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Analysis and Mapping Plan

City of Mt. Carmel Levee

Wabash County

Illinois

11/20/2018



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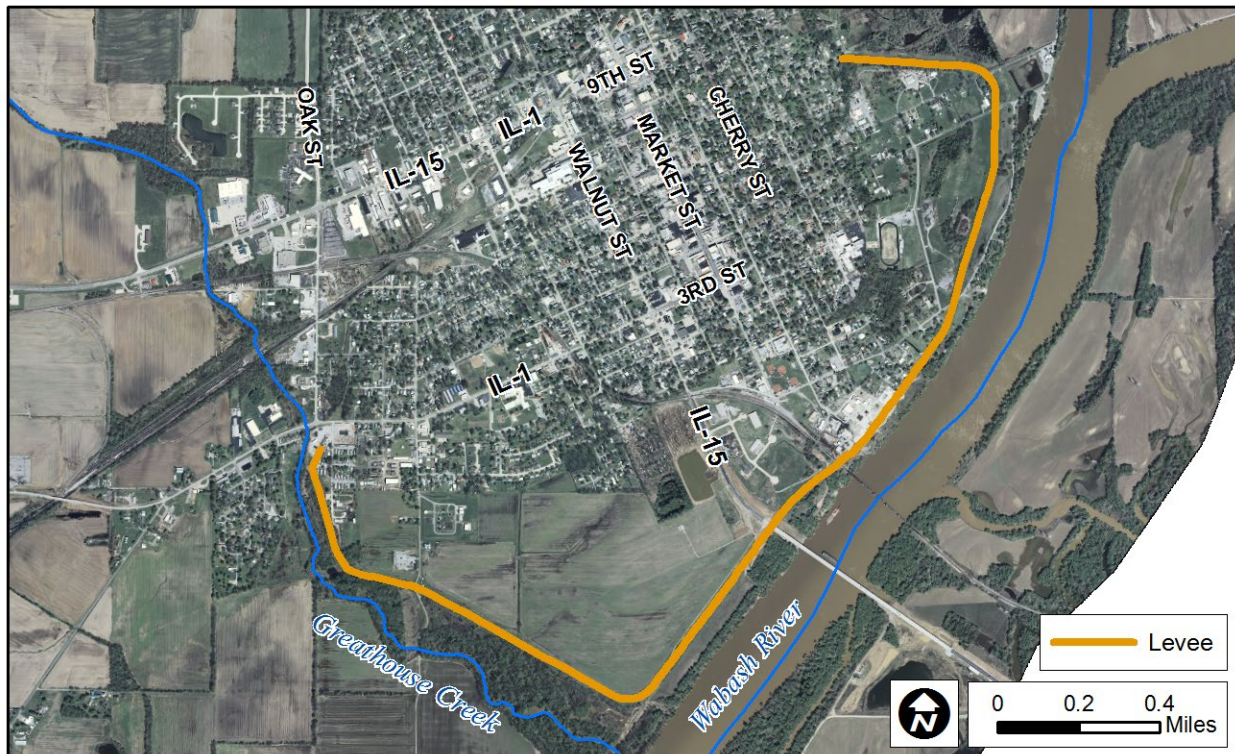
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1 Introduction

The Mt. Carmel Levee System is located along the western bank of the Wabash River in Wabash County, Illinois. The total length of the levee system is approximately 17,425 feet long consisting of 15,998 feet of levee embankment and 1,427 feet of floodwalls. The levee system was designed to reduce the risk of flooding for a portion of the City of Mt. Carmel shown in Figure 1. The levee system is in the inspection program of the U. S. Army Corps of Engineers (USACE), Louisville District and is operated and maintained by the City of Mt. Carmel.

Figure 1 – Mt. Carmel Levee General Overview



Per coordination with stakeholders throughout the levee project, it is FEMA’s understanding that the goal of the City of Mt. Carmel is to provide certified data and documentation to demonstrate that the modified Mt. Carmel Levee meets the requirements of Title 44, Chapter 1, of the Code of Federal Regulation (CFR) Section 65.10 (44 CFR 65.10). FEMA has structured this levee plan to provide information relative to this scenario in addition to a scenario in which incomplete or no additional documentation is provided under the required timeframe.

1.1 Plan Purpose

The purpose of this Analysis and Mapping Plan is to:

1. Document, coordinate and facilitate communication among the stakeholders affected by the Mt. Carmel Levee system.
2. Provide information to FEMA and the City of Mt. Carmel regarding near-term options for designation of flood risk landward of the Mt. Carmel Levee system.

1.2 Levee System Description

The Mt. Carmel Levee system was initially constructed by USACE from October 1966 to October 1971, per to the USACE Mt. Carmel Levee Periodic Inspection Report (USACE, Chicago District 2017). The levee system was turned over to the City of Mt. Carmel as the public sponsor for operations and maintenance.

The levee system consists of approximately 16,000 feet of earthen embankment in two contiguous reaches, Figure 2. The southern reach starts at the downstream extent of levee system near Greathouse Creek at 3rd Street. The northern reach terminates at the intersection of East 7th Street and Peach Street at the upstream extent of the levee system. A single reach of floodwall approximately 1,450 feet in length connects the earthen embankments through a sand and gravel company. The floodwall starts just north of the upstream face of the Norfolk Southern Rail Road and terminates to the north near the intersection of Sharp Avenue and Ogden Avenue.

Figure 2 – Mt. Carmel Levee/Floodwall Alignment



The levee system also includes nine gravity drainage structures, of which seven pass under the levee. Of the seven, two sanitary treatment plant discharge sewers are fitted with manually activated sluice gates. The remaining five storm drains are fitted with both flap gates and manually activated sluice gates. The levee system includes three pump stations. The Division Street Pump Station provides high water

discharge of the Mt. Carmel sewage treatment plant effluent. The Flintkote Ditch and Stein Street Pump Stations discharge stormwater to the Wabash River during periods of high flow.

The levee system also includes 22 relief wells within the area of the sand and gravel company behind the floodwall but also extend a few hundred feet to the north and south.

The levee is crossed by five un-named roads or tracks and four named streets including Illinois Highway 15/South Walnut Street, Hydraulic Avenue, 4th street and 5th Street and the Norfolk Southern Railroad. In the floodwall which divides the sand and gravel company there are three removable closures to provide private operational access to the riverward portion of the property. Of the three, two are normally closed, one is normally open. These closures are designed to be installed by a crew of six using prefabricated aluminum panels and trusses.

