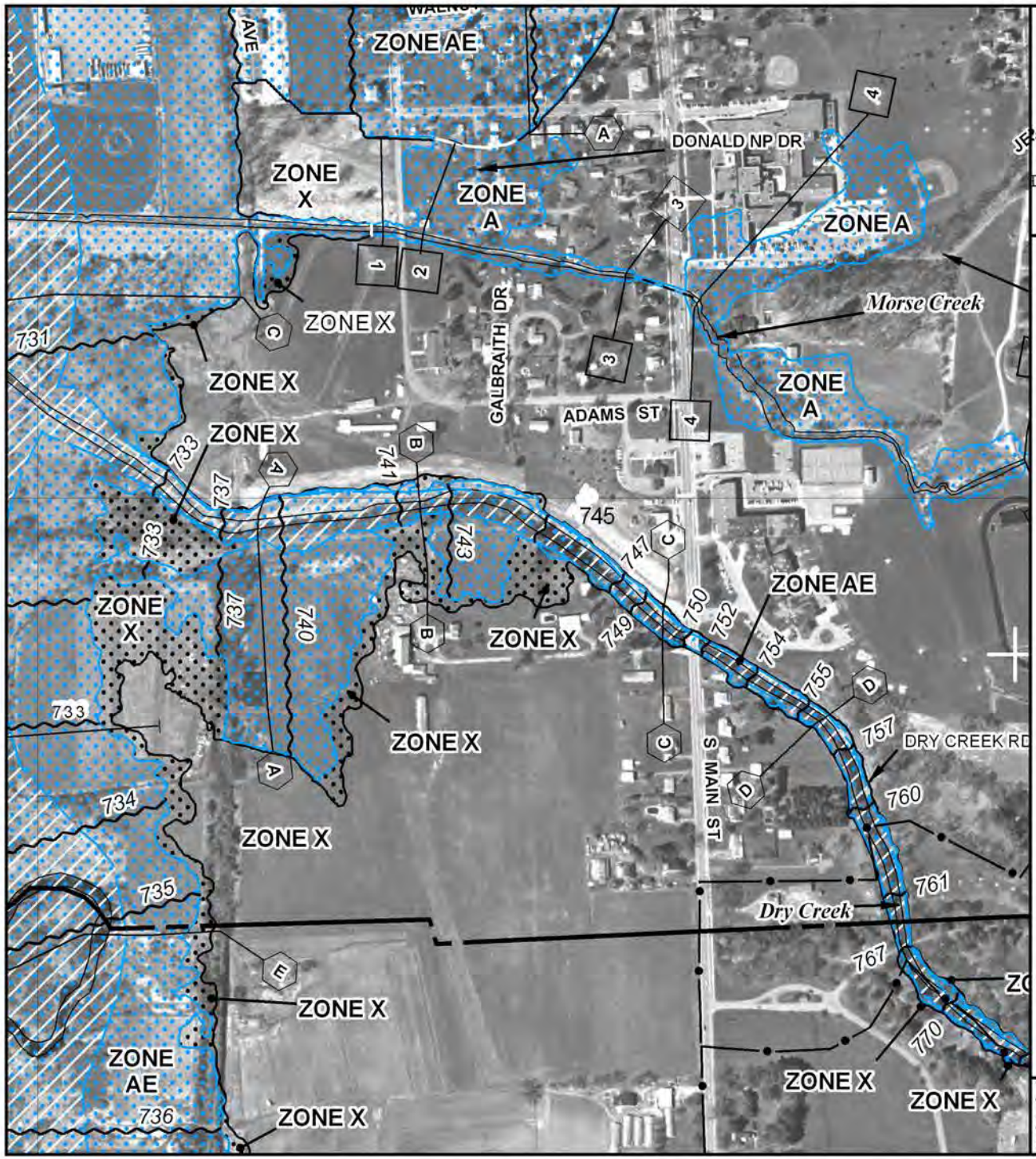
  Stephanie: We are looking to finalize the current levee mapping project. At this point, we are concluding our analysis in a document for everyone's awareness. We are open for comments, but the comment period is not open-ended.

