Levee Analysis and Mapping Plan
Root Creek Flood Control System

Village of Bolivar

Allegany County, New York

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FEMA

RiskMAP

Increasing Resilience Together

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Acronyms

BFE	Base Flood Elevation
BLE	Base Level Engineering
CERC	Community Engagement and Risk Communication
CFR	Code of Federal Regulations
DEM	Digital Elevation Model
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
NLD	National Levee Database
NYSDEC	New York State Department of Environmental Conservation
O&M	Operations and Maintenance
PTS	Production and Technical Services
SFHA	Special Flood Hazard Area
STARR II	Strategic Alliance for Risk Reduction
USACE	U.S. Army Corps of Engineers

Definitions

The terms below have been used in this document. Additional terms are provided in FEMA's *Guidance for Flood Risk Analysis and Mapping, Levees* (November 2019) in the Glossary. This guidance document is available from the FEMA Library at https://www.fema.gov/media-collection/guidance-femas-risk-mapping-assessment-and-planning.

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 – Analysis and mapping procedures for non-accredited levees, which include Sound Reach, Freeboard Deficient, Overtopping Analysis, Structural-Based Inundation, and Natural Valley. Details on these approaches can be found in FEMA's *Guidance for Flood Risk Analysis and Mapping, Levees*.

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

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

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

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

National Levee Database (NLD)* – A database developed by the U.S. Army Corps of Engineers (USACE) in cooperation with FEMA, which is a dynamic, searchable inventory of information for all levee systems in the Nation. The NLD contains information to facilitate and link activities, such as flood risk communication, levee system evaluation for the NFIP, levee system inspections, floodplain management, and risk assessments.

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

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

Zone D – Area of possible but undetermined flood hazard.

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

Executive Summary

The Village of Bolivar has a levee system that was constructed by the United States Army Corps of Engineers (USACE). The levee system is known as the Root Creek Right Bank Levee system, located along Root Creek in the Village of Bolivar, New York. It is part of the Root Creek Flood Control System which is located in the Village and Town of Bolivar.

Root Creek flows from east to west through the Village and Town of Bolivar to its confluence with Little Genesee Creek. The flood hazard due to the 1-percent-annual-chance flood (base flood) of Root Creek is contained within the Root Creek channel in the current effective Flood Insurance Study (FIS) and on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) from 1996.

FEMA Region II plans to develop a modernized county-wide digital FIS and FIRMs for Allegany County, New York. These updates will replace community based FISs and FIRMs. As part of the update process, FEMA Region II is engaging the Village and Town of Bolivar early to identify flood risk related to the levee system.

FEMA guidance was revised in 2013 by the *Analysis and Mapping Procedures for Non-Accredited Levee Systems*. These procedures feature more interactive stakeholder engagement. They also provide additional options to analyze and map flood hazards for non-accredited levee systems. FEMA Region II funded a Levee Discovery project utilizing those procedures in the Village and Town of Bolivar.

In June 2019, FEMA Region II partnered with local, regional, and Federal levee stakeholders to form a Local Levee Partnership Team (LLPT). The LLPT coordinated to develop potential analysis and mapping procedures that could be applied to the local levee system. This involved collecting and evaluating available data, completing an initial data analysis, and holding discussions about mapping needs.

This levee plan summarizes that information. The plan outlines potential options to identify the flood hazard behind the levee on future FIRMs. It also identifies additional data collection needs.

The effective base flood of Root Creek is contained within the Root Creek channel; therefore, the levee system is not accredited on the effective FIRM. If future flood risk is higher, the levee sponsor may need to supply certified data compliant with Title 44, Code of Federal Regulations, Chapter 1, Part 65, Section 10 (44 CFR §65.10) to FEMA to map the levee system as accredited. This data submission would need to be reviewed by FEMA. Accreditation would be based on the effective flood risk at that time. In this scenario, if the levee sponsor does not submit data or submits incomplete information to FEMA, accreditation will not be provided. Future FIRMs would depict flood risk based on modeling without the levee systems being considered as reducing flood hazards of the base flood.

If levee accreditation data were to later become available, it could be submitted to FEMA using the Letter of Map Revision (LOMR) process.

1 Introduction

Under FEMA's prior levee approach, a levee system that did not meet the National Flood Insurance Program (NFIP) requirements of 44 CFR §65.10 was analyzed and mapped as if the levee system had no effect on flooding on the landward side of the levee system during the base flood. This was known as the "without levee" approach.

Stakeholders expressed concern about the "without levee" approach. Members of both the U.S. House of Representatives and Senate echoed this concern They requested FEMA consider discontinuing the "without levee" approach. FEMA used current modeling techniques to refine flood hazard reduction provided by non-accredited levee systems. This process, known as the Analysis and Mapping Procedures for Non-Accredited Levee Systems, enhances interactive stakeholder engagement. This process recognizes the uncertainty associated with hazard identification of levee-impacted areas providing multiple options to show flood hazards.