The levee impacted area is approximately 540 acres. The levee alignment used in this report is based on USACE National Levee Database (NLD) alignment supplemented with survey data provided by the USACE.

1.3 USACE PL 84-99 Rehabilitation and Inspection Program History

As an USACE designed and constructed facility the USACE performs regular and periodic inspections of the Mt. Carmel Levee System. As stated in the 2016 Mt. Carmel Routine Inspection Report, *“The primary purpose of these inspections is to prevent loss of life and catastrophic damages; preserve the value of Federal investments, and to encourage non-Federal sponsors to bear responsibility for their own protection. Inspections should assure that Flood Damage Reduction structures and facilities are continually maintained and operated as necessary to obtain the maximum benefits. Inspections are also conducted to determine eligibility for Rehabilitation Assistance under authority of PL 84-99 for Federal and non-Federal systems.”*

As the public levee sponsor, the City of Mt. Carmel is responsible for the operation and maintenance of the system. Until relatively recently, the Mount Carmel Levee has been active in the USACE Public Law (PL) 84-99 Rehabilitation and Inspection Program (RIP). When a levee system is active in the USACE RIP, the program can provide levee rehabilitation funding should the levee be damaged by a flood event. To remain active in the USACE RIP a levee system must maintain an Overall System Rating of Acceptable. An Overall System Rating of Minimally Acceptable requires action by the sponsor within the established timeframe required to correct deficiencies. With an Overall System Rating of Unacceptable a levee system becomes inactive in the USACE RIP and remains inactive until the sponsor presents USACE with documentation showing that all items rated Unacceptable have been corrected. The Mt. Carmel levee system received an Overall System Rating of Minimally Acceptable with the 2013 Routine Inspection and Unacceptable with the 2016 Routine Inspection and 2017 Periodic Inspection. The Mt. Carmel Levee System is currently inactive in the USACE RIP.

The USACE PL 84-99 RIP is an important program and active participation in it may potentially facilitate the City of Mt. Carmel’s ability to demonstrate compliance with the requirements of FEMA’s 44 CFR 65.10, *Mapping of areas protected by levee systems*, but it is important to emphasize that these are two separate programs. Active participation in the USACE’s PL 84-99 RIP does not imply compliance with 44 CFR 65.10. The documentation required to restore a levee system to active participation in the USACE RIP may also comprise part of the documentation required to show compliance with 44 CFR 65.12. Perhaps more importantly active participation in the USACE RIP provides for levee rehabilitation funding should the levee be damaged by a flood event. USACE PL 84-99 Rehabilitation and Inspection Program deficiencies are discussed further in Section 2.5 USACE PL 84-99 Deficiencies.

1.4 Mapping History

The effective Flood Insurance Study for the Wabash County is dated December 16, 2011. Panel 17185C0120C of the effective FEMA Flood Insurance Rate Maps (FIRM) from this study show the Mt. Carmel levee as a Provisionally Accredited Levee (PAL) with a reduced risk of flooding. The levee was originally shown as providing protection on the previous effective FIRMs for Wabash County and the City of Mt. Carmel was offered a Provisionally Accredited Levee (PAL) designation on January 19, 2009. The levee owner and community signed the PAL form on March 26, 2009 which kicked off the 2 year data and documentation collection period. FEMA held a PAL outreach meeting on November 17, 2010 to check on progress and give clarification on the requirements for 44 CFR 65.10. No data was received by the accreditation package deadline of April 19, 2011.

A levee de-accreditation meeting was held on September 12, 2012 where the Levee Analysis and Mapping Procedures (LAMP) process for Non-Accredited Levee Systems was introduced. To date FEMA has not received any data or documentation regarding this levee in support of accreditation or LAMP. In July 2013, FEMA released the Approach Document related to the Levee Analysis and Mapping Procedures for non-accredited levees (see Section 1.5).

1.5 LAMP Overview

FEMA's updated LAMP process was created to provide a more refined approach to analyze and map flood hazards in areas landward of non-accredited levee systems. FEMA's previous approach to mapping these areas involved an analysis of non-accredited levee systems as if they had no effect on the landward side of the levee system during the base flood event (1% annual chance flood). The updated approach under the LAMP process provides multiple procedures for analyzing and mapping of these areas based on the height, condition, and available documentation related to the levee system.

An overview of the methods available to depict flood risks under the updated FEMA LAMP process is summarized in Table 1, below. The submitted levee data is evaluated, and applicable procedures are applied resulting in the maximum inundated areas using each of these procedures depicted landward of the levee. For a more detailed description of these methodologies, please refer to the FEMA guidance document entitled "Analysis and Mapping Procedures for Non-Accredited Levee Systems" dated July 2013 or handouts included in Appendix A.

These procedures summarize the methods used to define the Special Flood Hazard Area (SFHA) landward of the levee system. For accredited levee systems, the landward inundation area resulting from the base flood event is depicted as "Shaded Zone X". For non-accredited levee systems, this area is generally depicted as "SFHA" using one of the procedures described in Table 1; however, for Freeboard Deficient levee systems, the area landward of the levee system (as determined using the Natural Valley Procedure) is depicted as Zone D. The Zone D designation is a possible, but undetermined, flood hazard. A brief summary of the Zone D mapping designation is given below.

Table 1 – Available Methods for Non-Accredited Levee Analysis and Mapping Procedures

<i>Procedure</i>	<i>Description</i>
Sound Reach	A continuous section of a levee system that has been designed, constructed, and maintained to withstand the flood hazards posed by a 1-percent-annual-chance flood, in accordance with the standards in 44CFR65.10 of the NFIP regulations.
Freeboard Deficient	Can be applied if the 1-percent-annual-chance flood does not overtop the top of levee and does not meet the freeboard standard. A structural analysis, Operation and Maintenance Plan, and inspection standards are required for a Freeboard Deficient Reach.
Overtopping Approach	Can be applied when the Base Flood Elevation (BFE) is above the levee crest for a reach and it can be demonstrated that the 1 percent-annual-chance flood will not cause structural failure of the levee. Requires development of an unsteady hydraulic model to allow overtopping of the levee.
Structural-Based Inundation	In levee reaches where the BFE is above the levee crest and there is a known structural deficiency or a lack of data to support one of the other procedures mentioned above, the Structural-Based Inundation Procedure may be used. This method involves defining the inundation extents resulting from breaches along the levee reach during the 1-percent-annual-chance flood.
Natural Valley	Can be applied to all non-accredited levee reaches to determine the Special Flood Hazard Area (SFHA) or to determine the Zone D extents when freeboard deficient, sound reach, overtopping, or structural-based inundation procedures are implemented.