CLOSING

Meeting Notes

All participants were thanked and encouraged to reach out with questions, comments, or concerns. They can work with the Village in the future if they are interested in adopting work plans.

Appendix D
Flood Insurance Rate Map



MAP SCALE 1" = 500'

250 0 500 1000

FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0508E

FIRM

FLOOD INSURANCE RATE MAP

for CAYUGA COUNTY, NEW YORK
ALL JURISDICTIONS

CONTAINS:

COMMUNITY	NUMBER
LOCKE, TOWN OF	360114
MORAVIA, TOWN OF	360117
MORAVIA, VILLAGE OF	360118

PANEL 508 OF 635
MAP SUFFIX: E

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

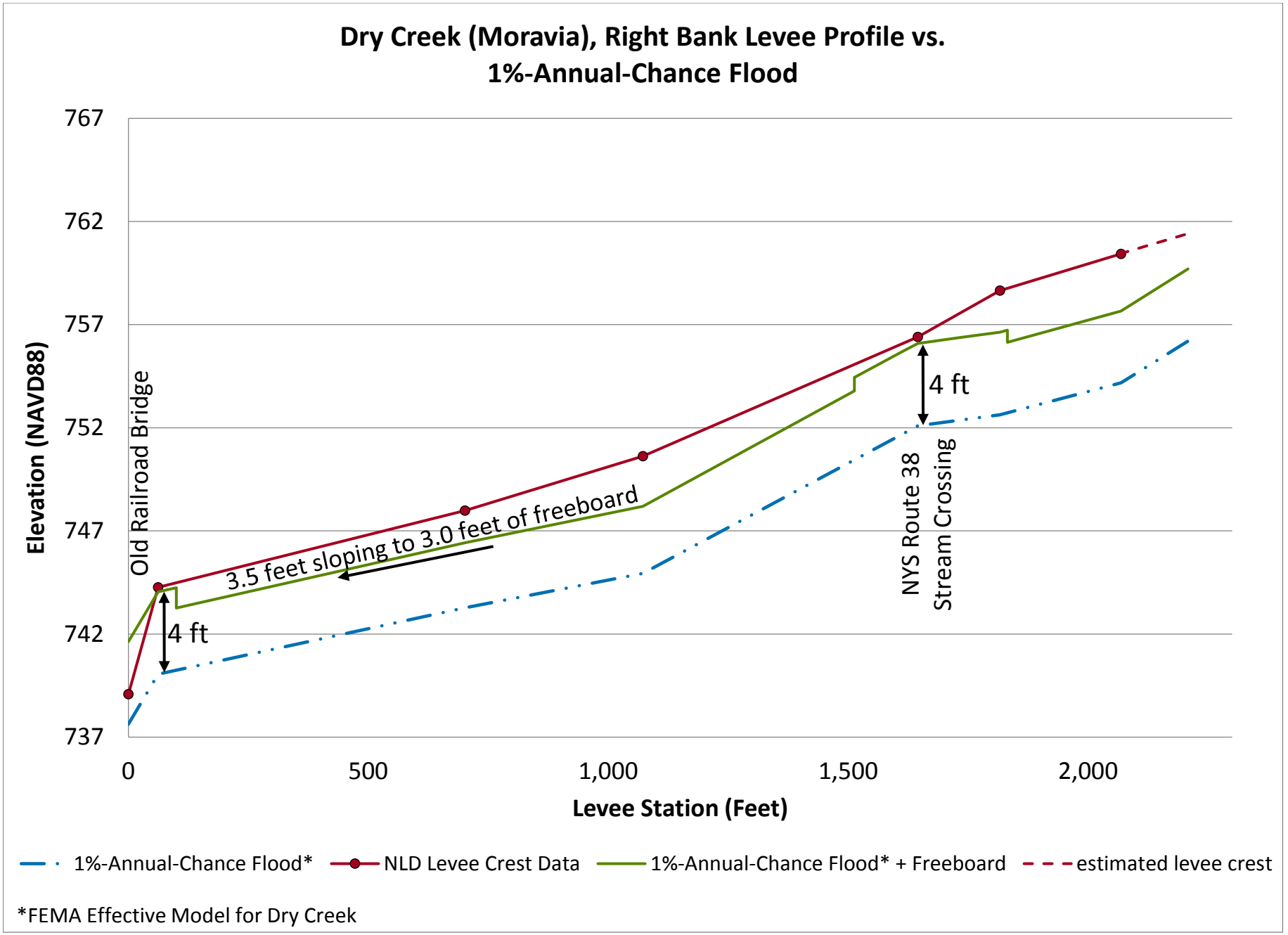
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
36011C0508E