This approach is being applied to the Root Creek Right Bank Levee system within the Village of Bolivar. Analysis and Mapping Procedures for Non-Accredited Levee Systems activities were initiated by FEMA; its Production and Technical Services (PTS) provider, Strategic Alliance for Risk Reduction II (STARR II); and its Community Engagement and Risk Communication (CERC) provider (*Resilience Action Partners*).

Flood hazards change over time. Conditions within a watershed may also change. FEMA has funded a Base Level Engineering (BLE) project for the Upper Allegheny River Watershed to help inform flood risk mapping projects. This BLE project includes Root Creek in the Village and Town of Bolivar. This BLE project provided flood risk datasets, including flood hazard information for Root Creek. The results of the BLE project can be used to expand risk awareness discussions with communities.

When a stream with a levee system is restudied, the protective status of the levee system is reevaluated. In this case, if Root Creek is restudied the levee system in the Village of Bolivar will be reevaluated. FEMA leveraged the BLE project to develop a first pass estimate of the potential base flood hazard for the Root Creek Right Bank Levee system. That data analysis is discussed in Sections 4 and 5 of this levee plan.

This levee plan is the result of collaboration between FEMA, the Village of Bolivar, Town of Bolivar, the New York State Department of Environmental Conservation (NYSDEC), Allegany County, USACE, and other stakeholders. The plan summarizes stakeholder coordination, initial data analysis, and potential options for depicting the flood hazard for the levee system on a future FIRM.

2 Levee System Description

2.1 Root Creek Flood Control Project

Root Creek flows east to west through the Town of Bolivar and the Village of Bolivar to its confluence with Little Genesee Creek. The Root Creek Flood Control Project was constructed along Root Creek to reduce flood risk to the Village and Town of Bolivar. The flood control project

included a levee system identified as the Root Creek Right Bank Levee System in the USACE National Levee Database (NLD). It is identified as the right bank in relation to looking downstream. The physical levee system is located in the Village of Bolivar. The leveed area shown in the NLD is located within the Village of Bolivar and includes a small area in the Town of Bolivar that does not affect any structures.

The USACE Root Creek Flood Control Project design was based on the June 1972 flood event associated with Tropical Storm Agnes. The project consisted of channel improvements and modifications to approximately 5,000 feet of the Root Creek channel; it included channel widening and lowering, and modification to the Main Street bridge. The project extended from approximately 900 feet downstream of the Main Street bridge to approximately 4,100 feet upstream. The project included installing several drop structures and channel lining intended to convey the base flood within the channel. According to design data, during conditions when Root Creek overtops the channel banks, sheet flow behind the levee would be conveyed from east to west and not pond.

Project construction ended in the early 1980's when the contractor defaulted prior to project completion. Complete as-built plans of the project are not available. No USACE Operation and Maintenance (O&M) Plan is available for the levee system.

The levee system has multiple sponsors that play different roles to support the levee system. The levee sponsors include the USACE, Pittsburgh District as the Federal sponsor, NYSDEC as the non-federal sponsor, and the Village of Bolivar as the local sponsor. NYSDEC has an agreement with the Village of Bolivar in which the Village of Bolivar is responsible for the operations & maintenance (O&M) of the levee system. It should also be noted that Emergency Management procedures, such as those for public evacuation, are the responsibility of the local sponsor and county stakeholders.

More information about the levee systems is provided in Table 1 and the levee system alignments are shown in Figure 1.

Table 1. Levee Summary

Levee System Name	Levee System ID	County	Community[1]	Approximate Total Length of Levee (ft)	Approximate # of Structures Affected[2]
Root Creek Right Bank	4905000073	Allegany	Village of Bolivar	1,370	117

[1] Town of Bolivar is impacted by Root Creek Flood Control Project, but the levee system alignment is in the Village of Bolivar.
[2] Data from USACE NLD.