1.5.1 Zone D Risk Depiction for Non-Accredited Levees

FEMA accredits a levee system when the owner or other interested parties have submitted data which show that the levee system infrastructure meets applicable standards for design and operations and maintenance specified in accordance with the requirements of 44 CFR 65.10. Accreditation allows FEMA to show low to moderate flood risk landward of the levee or floodwall using the Zone X risk designation.

Under 2013 procedures for non-accredited levee analysis, a levee or floodwall that has height at least equal to the BFE allows for the use of the Zone D for landward risk depiction as long as all other stability criteria are met. Zone D is defined as an area of possible, but undetermined, flood hazard. Areas shown as Zone D are not to be interpreted as SFHA and property owners are not subjected to federal flood insurance purchase rules in situations where a mortgage is held on an insurable structure secured by federally-regulated loans. Zone D also gives communities discretion in the measures adopted for flood damage reduction under their floodplain management ordinance. To reduce potential flood risk communities may consider adopting standards in Zone D that are less stringent than the National Flood Insurance Program’s minimum standards that will otherwise be required for SFHA.

While FEMA does not mandate insurance in Zone D areas, lenders may require it as a business practice. Property owners may want to further understand the costing of Zone D insurance policies so that they can make a judgement on whether to carry this insurance. In general the cost of a Zone D insurance policy will follow Zone A premium structure for Pre- FIRM Construction Rate Tables. However, certain elevated structures may qualify for Post-FIRM Construction Rates which may be less costly.

Under FEMA’s 2013 procedure for levee analysis and mapping, all non-accredited levees are initially analyzed using the Natural Valley approach. Natural Valley modeling will show the natural extent of the floodplain if unimpeded by the levee. The procedure then seeks to define flood inundation on the landside of the levee system under each potential method of analysis (see Table 1 for list of all methods) based on coordination and discussions with interested levee stakeholders, who are part of the Local Levee Partnership Team (LLPT). Where the extent of Natural Valley exceeds the determined inundation, the difference between the two is mapped as Zone D.

2 Stakeholder Engagement and Data Collection

2.1 Initial Stakeholder Meeting

A FEMA-led Project Team engaged the Mt. Carmel levee stakeholders during the Initial Levee Stakeholder Engagement Meeting held on April 17, 2018 to introduce concepts of the LAMP in context of the Mt. Carmel Levee. The purpose of this initial engagement was twofold: (1) to discuss the LAMP process and (2) to collect/determine availability of community/levee-related data, information, and documentation to help streamline and facilitate future coordination meetings. A copy of the meeting presentation material, sign-in sheet, and meeting minutes can be found in Appendix A.

2.2 Local Levee Partnership Team (LLPT)

The LLPT is a group of personnel assembled to provide data and input to FEMA, including commenting on the creation of levee reaches and the procedures to be used for analyzing and mapping the reaches based on local levee conditions. A summary of LLPT meetings, including attendees, meeting minutes, and presentations, are included in Appendix D. Members of the LLPT are shown in Table 2.

Table 2 – LLPT Participants

<i>LLPT Member</i>	<i>Role</i>	<i>Address</i>	<i>Phone/Email</i>
Rudy Witsman	City of Mt. Carmel, City Administrator	219 N. Market St. Mount Carmel, IL 62863	(618) 262-4822 / rudyw@cityofmtcarmel.com
Gerald Brooks	Emergency Manager Wabash Co. EMA	930 1/2 N. Market St. Mt. Carmel, IL 62863	(618) 262-6715 / gbrooks50@live.com
Ken Hinterlong	FEMA Region V, Regional Engineer	536 S Clark St. Chicago, IL 60605	(312) 408-5529 / ken.hinterlong@fema.dhs.gov
Steve Altman	Illinois Department of Natural Resources – Office of Water Resources (IDNR-OWR)	1 Natural Resources Way Springfield, IL 62702	(217) 524-1028 / steve.altman@illinois.gov
William Milner	IDNR-OWR	1 Natural Resources Way Springfield, IL 62702	(217) 524-1458 / bill.milner@illinois.gov
Jesse Tinch	IDNR-OWR	1 Natural Resources Way Springfield, IL 62702	(217) 782-4545 / Jesse.Tinch@illinois.gov
Paul Osman	IDNR-OWR	1 Natural Resources Way Springfield, IL 62702	(217) 782-4428 / paul.osman@illinois.gov
Dan Frank	USACE, Louisville District	600 M. L. King Pl. 40202	(502) 315-6291 / daniel.d.frank@usace.army.mil
Jim Kelly	USACE, Louisville District	600 M. L. King Pl. 40202	(502) 315-2612 / j.a.kelly@usace.army.mil
Jonathan Hocker	Norfolk Southern Corp. Regional Engineer Structures	1600 Peachtree St., NE Atlanta, GA 30309	(404) 529-1362 / jonathan.hocker@nscorp.com
Jennifer Sunley	Hanson Professional Services Inc.	13801 Riverport Dr., Suite 300 St. Louis, Missouri 63043	(314) 942-5287/ jsunley@hanson-inc.com
Roger Denick	FEMA Region V, Regional Service Center Lead	350 N. Orleans St., Suite 1301, Chicago, IL 60654	(312) 262-2281 / Roger.Denick@stantec.com
Brian Chaille	Illinois State Water Survey	2204 Griffith Dr. Champaign, IL 61820	(217) 244-3522 / bchaille@illinois.edu

2.3 Data Collection

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

Table 3 provides a summary of the data, information, and documentation collected during the Stakeholder Coordination and Data Collection process. The collected data is provided in Appendix B.