EFFECTIVE DATE
AUGUST 2, 2007

Federal Emergency Management Agency

Appendix E
Freeboard Profile Comparison


Dry Creek (Moravia), Right Bank Levee Profile vs.
1%-Annual-Chance Flood
767
762
757
752
747
742
737
Elevation (NAVD88)
0
500
1,000
1,500
2,000
Levee Station (Feet)
Old Railroad Bridge
3.5 feet sloping to 3.0 feet of freeboard
4 ft
4 ft
NYS Route 38
Stream Crossing
1%-Annual-Chance Flood*
NLD Levee Crest Data
1%-Annual-Chance Flood* + Freeboard
estimated levee crest
*FEMA Effective Model for Dry Creek

Appendix F
Site Photographs

Appendix Provided Separately

Appendix G
Levee Accreditation Checklist

FACT SHEET

LEVEES
IDENTIFYING THE RISK

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.

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:

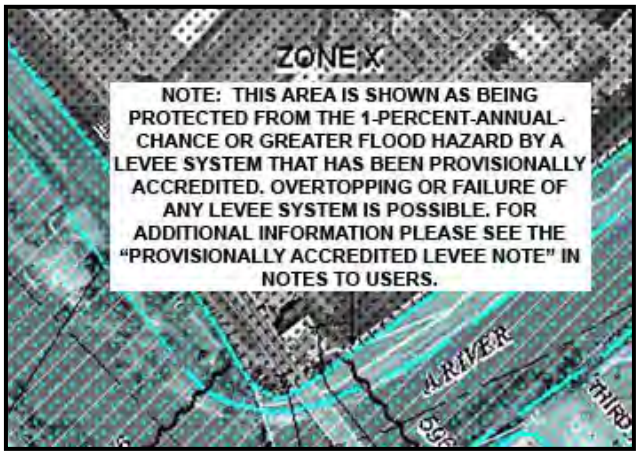
www.fema.gov/plan/prevent/fhm/lv_fpm.shtm

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)
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. The following requirements must be met:	
Checklist for Design Criteria:	
☐	**Freeboard.** 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)).
☐	**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.

Operation Plan*	Paragraph 65.10(c)(1) of the NFIP Regulations
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.	
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 one-year intervals, of the closure structure for testing and training purposes.
	Interior Drainage Plan. See below.
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 protection 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 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.

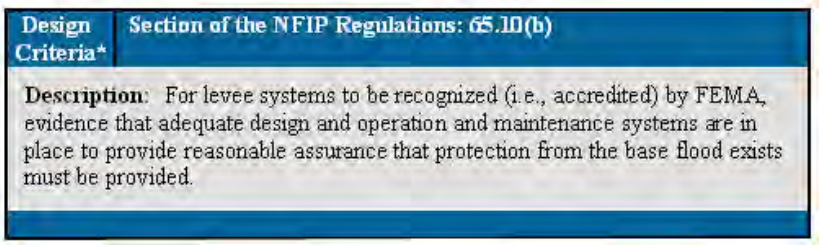
Levee systems also decay over time. They require regular maintenance and periodic upgrades to retain their level of protection. When levees do fail, they often fail catastrophically. The resulting damage, including loss of life, may be much greater than if the levee system had not been built.