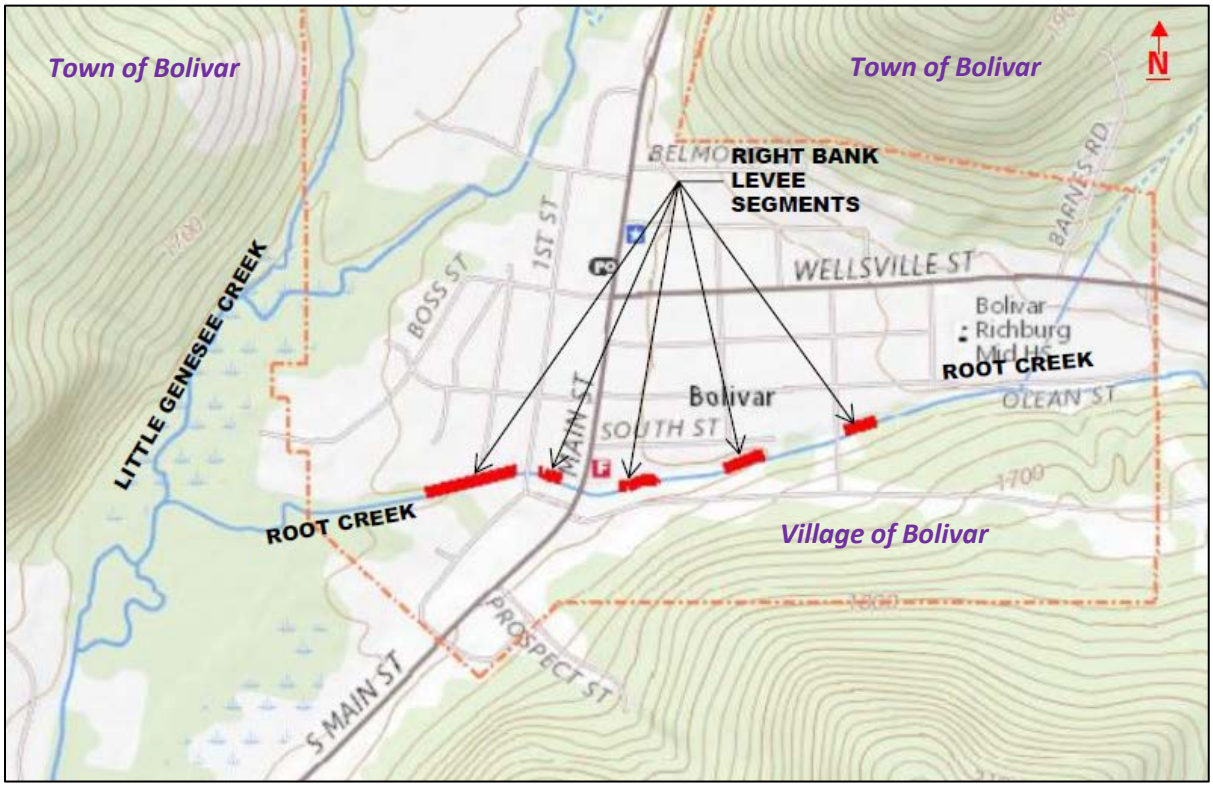

Figure 1: Location Map

2.2 Community NFIP and FIS History

Table 2 summarizes the NFIP participation and FIS history of the Village and Town of Bolivar.

Table 2. Community Map History

Community Name	Participating in the NFIP?	Initial Identification	Flood Hazard Boundary Map Revision Date(s)	FIRM Effective Date	FIRM Revision Date(s)
Village of Bolivar	Yes	January 9, 1974	January 7, 1977	January 19, 1996	January 19, 1996
Town of Bolivar	Yes	November 1, 1974	October 29, 1976	July 30, 1982	N/A

The effective FIRM, dated January 19, 1996, shows the base flood for Root Creek as contained in the channel in the Village of Bolivar. The levee-impacted area and the alignment of the levee system is not depicted on the FIRM.

2.3 Upper Allegheny River Watershed BLE

FEMA funded a large-scale BLE project for the Upper Allegheny River Watershed, which includes Root Creek in the Village and Town of Bolivar. This watershed-wide BLE project is intended to inform future mapping updates.

The effective study for Root Creek is a detailed study (Zone AE Special Flood Hazard Area (SFHA) with floodways). This BLE project has limited information compared to a detailed study and so it cannot replace the detailed effective study. This is because any replacement study will have to produce a minimum of the same level of output (SFHA with floodway) shown on the effective FIRMs.

The BLE project provides updated information but is limited in detail. The resulting flood risk dataset can be used to initiate flood risk awareness discussions. The final report for the Upper Allegheny River BLE will be released to the public upon completion.

2.4 Future Detailed Study

In the future, FEMA may fund a detailed study of Root Creek in the Village and Town of Bolivar. The detailed study would supersede the effective FIS report and FIRMs on the effective date of the new study.

A detailed study is an enhanced level of study that may include hydrologic and hydraulic analysis. The detailed hydraulic analysis may include ground survey, additional information about stream crossings such as bridges, and more manipulation of models than the leveraged hydraulic analysis from the BLE project.

3 Stakeholder Engagement and Data Collection

3.1 Local Levee Partnership Team

The LLPT is a group of levee stakeholders who provide FEMA with data and information on local levee conditions. They also share feedback on the procedures to be used for analyzing and mapping. The stakeholders who participated in the LLPT for this project are listed in Table 3.