Table 3 – Data Sources for the Levee System

<i>Data Type</i>	<i>Data Description</i>	<i>Source</i>	<i>Date Obtained</i>
Wabash River Hydraulic Model	HEC-RAS v. 4.1 Steady State model dated February 2018 submitted to Indiana Department of Natural Resources – Division of Water	Illinois Department of Natural Resources – Office of Water Resources (IDNR-OWR)	February 2018
Wabash River GIS Data	March 2018 GIS shape files (work maps) of Wabash River Centerline, Cross Section Alignments	IDNR-OWR	March 2018
Topographic Data	2010 LiDAR derived Digital Elevation Model (DEM) of the Middle and Lower Wabash River “Corridor”	FEMA: STARR Contract # HSFEHQ-09-D-0370 Task Order # HSFE05-11-J-0090	April 2018
Levee Elevation Data	Mount Carmel Levee Centerline and Floodwall Points (NAVD88) – Collected January 2007	USACE-Louisville District	April 2018
Levee Design Memoranda	1963 Mt. Carmel Local Flood Protection Project, General Design Memorandum Number 1, revised 1965	Warren and Van Praag, Inc., Consulting Engineers, Decatur, Illinois	June 2018
Levee Design Memoranda	February 1966 Mt. Carmel Local Flood Protection Project, Design Memorandum Number 2, Pumping Stations and October 1966 Supplement to Design Memo. No. 2	USACE-Nashville District	June 2018
Record Drawings	1963 Mt. Carmel Local Flood Protection Project, Soil Classification Chart; Boring Logs; Plan, Profile, Section	Warren and Van Praag, Inc., Consulting Engineers, Decatur, Illinois	June 2018
USACE 2017 Periodic Inspection Reports	April 4, 2017 USACE Periodic Inspection (PI) #3 Reports and PI Letter dated February 2, 2018 (three documents: Mt Carmel 2017 PI Letter.pdf, Mt Carmel PI Report Final.pdf and CELRL_MOUN_2017_a_1a1.pdf)	USACE-Louisville District	March 2018
USACE Routine Inspections	March 14, 2013 Maintenance Letter June 4, 2015 Routine Inspection including cover letter and checklist August 22, 2016 Routine Inspection including cover letter and checklist	USACE-Louisville District	March 2018
USACE Levee Screening	December 2011 levee screening, preliminary risk-based assessment, (USACE Mt Carmel Screening Dec 2011.pdf)	USACE-Louisville District	July 2018
FEMA PAL Documentation	Notes and correspondence RE: Mt. Carmel Levee Provisionally Accredited Levee (PAL) status.	STARR II, FEMA Region 5, Regional Service Center	June 2018
USACE NLD Data, Wabash County, IL	GIS Geodatabase (National Levee Database) of levee alignment centerlines and station points for Wabash County, IL	STARR II, FEMA Region 5, Regional Service Center	June 2018
Hydrologic Analysis	USGS Gage Data Analysis for Wabash River including Mt. Carmel, Illinois site	USACE-Louisville District	May 2018

2.4 Related Initiatives

From 1943 to 1966 the USACE built a giant physical model of the Mississippi River Basin, which included the Wabash River. This physical model occupies nearly 200 acres near the USACE Waterways Experiment Station in Vicksburg, Mississippi. The effective study along the Wabash River, as depicted in the 2011 Flood Insurance Study (FIS), utilizes the Wabash River basin segment of this physical USACE model of the Mississippi River basin rather than a mathematical model such as HEC-2. The Mississippi River Basin model was in operation from 1949 until 1973. It was subsequently abandoned and is no longer functional. See Figure 3.

Figure 3 – Mississippi Basin Model: Vertical scale – 1:100; horizontal scale – 1:2000. Looking upstream on the Ohio River from Evansville. Indiana, Tennessee, and Cumberland Rivers are in the foreground showing the site of the Kentucky and Barkley Dams. Tradewater and Green Rivers are shown center. File No. 1270-4
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Since their substantial completion around 1969, reservoirs and levees throughout the Wabash River basin have a direct impact on flooding on the river. At the time of the Wabash River study, limited valid calibration data (which reflected the impact of these recently completed levees and reservoirs) was available at the time of the Wabash River study as the Wabash County Flood Insurance Study (December 16, 2011) explains:

“ In order to calibrate the model, a flood of recent occurrence was necessary because the levees along the Wabash and its tributaries were built over an extended period of time and subject to several failures due to high water conditions. At the time of this study, only one flood of significance, the 1969 event, has occurred since the levee system has been completed; therefore, the 1969 flood was used to calibrate the model to simulate flood conditions.”

According to the National Weather Service web site for the USGS stream gage at Mt. Carmel the February 2, 1969 flood crest was the 26th highest on record. Of the 25 larger floods, only one, in 1913, precedes the 1969 flood. From an engineering perspective, the more data available the more reliable the results. The methods used for the effective Wabash River FIS are sound. However, a more reliable estimate of the current flood hazard can now be made due to the availability of more than 40 years of data since the levee systems and other flood controls have been constructed. In addition the Wabash River is a meandering river in which the channel tends to migrate, winding sinuously across the floodplain. This natural action may actually affect expected flood elevations over time. As upstream and downstream reaches of a meandering river approach each other they may reconnect, shortening the length of the channel and forming an “ox bow” lake. This occurred near the Ohio River confluence on the Wabash River between 2008 and 2013, eliminating approximately 7.5 miles of the river channel.

Due to these factors, the Illinois Department of Natural Resources-Office of water Resources (IDNR-OWR) determined that a new mathematical hydraulic model of the Wabash River was needed from the Ohio River confluence upstream along the state line with Indiana.