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)
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.	

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. The FEMA resources referenced in this fact sheet, listed below, are directly accessible through 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 or on the NFIP's consumer Web site, 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.

Appendix H
Collected Data

Appendix Provided Separately

Appendix I
Initial Data Analysis

Full Appendix Provided Separately

STARR II Strategic Alliance for Risk Reduction

MEMORANDUM

To: Shudipto Rahman, Alan Springett

From: Stephanie Nurre, Nick Mueller

Cc: Srikanth Koka

Date: February 8, 2018

Subject: Analysis and Mapping Procedures for Non-Accredited Levees - Initial Data Analysis Village of Moravia, Cayuga County, NY

Purpose

This memorandum summarizes the application of Natural Valley (NV) and Structure Based Inundation (SBI) procedures for developing flood hazard data for the Dry Creek Right Bank Levee system adjacent to Dry Creek in the Village of Moravia, Cayuga County, NY (Figure 1). The Dry Creek Right Bank Levee system is part of the Moravia Flood Damage Reduction Project.

The hydrologic and hydraulic assumptions, approaches, and methodology applied to develop NV and SBI floodplains 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.

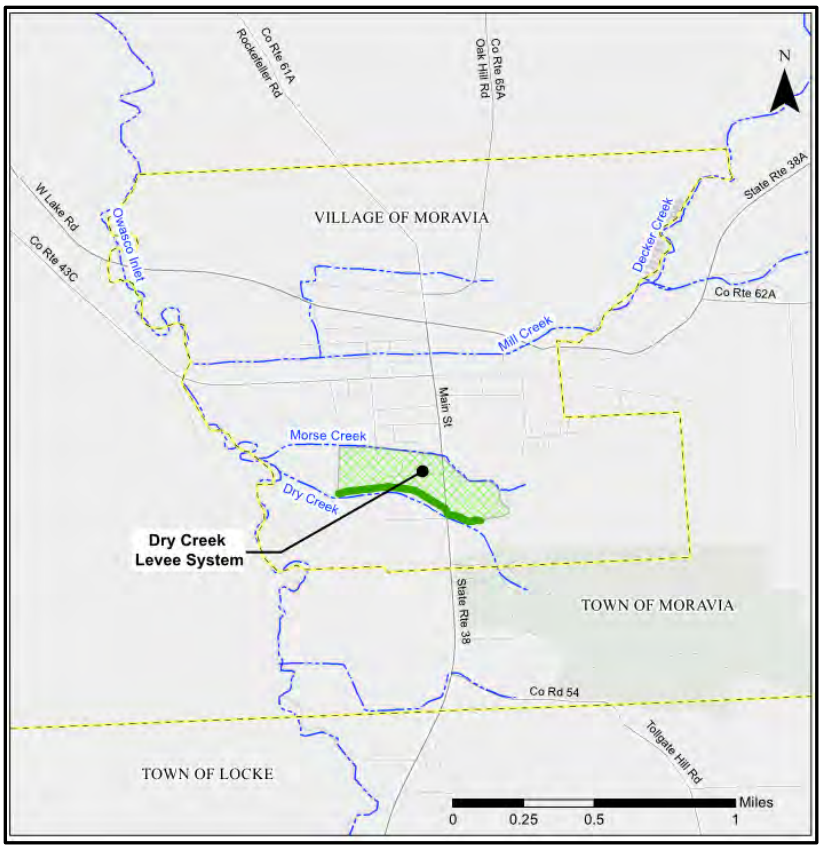


Figure 1: Levee System at the Village of Moravia, NY

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 Cayuga County, New York Flood Insurance Study (FIS) report flow rates were used for the one-dimensional (1-D) steady-state models leveraged to develop the 2-D unsteady-state model of Dry Creek.