Table 3. LLPT Participants

LLPT Member	Contact Information
Wayne Stone Metz	Village of Bolivar, Director of Public Woks 585-928-1860; boltwnclerk@yahoo.com (email, phone number, courtesy of Town/Village Clerk)
Bob Mitchell	Village of Bolivar, Mayor 585-928-1860; boltwnclerk@yahoo.com (email, phone number, courtesy of Town/Village Clerk)
Jeff Luckey	Allegany County, Director of Emergency Management 585-268-7658; luckeyj@alleganyco.com
Kier Dirlam	Allegany County, County Planning Director 585-268-7472; dirlamhk@alleganyco.com
Brienna Wirley	NYSDEC 585-226-5465; brienna.wirley@dec.ny.gov
David Wolowsky	NRCS 315-477-6531; david.wolowsky@usda.gov
Brad Wenskoski	NYSDEC, Environmental Program Specialist 518-402-8280; brad.wenskoski@dec.ny.gov
Theodore Myers	NYSDEC Region 9 theodore.myers@dec.ny.gov
Kerrie O'Keeffe	NYSDEC Region 9 kerrie.okeeffe@dec.ny.gov
Mary Binder	NYSDEC 585-226-5144; mary.binder@dec.ny.gov
Michael Debes	U.S. Army Corps of Engineers, Pittsburgh District, Plan Formulator Civil Engineer 412-395-7327; michael.r.debes@usace.army.mil
Tom Brown	U.S. Army Corps of Engineers, Pittsburgh District 412-395-7459; thomas.m.brown@usace.army.mil
Joseph Bossard	U.S. Army Corps of Engineers, Pittsburgh District 412-395-7358; joseph.bossard@usace.army.mil
Stephen Hutzler	U.S. Army Corps of Engineers, Pittsburgh District 412-395-7165; stephen.hutzler@usace.army.mil
Alan Springett	FEMA Region II, Senior Engineer, Risk Assessment Lead 212-680-4342; alan.springett@fema.dhs.gov
Curtis Smith	STARR II, Region II RSC Lead 646-490-3929; curtis.smith@stantec.com
Trevor Cone	STARR II, Water Resource Engineer 212-330-6157; trevor.cone@stantec.com
Stephanie Nurre	STARR II, FEMA Technical Support Provider, Project Manager 312-262-2284; stephanie.nurre@stantec.com
Nick Mueller	STARR II, FEMA Technical Support Provider 513-842-8200; nick.mueller@stantec.com
Matt Kroneberger	*Resilience Action Partners*, Outreach Provider 212-237-6373; matt.kroneberger@ogilvy.com

3.2 Data Collection

Through the stakeholder coordination and data collection process, FEMA asked the LLPT for all available data, information, and documentation associated with the levee system.

Table 4 provides a summary of the data and documentation collected during the stakeholder coordination and data collection process. The data is included in Appendix D[3].

Table 4. Data Collection Summary

Data Type	Data Description	Source	Date Developed or Obtained
Effective Flood Insurance Study	Allegany County, New York, Village of Bolivar, FEMA	FEMA Map Service Center	January 19, 1996
BLE Analysis, Upper Allegheny River Watershed	BLE Upper Allegheny Watershed Engineering Analysis (HEC-RAS)	STARR II	2019
Topography	Topographic LiDAR, FEMA 2-Meter Digital Elevation Model (DEM)	New York State GIS Clearinghouse	2019 (Obtained)
Design Drawings	Bolivar Flood Protection Project, Root Creek	USACE	1979
Design Drawings	Bolivar, N.Y. Local Protection Plan, Sections, profile pp.3	USACE	1992
Documentation	Periodic Inspection Report	USACE	2017
Documentation	Routine Inspection Reports	USACE	2005 - 2017
Documentation	Summary of Pertinent Date – Bolivar, New York Local Protection Project	USACE	1992
Documentation	Root Creek, Bolivar, NY Local Flood Protection Project Detailed Project Report	USACE	1975
Documentation	Final Environmental Statement	USACE	1975
Hydrologic Data	Streamstats Web Application, Magnitude and Frequency of Floods in New York, USGS 2006-5112	USGS	2020

3.3 Levee Inspection Reports

As noted in Table 4, USACE provided the FEMA project team with the Periodic Inspection Report No. 1 for the Bolivar, Root Creek Right Bank Levee system, dated June 12, 2017. The USACE also provided the Routine Inspection reports completed between 2005 and 2017.

[3] Data and documentation from the USACE are discussed in this levee plan; however, copies of data must be requested from the USACE Pittsburgh District.

A Routine Inspection is currently completed by USACE Districts on an annual basis. A Routine Inspection is a visual inspection to verify proper operation and maintenance of flood control projects, including levee systems. A Periodic Inspection is a more rigorous process currently completed every 5 years. It includes verification of system operation and maintenance.

A levee system must meet certain criteria and standards and keep an acceptable or minimally acceptable rating to stay active in the Public Law (PL) 84-99 Rehabilitation and Inspection Program. Under PL 84-99, USACE has authority to supplement local efforts to repair flood control projects, including levee systems, which are damaged by a flood event.

The 2017 Periodic Inspection report rated the Root Creek Right Bank Levee system as minimally acceptable. A minimally acceptable rating indicates that the levee system remains active in the PL 84-99 Rehabilitation and Inspection Program. This means that the levee system is eligible for Federal rehabilitation assistance for flood damage of system features that satisfy the eligibility criteria. However, some minor deficiencies were identified in the Periodic Inspection report. These features will require maintenance to receive an acceptable rating.