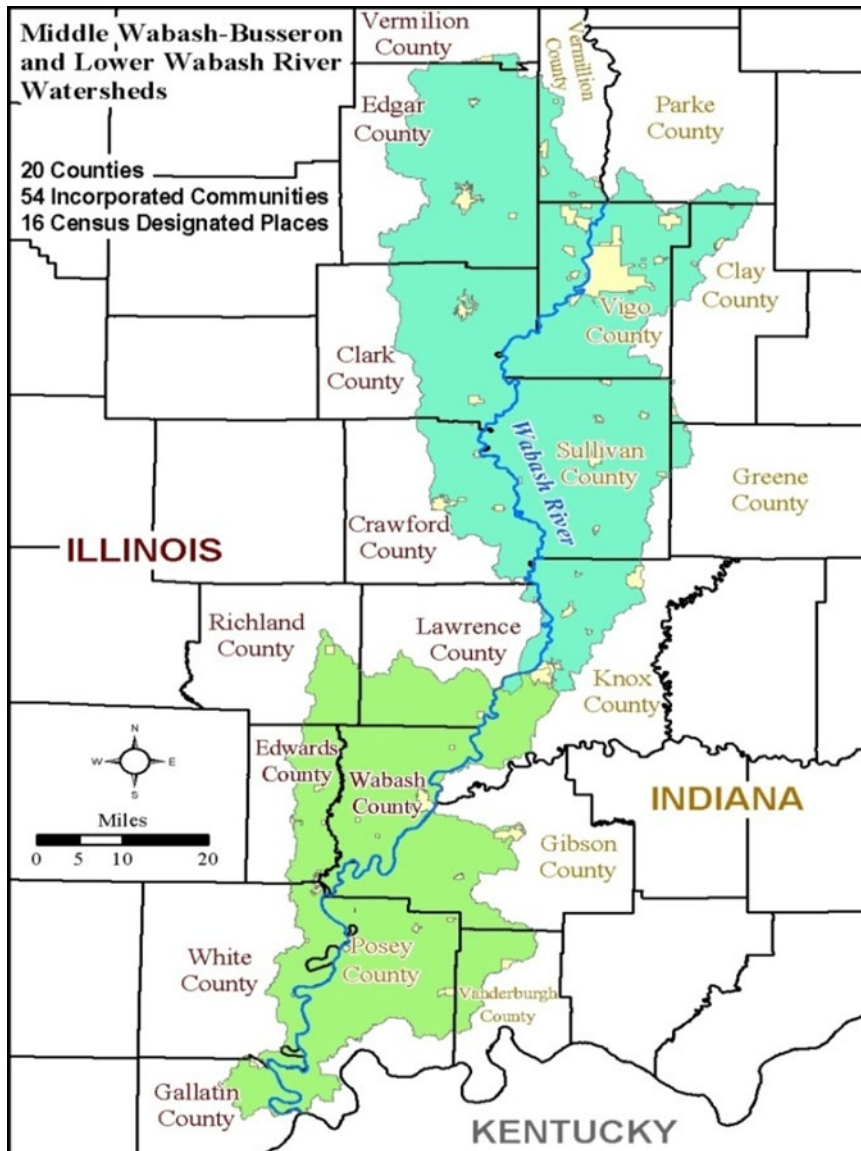
Illinois State Water Survey is currently under contract with FEMA to provide data development for Illinois Counties within the Middle Wabash – Busseron and Lower Wabash HUC-8 watersheds. This hydrologic and hydraulic (H&H) study entails development and/or support of flood hazard data and program-related tasks through completing technical risk analysis and mapping activities. These activities may or may not result in a new or updated Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS) report for communities within the project area.

The Lower Wabash (HUC 05120113) and Middle Wabash-Busseron (HUC 05120111) watersheds are located in southeastern Illinois and southwestern Indiana. The Wabash River forms an approximate 200 mile section of the Illinois-Indiana border before draining into the Ohio River. The Illinois and Indiana Departments of Natural Resources have coordinated study efforts to update the Wabash River hydrologic and hydraulic models. The recently completed hydraulic model was produced using the USACE HEC-RAS computer program (v. 4.1, 1D, steady-state) and provided to ISWS by the Illinois DNR. The flow rates used in the main stem hydraulic analysis are based on historic gage data (as agreed by Illinois and Indiana DNRs), and will not be changed by ISWS.

These updated models and resulting GIS database may be used to update the affected Flood Insurance Rate Maps and Flood Insurance Studies in Illinois in future funding years. The period of performance for hydraulic data development concludes August 31, 2022. Should production of new FIRMs and FIS be authorized by FEMA they are not likely to be finalized prior to 2025.

The map Figure 4 below shows the Middle Wabash-Busseron and Lower Wabash River Watersheds in relation to the Illinois and Indiana county boundaries.

Figure 4 – Wabash River Watershed Project Area



3 Initial Data Analysis

3.1 Understanding of Mt. Carmel Levee Existing Conditions

As part of the LAMP process, the existing conditions of the Mt. Carmel Levee system were evaluated in the context of the additional data provided from the LLPT discussions. The effective study along the Wabash River, as depicted in the 2011 Wabash County, Illinois, Flood Insurance Study, utilizes the physical USACE model of the Wabash River basin segment of the Mississippi River basin located near Vicksburg, Mississippi discussed above rather than a mathematical model such as HEC-RAS. As discussed in Section 2.4 above, a new HEC-RAS model of the Wabash River has been developed by Illinois DNR (IDNR-OWR) and has been reviewed by Indiana DNR is used for this evaluation. To facilitate the analysis required for this LAMP project, a portion of this model was extracted and brought into HEC-RAS version 5.0.5. Model results between versions were verified to be identical within 0.01 ft.

This model was used for the purpose of evaluating potential reach scenarios for non-accredited levees (See Table 1).

Levee freeboard was evaluated as part of this LAMP study using 44 CFR 65.10(b)(1) freeboard requirements and 1-percent-annual-chance flood elevations depicted in the updated HEC-RAS model for Wabash River. The requirements of 44 CFR 65.10(b)(1) as they apply to the Mt. Carmel Levee are summarized on Figure 5A. See Appendix E Figure 5A “pdf” for details.

Please note that reference levee stationing (points along the levee at even 100 foot increments) have been associated with the Mt. Carmel Levee since its construction. For example station 10+00 is equivalent to 1,000 ft. The Mt. Carmel Levee stationing increases from downstream to upstream (south to north) along the levee and is contiguous with the exception of a discontinuity in stationing at downstream station 94+29. At this point the reference stationing jumps to station 178+20 and then stationing proceeds in the upstream direction (to the north) from this reference. This is known as a “station equation.” The station equation is D/S 94+29 = U/S 178+20. The station equation is retained to provide consistency with station numbers in prior studies and reports.