An inflow hydrograph was required for 2-D unsteady-state flow modeling of the NV and SBI Procedures; however, stream gage data was not available in the vicinity of the Dry Creek study. To develop a hydrograph for the 2-D unsteady-state analysis, the dimensionless unit hydrograph generation approach by USDA-NRCS (2007) was utilized. The time of concentration (t_c) was estimated based on Kirpich (1940) equation:

$t_c = 0.0078\ L^{0.77}\ (L/H)^{0.385}$

L – maximum flow path (ft), H – elevation difference (ft)

The flow path and elevation were determined for the Dry Creek watershed from the U.S. Geological Survey StreamStats application. The peak discharge used for the unsteady-state

discharge hydrograph was from the effective FIS 1-percent-annual-chance flood. Table 1 below summarizes hydrologic inputs used to generate the discharge hydrograph.

Flooding Source	Flow Length (feet)	Elevation Change (feet)	Time of Concentration (minutes)	Time to Peak (hours)	Peak Discharge (cfs)
Dry Creek	34,807	986	96.6	1.07	2,020

Table 1 - Hydrograph Development Parameters

Figure 2 shows the computed discharge hydrograph for Dry Creek.

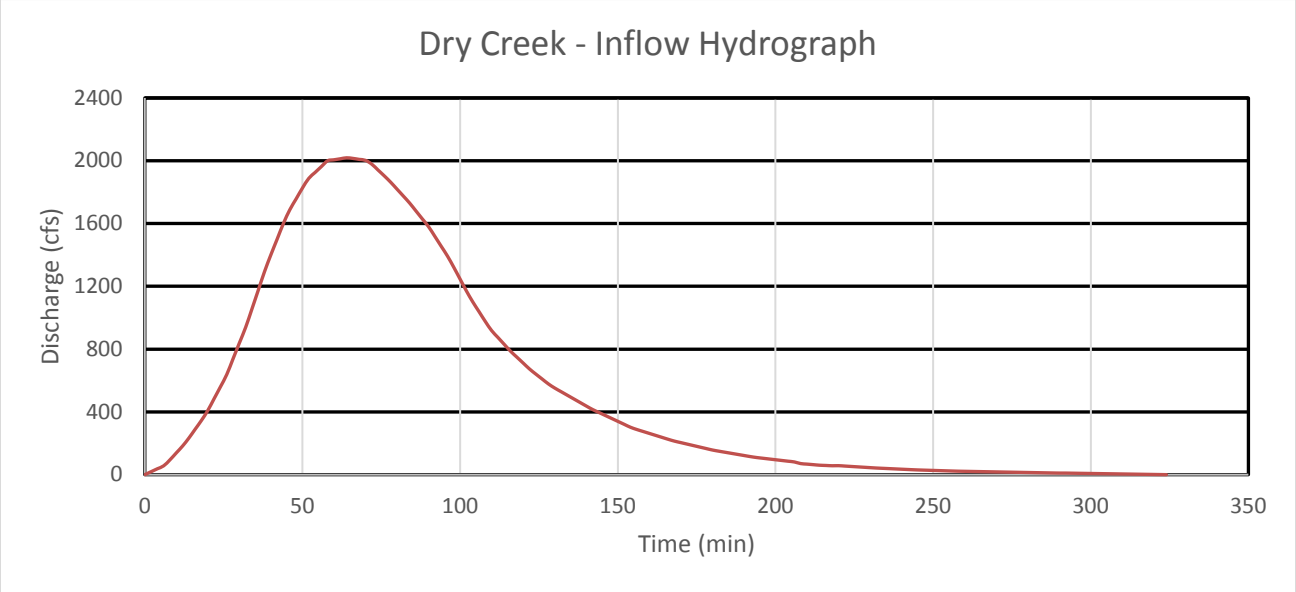


Figure 2 – Dry Creek Discharge Hydrograph

Hydraulics: Methodology

This section summarizes hydraulic methods and assumptions used to model NV and SBI Procedures for the Dry Creek Right Bank Levee system. Models used for this analysis were adapted from the effective HEC-RAS model for Dry Creek.