USACE requirements vary from FEMA's levee data certification requirements under 44 CFR §65.10. The primary reasons for the rating of minimally acceptable rating for the Root Creek Right Bank Levee system included areas of heavy unwanted vegetation in the channel or along levee embankments. The inspection results also noted that an O&M Manual and a project specific Emergency Action Plan are not available for the project. The development of an O&M Manual would enhance risk reduction by memorializing current best practices. This would also provide a required document for potential certification under 44 CFR§65.10 or for NFIP Community Rating System (CRS) rating credits.

Copies of the inspection reports can be requested from USACE Pittsburgh District.

3.4 LLPT Meeting 1

A FEMA project team met with Root Creek Right Bank Levee stakeholders at the first LLPT meeting on June 27, 2019. The meeting was held at the Village of Wellsville Board Room. The overall intent of the meeting was to gain local insight on the status of the levee systems and confirm the stakeholders who would like to take part in the LLPT. The meeting also discussed the data available for the levee systems and introduced the Analysis and Mapping Procedures for Non-Accredited Levee Systems. More details about the LLPT meeting are in Appendix A.

3.5 LLPT Meeting 2

The LLPT Meeting 2 between FEMA's project team and levee stakeholders occurred February 5, 2020, at the Village of Wellsville Board Room. Representatives from the Village of Bolivar, along with other project stakeholders, participated in the meeting. The meeting built upon discussions held at LLPT Meeting 1. The FEMA project team also updated the LLPT on data collection and the initial data analysis. The potential flood hazard areas from the Natural Valley Procedure were also discussed. Additionally, the LLPT discussed future map updates and potential options for identifying and mapping the levee flood hazard on future FIRMs.

3.6 LLPT Meeting 3

The FEMA project team held a virtual LLPT Meeting 3 on April 27, 2020. Representatives from the Village of Bolivar, along with other project stakeholders, participated in the meeting. The meeting built upon discussions held at LLPT Meeting 2. The FEMA project team provided a preview of this Levee Analysis and Mapping Plan and an overview of the mapping update process. More details about this LLPT meeting are in Appendix A.

After the review period concluded on May 31, 2020, comments received were incorporated into the document. The document was finalized and shared with the LLPT in February 2021.

4 Initial Data Analysis

4.1 Understanding of Existing Conditions

The effective hydraulic study for Root Creek was developed using the USACE HEC-2 hydraulic modeling program. The HEC-2 model for Root Creek is no longer available and the program is no longer used for new studies.

The Upper Allegheny River Watershed BLE project used the USACE HEC-RAS hydraulic modeling program for stream analysis. The HEC-RAS hydraulic model of Root Creek was leveraged to conduct the initial data analysis of the Root Creek Right Bank Levee system. The initial data analysis was performed to provide a first pass estimate of the potential base flood elevations and inundation areas associated with the levee system.

The base flood is contained in the channel on the effective FIRM. To date, the levee sponsor for the Root Creek Right Bank Levee system has not provided data in support of 44 CFR §65.10 certification. Until the base flood is identified through a detailed study as above the channel banks, there is no requirement to provide data to support accreditation under 44 CFR §65.10.

4.2 Hydrologic and Hydraulic Analyses

The Upper Allegheny River Watershed BLE project was leveraged as the baseline condition for the initial data analysis. The BLE analysis included the following methodology:

- Topographic data processing of publicly available LiDAR data;
- Hydrologic analysis using gridded input parameters, rural regression equations, and gage analysis, where applicable;
- Basin-wide hydraulic analysis (HEC-RAS) and generation of approximate floodplain mapping; and
- Structure data based on the National Bridge Inventory.

As part of the initial data analysis, the BLE project HEC-RAS hydraulic model for Root Creek was modified. The modification included estimates of the channel geometry and adding channel

manning's (roughness) values. Additionally, in-line channel structures are included based on available plans. This analysis is referred to as the "modified BLE model" in this levee plan.

The modified BLE model was updated to reflect the "with levee" condition. This "with levee" modified BLE model does not allow flow on the land side of the levee system for estimated levee crests above the base flood. The "with levee" condition may produce higher water surface elevations than the traditional Natural Valley Procedure, which allows flow on both sides of the levee. The "with levee" condition is used to estimate the base flood elevations on the river side of the levee systems and is used for estimating minimum freeboard requirements. Additional details regarding the modified BLE model can be found in the profile comparison exhibits and technical memorandum provided in Appendix E.

The BLE project provides less local detail than the effective detailed study of Root Creek; therefore, only a future detailed study of Root Creek would supersede the effective information. The results of the initial data analysis for Root Creek are non-regulatory and will help inform future detailed analyses. These results should not be used for regulatory activities. If a restudy is funded in the future, FEMA will reengage the community throughout the restudy and mapping process.