Figures 5B and 5C are a profile plots of the top of levee/levee crest survey elevation compared to the 1-percent-annual-chance flood elevations from the IDNR-OWR HEC-RAS model and corresponding minimum freeboard elevation requirements. Figure 5B is the portion of the levee south of the station equation, Figure 5C is north of the station equation. The levee crest (“Top of Levee”) appears to be above the 1-percent-annual-chance water surface elevations of the IDNR-OWR model along the length of the levee (“New WSEI”). With respect to the effective 1-percent-annual-chance water surface elevation (“Effective WSEI”) the existing crest elevation of the Mt. Carmel Levee does not meet FEMA minimum freeboard requirements at all points along the entire length of the levee. Larger versions of these figures are provided in Appendix B. The minimum freeboard available is 0.93 ft. near the northern end of the floodwall at Sta. 205+12. This location has a freeboard deficiency of 2.39 ft. of the required 3.32 ft. The maximum freeboard deficiency is 3.04 ft. at Sta. 189+43, just north of the Norfolk Southern Railroad where the required freeboard is 4.00 ft. The available freeboard at this location is 1.21 ft.

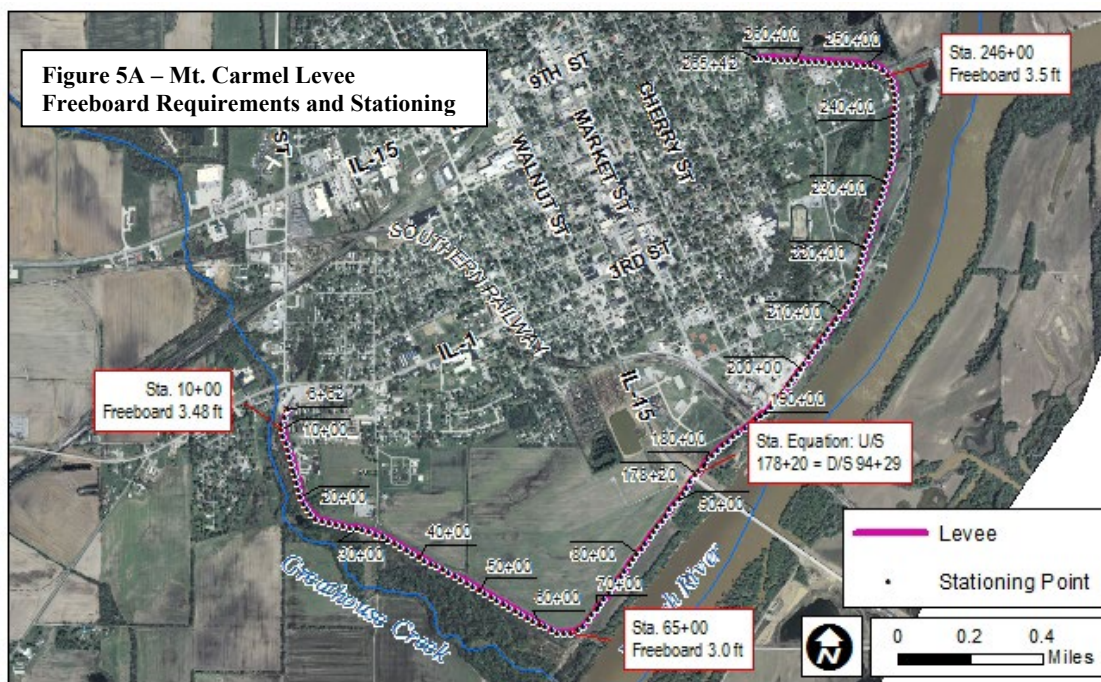


Figure 5B – Mt. Carmel Levee Profiles: South of IL – Highway 15

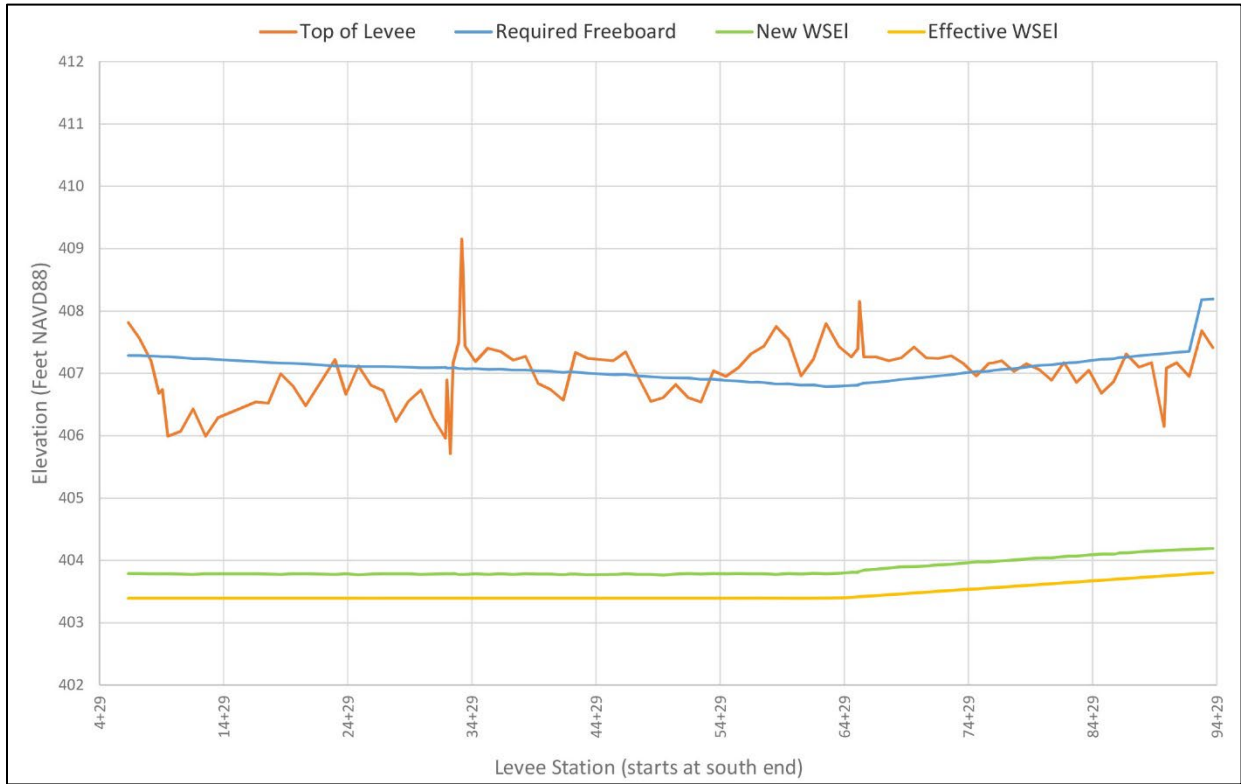


Figure 5C – Mt. Carmel Levee Profiles: North of IL – Highway 15

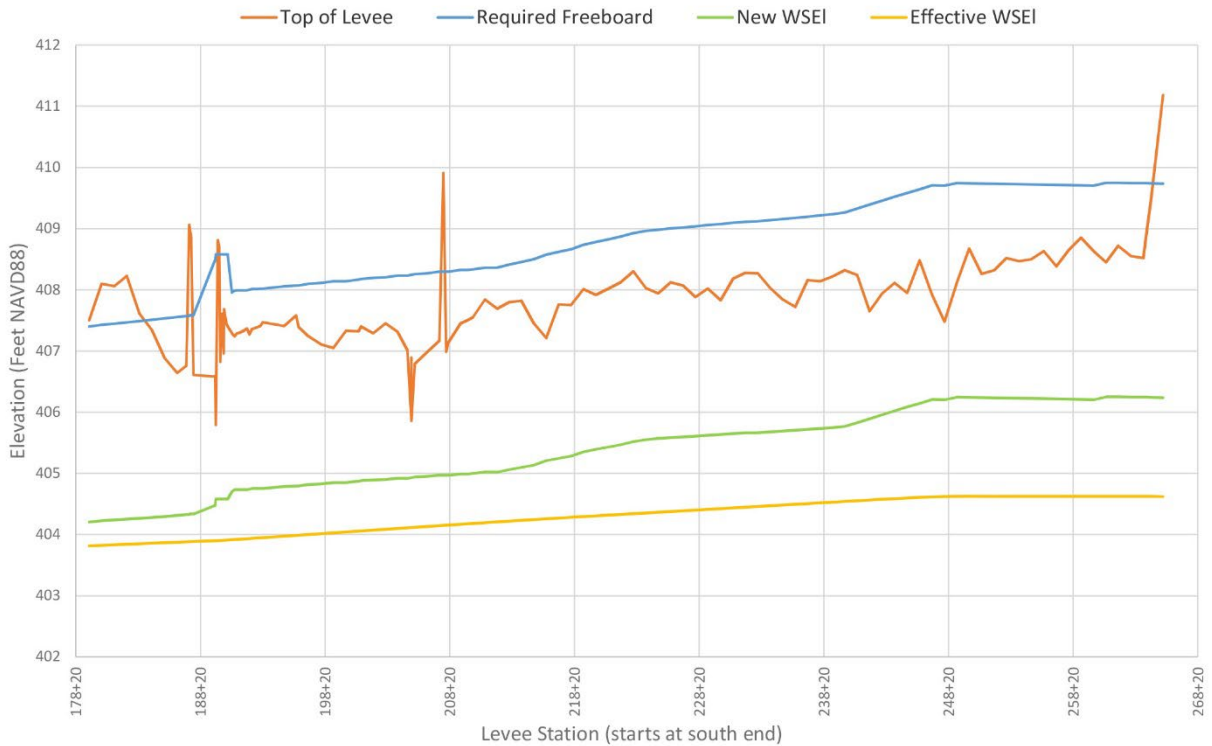
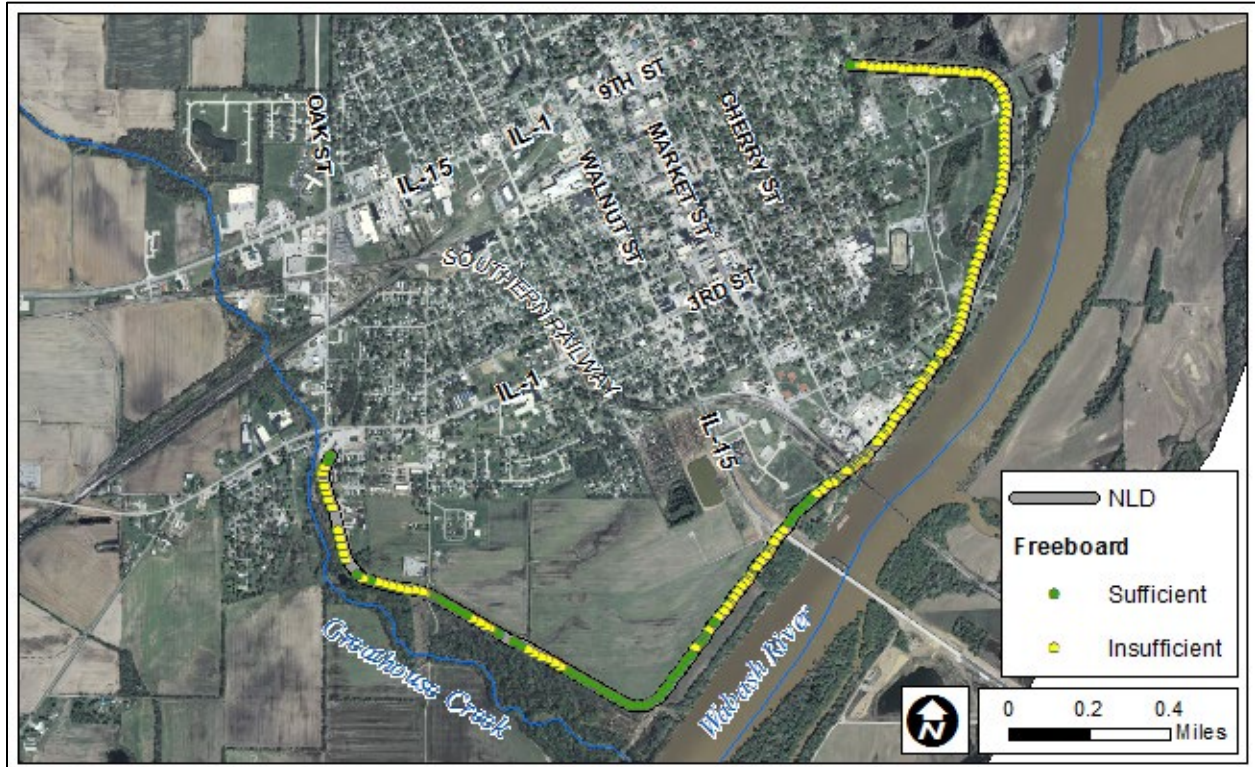


Figure 6 provides an aerial/plan view of the levee system and displays locations where the levee crest elevation corresponds to one of the following:

1. Levee crest meets 65.10 freeboard requirements. (green dot)
2. Freeboard Deficient Levee Crest Elevation. Levee crest is above the BFE but does not meet 44 CFR 65.10 freeboard requirements. (yellow dot)

Figure 6 – Mt. Carmel Levee System Freeboard Deficient Overview



3.2 Establishment of Levee Systems/Reaches

A key component of LAMP is to define appropriate segmentation of levee systems and reaches to identify potential mapping approaches for each system/reach based on available data and conditions.