Natural Valley Procedure

Due to the sloping topography away from Dry Creek in the leveed area, it was determined that the inundations extents and depth of flooding for the study area could be better represented through a 2-D unsteady-state analysis. A 2-D unsteady-state HEC-RAS model was developed to perform the NV and SBI Procedures.

The reach upstream boundary condition was set to the 1-percent-annual-chance inflow hydrograph. The downstream channel boundary condition was set as normal depth with friction slope of 0.005 ft/ft to match the effective HEC-RAS model.

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 a 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 northern extent of the mesh is Morse Creek.

The 2-D mesh contains an outflow boundary along Morse Creek and the Owasco Inlet floodplain. The boundary condition was set to normal depth with a friction slope of 0.01 ft/ft for Morse Creek, and 0.004 ft/ft for Owasco Inlet Tailwater from Owasco Inlet was assumed to have no effect the Dry Creek water surface elevation as the peak flows are not expected to be coincident. The 1-percent-annual-chance flood of Morse Creek has little overlap with the Dry Creek leveed area and was not considered to have an effect on the Dry Creek water surface elevations.

The Natural Valley Procedure was modeled for the Dry Creek Right Bank Levee system by connecting the 1-D cross sections to the 2-D mesh and allowing the discharge to flow from Dry Creek naturally as if the levee was not in place.

Structural-Based Inundation Procedure

The georeferenced, steady-state, 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 north 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 Dry Creek earthen embankment levee extends from approximately 470 feet upstream of North Main Street to approximately 900 feet upstream of its mouth at Owasco Inlet. The total levee length is approximately 2,200 feet. The Structural-Based Inundation Procedure was performed by breaching the levee on the right bank at three locations. Beach locations were not selected between lateral structure station 0+00 and 7+00 because the ground elevation landward of the levee is above the effective 1-percent annual-chance flood.

Breach parameters used at each location are summarized in Table 2. Because the levee does not overtop, each breach assumed a piping failure triggered when the water surface elevation reached the approximately landside levee toe elevation. Each breach shape was assumed to be a trapezoid with a 1:1 side slopes, a breach weir coefficient of 2.6, and piping coefficient of 0.5. Breach formation times were limited to a maximum of 1.0 hour because of the short duration of the peak

hydrograph. Maximum breach widths were limited to 300 feet because the duration of maximum pressure on the levee during peak flow is relatively short.

Breach ID	Lateral Structure Station	Final Bottom Width (feet)	Initial Piping /Final Bottom Elevation (feet)	Breach Formation Time (hours)
1A	2025	300	738.6	1.0
1B	2025	100	737.2	0.16 (10 mins.)
1C*	2025	300	738.6	0.16
2A	1475	300	742.6	1.0
2B	1475	100	742.3	0.16
2C*	1475	300	742.6	0.16
3A	1200	300	744.7	1.0
3B	1200	100	744.7	0.16
3C*	1200	300	744.7	0.16

*Selected for composite inundation area / depth grid mapping

Table 2 –Breach Parameters

The location of the breach resulted in minor variations in the inundation areas and depth of flooding. Changes in breach parameters (width, formation time) had a minor effect on the overall inundation areas and depth of flooding. Structural-Based Inundation Procedure results can be found in the attached maps, Appendices B and C. The final inundation limits were determined by creating a composite inundation area from the three breach scenarios.

Results

Results for all modelling scenarios were presented at the Local Levee Partnership Team (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.