4.3 Computation of Freeboard

The base flood profile of Root Creek "with levee" modified BLE HEC-RAS model was used to estimate minimum freeboard, per the requirements of 44 CFR §65.10(b)(1), which include:

- "... a minimum freeboard of three feet above the water-surface level of the base flood."
- "An additional one foot above the minimum is required within 100 feet in either side of structures (such as bridges) riverward of the levee or wherever the flow is constricted."
- "An additional one-half foot above the minimum at the upstream end of the levee, tapering to not less than the minimum at the downstream end of the levee, is also required." These are additive and not an either-or situation.

The estimated base flood profile of Root Creek was plotted against the levee crest elevation to see if the levee crest met minimum freeboard requirements. The levee crest elevations for the Root Creek Right Bank Levee systems were estimated from available Digital Elevation Model (DEM) and available 1979 design plans.

The approximate freeboard comparison exhibits in Appendix B show the Root Creek Right Bank Levee system crest elevations just above the profile of the base flood from the Modified BLE model. The levee system does not appear to meet minimum freeboard requirements.

It should be noted that the freeboard comparison was performed using the first-pass data from the "with levee" modified BLE model. The results of the first-pass analysis do not supersede the effective FIS report and FIRM for Root Creek and are intended for discussion and risk awareness purposes and to inform future detailed studies.

Information from a future detailed study of Root Creek may change the base flood elevation, which would revise minimum freeboard requirements. Additionally, the levee crest elevations for the freeboard comparison are based on available DEM and plan data. A future field survey of the levee crest would be the responsibility of the levee sponsor, if they choose to do so, and may produce results different from this freeboard comparison. A field survey of the levee crest may facilitate the future application of an appropriate levee analysis and mapping procedure.

4.4 Potential Levee Reach[4] Analysis Procedures

Potential reach analysis procedures are in FEMA's *Guidance for Flood Risk Analysis and Mapping, Levees*. The potential reach analysis procedures include: Natural Valley, Structural-Based Inundation, Overtopping, Freeboard Deficient, and Sound Reach Procedures. These procedures may be assigned for separately defined levee reaches of an entire system. Each procedure requires the use of different components of data from 44 CFR §65.10.

Mapping zones within the levee impacted area landward of the levee also vary. The Natural Valley Procedure defines the levee impacted area landward of the levee system. The mapping zone for the Natural Valley procedure landward of the levee system is Zone AE SFHA. Sound Reach, Overtopping, and Structural-Based Inundation procedures may result in a combination of a landward SFHA and Zone D. The Freeboard Deficient procedure may result in mapping flood risk as Zone D landward of the levee system. Interior drainage may also be mapped as SFHA if it is shown to be the dominant source of flooding for an area.

5 Potential Analysis Methods

A brief description of the various methods available to study the Root Creek Right Bank Levee system based on the FEMA guidance are presented below. A brief evaluation of the appropriateness of each procedure is presented and focuses primarily on the data available.

[4] See Levee Reach under Definitions on page iii.

Table 5. Levee Data Summary

Data Type	Levee Reach Analysis Procedure					Levee System Data Collected
	Sound Reach	Freeboard Deficient	Overtopping	Structural-Based Inundation	Natural Valley	Root Creek Right Bank
Levee Crest Information	Required[5], BFE + Freeboard Less than Levee Crest	Required[5], BFE Less than Levee Crest	Required[5]	Required[5]		No levee crest survey. Estimate from DEM
O&M Plan, Emergency Action Plan	Required[5]	Required[5]	Required[5]	Recommended		No
Certified As-Built Plans	Required[5]	Required[5]	Required[5]			Yes; however, as-built status unknown[6]
Structural Design Requirements[7]	Required[5]	Required[5]	Required[5]			Unknown[6]
Inspection Plan/ Inspection Reports	Required[5]	Required[5]	Required[5]	Recommended		Yes
Evaluation of overtopping Erosion Potential			Required[5]			No

5.1 Sound Reach

A Sound Reach is a continuous section of a levee system that has been designed, constructed, and maintained to withstand the flood hazards posed by a base flood. A Sound Reach differs from an accredited levee system because it is a part of a levee system that overall cannot meet accreditation requirements.

Based on the initial data analysis, the Root Creek Right Bank Levee system is being considered a levee system composed of a single reach; therefore, the Sound Reach Procedure does not apply.

5.2 Freeboard Deficient

The Freeboard Deficient Procedure can be applied if the levee crest is above base flood elevation, but the levee crest does not meet minimum freeboard requirements. A Freeboard Deficient Reach must meet structural requirements, O&M, and inspection standards.

[5] Data required from levee stakeholder.
[6] Due to security policies, the interested parties will have to request available documents directly from the USACE Pittsburgh District.
[7] Structural design requirements include: freeboard, closures, embankment protection, embankment and foundation stability analyses, settlement analyses, and interior drainage. These requirements are listed in 44 CFR §65.10(b). A checklist of the levee certification data required under 44 CFR §65.10 is provided in Appendix C.

As with the Sound Reach Procedure, no reach-specific modeling is required for a Freeboard Deficient Reach. However, SFHAs from the system-wide interior drainage analysis, and/or adjacent levee reaches, may still be delineated landward of Freeboard Deficient Reaches.

Based on the initial data analysis, the levee crest elevation for the Root Creek Right Bank Levee system is below the estimated base flood profile plus freeboard; therefore, the Freeboard Deficient Procedure may apply. Once a detailed analysis of Root Creek is available, the freeboard estimate of the levee system can be reevaluated. If the levee system is Freeboard Deficient and the Village of Bolivar provides 44 CFR §65.10 levee data as noted in Table 5, the Freeboard Deficient Analysis may be performed. The mapping zone associated with the Freeboard Deficient Procedure is Zone D.

5.3 Overtopping

The Overtopping Procedure can be considered when the base flood elevation is above the levee crest for a reach; however, the community or levee sponsor must provide technical justification that the base flood and anticipated erosion will not cause structural failure. In addition to the structural standards established in 44 CFR §65.10, more detailed structural analysis may be required to justify the levee system's ability to sustain the impact of a base flood elevation overtopping the levee system. As with the Sound Reach and Freeboard Deficient Reach procedures, an O&M Plan and documentation of inspection are required.

For an Overtopping Reach, technical analyses are performed to determine the volume of water that would overtop the levee during the base flood event. This volume of water is used to establish inundation area of the SFHA.

Based on initial data analysis, the Root Creek Right Bank Levee system was not designed to be overtopped by the base flood of Root Creek. As this levee system was not designed to be overtopped, the overtopping analysis may not be applicable without redesign and construction.

Once a detailed analysis of Root Creek is available, the freeboard estimate of the levee system may be updated. If the levee system is overtopped and the Village of Bolivar provides the additional data listed in Table 5, the Overtopping Analysis may be performed.

5.4 Structural-Based Inundation

In some instances, levee systems have reaches with either known structural deficiencies or unknown structural integrity (a common occurrence for older levee systems). Levee systems with structural integrity issues may provide some flood risk reduction by impeding conveyance to some degree. It is also possible that levee breaches may enhance localized damage due to increased velocity of flow through a breach. For these levee reaches, FEMA will rely on modeling breaches along the levee reach.

It is not possible to predict the exact location of a levee breach. This procedure neither predicts the probability of failure at any breach location, nor provides a specific determination or evaluation of the overall levee system performance. It also does not require a determination of the potential

failure mechanism. The procedure results in the development of a reach specific SFHA that might occur from potential breaches along a particular levee reach during the base flood. To determine this SFHA, FEMA will consider possible locations of system breaches, geometry, and failure duration.

Once a detailed analysis of Root Creek is available, the freeboard estimate of the levee system can be updated. If the levee system is not significantly overtopped by Root Creek, FEMA may perform the Structural-Based Inundation Analysis.

General practice is to perform such breach scenarios using a two-dimensional model. This may provide information that some areas within a certain radius from any levee breach will be subject to greater forces due to localized flood velocity increases in breach scenarios. Areas near levees are at greater risk due to this velocity increase.

5.5 Natural Valley Procedure

FEMA evaluates the Natural Valley Procedure for all levee systems due to data availability and to estimate the potential levee-impacted area if the levee system does not reduce flood risk. This is possible due to the fact all necessary information for a Natural Valley Procedure is available.

The base flood inundation associated with the Natural Valley Procedure was estimated by extending the "with levee" modified BLE model base flood elevations landward of the levee into the levee-impacted area. This may produce a more conservative (larger) inundation area than the traditional Natural Valley Procedure; however, for the first pass estimate it is an appropriate level of detail.

The results of the Natural Valley Procedure and the estimated inundation area for the base flood are shown in Figure 2: Natural Valley Procedure. The Natural Valley Procedure results estimate the levee-impacted area for the base flood and the potential flood risk if the levee system did not reduce the levee flood hazard. The levee-impacted area landward of the Root Creek Right Bank Levee system would be mapped as a Zone AE SFHA.

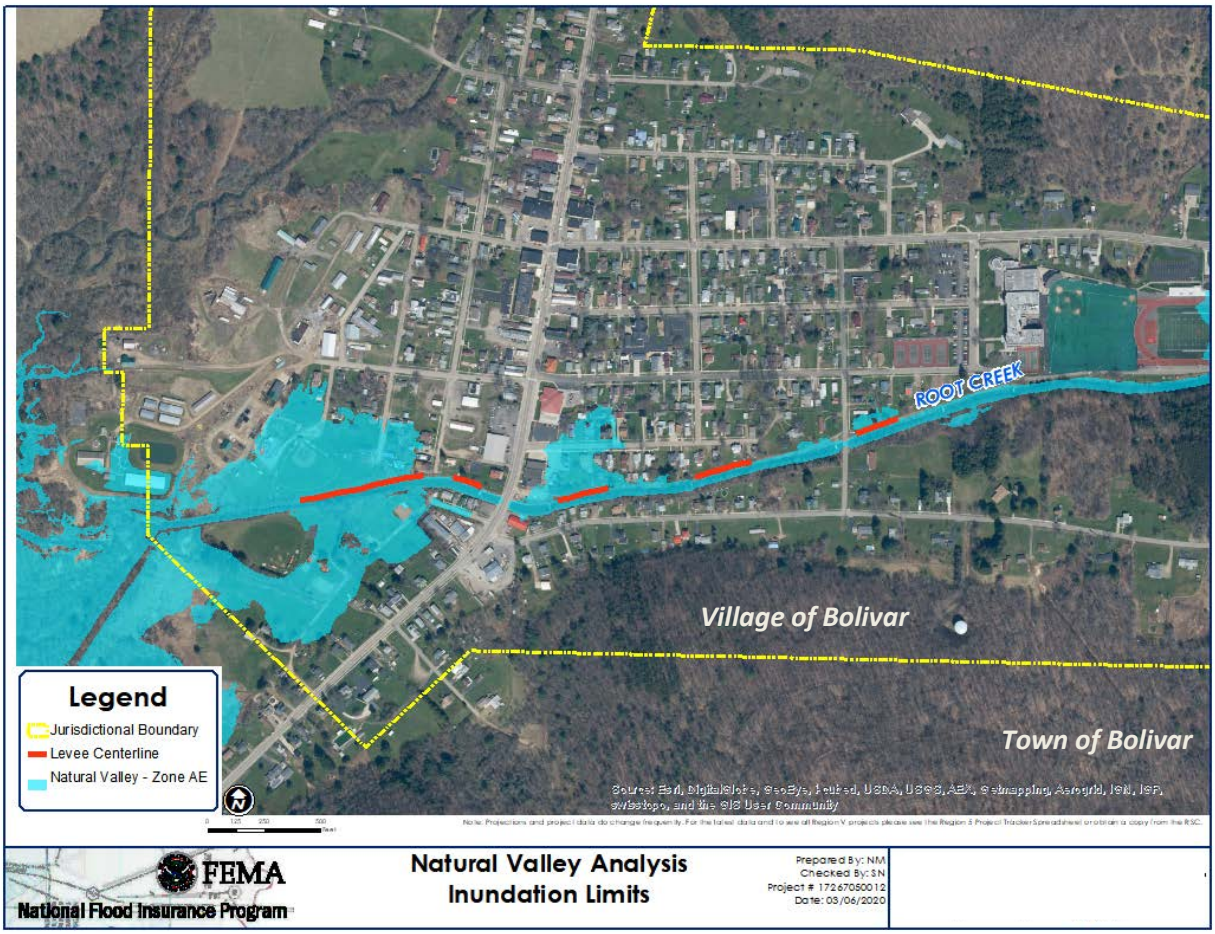

Figure 2: Natural Valley Procedure

For a more detailed description of these methodologies, please refer to FEMA's *Guidance for Flood Risk Analysis and Mapping, Levees*.

6 Path Forward and Next Steps

The information within this levee plan provides the community with a tool that can be used for planning and to increase flood risk awareness. This levee plan will also facilitate the scoping of a flood mapping project in accordance with the Analysis and Mapping Procedures for Non-Accredited Levee Systems. FEMA has not funded a mapping project at this time. A mapping project will require additional data collection, information gathering, levee owner coordination, detailed hydraulic analysis, and due process activities. The timetable for a potential project has not been determined as of the completion of this study; however, initiation of a mapping project is anticipated within the next few years.

Members of the LLPT will be included in future outreach to determine what, if any, changes have taken place with respect to existing or future conditions that may have an impact on the findings of

the Analysis and Mapping Procedures for Non-Accredited Levee Systems summarized in this levee plan.

For future mapping to show Root Creek Right Bank Levee system as providing flood hazard reduction if the base flood is not contained in the channel, the Village of Bolivar may need to provide FEMA with data that complies with 44 CFR§65.10. The certified data package may be incorporated into future mapping if FEMA receives it and confirms it is complete prior to the end of the 90-day appeals period after the Preliminary FIRM is released. It is important to note that this data may be submitted at any time in the future utilizing the LOMR process. If no levee certification data would be provided, the levee system would be shown as non-accredited.

7 References

FEMA: *Flood Insurance Study*, Allegany County, New York, Village of Bolivar, January 19, 1996

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

FEMA: *Guidance for Flood Risk Analysis and Mapping, Levees*, November 2019

USACE, National Levee Database (https://levees.sec.usace.army.mil/#/), 2020

New York State GIS Clearinghouse, FEMA 2-Meter Digital Elevation Model (DEM), Available at: https://gis.ny.gov/elevation/

Base Level Engineering Analysis, Region II Upper Allegheny Watershed (HUC8-05010001) MIP Case No. 19-02-0035S Deliverable Dated: November 30, 2019

Appendix A

Stakeholder Engagement - LLPT Meeting Information

Appendix B

Freeboard Profile Comparison

Appendix C

Levee Accreditation Checklist

Appendix D

Collected Data

(Digital data provided via FTP)

Appendix E

Initial Data Analysis

(Digital data provided via FTP)