A **levee system** is a hydraulically independent flood hazard-reduction system that consists of a levee, or levees, and associated structures, such as closure and drainage devices, which are constructed and operated in accordance with sound engineering principles. A **levee reach** is any continuous section of a levee system to which a single analysis and mapping procedure may be applied.

Topographic data and levee survey data were reviewed to define the system and reach boundaries in relation to available freeboard, as described in Section 3.1. As shown in Figure 6, with the exception of disconnected reaches downstream of the Norfolk Southern Railroad, the levee system is freeboard deficient. The levee system was therefore not divided into reaches because it would not impact the mapping of the SFHA on the landside of the levee.

3.3 Hydraulic Analysis

The application of the reach analysis procedures and corresponding hydraulic analyses for identifying flood risk in the leveed area are discussed within this section. Table 4 summarizes the available reach

analysis procedures and their application to the single reach of the Mt. Carmel Levee system based on existing data received to-date.

Table 4 – Potential Reach Analysis Procedures

<i>Reach Analysis Procedure</i>	<i>Applicable</i>	<i>Application of Procedure</i>
Natural Valley	Yes	Levee crest data available. No additional data required for analysis or mapping.
Structural Based	Yes	Levee crest data available. No additional data required for analysis or mapping.
Freeboard Deficient	Possible	Levee crest is above the BFE. Sponsor must provide information to demonstrate levee meets 65.10 criteria (except freeboard).
Overtopping	No	No evaluation of overtopping erosion potential. Levee system not designed to overtop.
Sound Reach	No	Levee crest does not meet minimum freeboard requirements along a portion of the levee system. Sponsor may consider alterations with a goal of meeting freeboard requirements. Permit approval of potential impacts in excess of the original levee design may prove difficult.

The options outlined in the sections below summarize the reach analysis procedure(s) used to identify flood risk landside of the levee. The proposed HEC-RAS base flood profiles along the Wabash River as modeled by IDNR-OWR, was used to assess levee freeboard requirements. This hydraulic model was also used to map estimated inundation areas landward of the levee system as discussed in sections 3.3.1 and 3.3.2.

The approaches mentioned in 3.3.1 and 3.3.2 were discussed during meetings with LLPT members and are based on submitted data for existing conditions. These options are dependent on whether 44 CFR 65.10-compliant data is provided to FEMA for the levee system.

Section 3.3.1 and 3.3.2 below elaborate on the reach analysis procedures evaluated based on 44 CFR 65.10 requirements for mapping the flood hazard in the leveed area on future FIRMs. Additional explanation of the analyses performed as part of this LAMP project are provided in the LLPT Meeting notes.

3.3.1 Incomplete or No Additional Data Provided for 44 CFR 65.10

Options 1 and 2 evaluate potential mapping of the landside flood risk should no additional data or documentation pertaining to the requirements of 44 CFR 65.10 be received or if data provided remains incomplete at the conclusion of the “Additional Data Collection” task described later in this plan.

3.3.1.1 Option 1- Natural Valley Procedure

The Natural Valley Procedure involves performing a hydraulic analysis to define the maximum extent of the 1-percent-annual-chance flood, per LAMP requirements. In this analysis, the levee was modeled as if it did not provide landside flood risk reduction and water is allowed to flow freely on both sides (riverside and landside) of the levee.

3.3.1.2 Option 2 – Structural-Based Inundation Procedure

The Structural-Based Inundation Procedure involves a hydraulic analysis where breaches are simulated along the levee system to estimate the resulting flood inundation, which would be mapped as Zone AE SFHA. If the water surface elevations resulting from the cumulative results of the breach analyses are

lower than the results of the Natural Valley Procedure, the difference between the areas can be mapped as Zone D.

3.3.2 Additional Data Provided for 44 CFR 65.10

Options 3 and 4 evaluate potential mapping of the landside flood risk if 44 CFR 65.10-compliant data is provided for the levee system.

3.3.2.1 Option 3 - Freeboard Deficient Procedure

Option 3, Freeboard Deficient Procedure, estimates the potential flood risk if documentation is provided prior to the end of the Additional Data Collection Phase to demonstrate the levee system meets 44 CFR 65.10 requirements, with the exception of freeboard, and the minimum levee crest elevation is at or above the base flood elevation. In this option, the Natural Valley Procedure is used to identify Zone D flood risk areas landside of the levee.

3.4 Results¹ and Options

The 1-percent-annual-chance flood inundation exhibits associated with Options 1 and 2 described in Section 3.3 are provided below and in Appendix E.

3.4.1 Incomplete or No Additional Data Provided for 44 CFR 65.10

The results of the Natural Valley Procedure (Option 1), shown in Figure 7, reflect the inundation area associated with the 1-percent-annual-chance flood on the river side of the levee and the inundation area landside of the levee without the levee reducing flood risk.

The results of the Structural-Based Inundation Procedure (Option 2), as depicted in Figure 8 (also provided in Appendix E), show significantly to moderately increased Base Flood Elevations and moderately increased inundation within the leveed area when compared to the results of the Natural Valley Procedure. The red tinted area along the blue Natural Valley Procedure delineation is the additional inundation area resulting from the Structural-Based Inundation Procedure.

¹ The findings of the Initial Data Analysis are not regulatory and are intended to inform the path forward for identification of flood risk associated with the levee system. The findings may be used for emergency planning purposes; however, they are subject to change and due process, and should not be used outside of this levee stakeholder group for any regulatory activities. The flood risk due to interior drainage in the leveed area is also not depicted and would need to be evaluated in the future prior to updating the FIRM. The flood risks depicted in the Figures are for the study area only and are not meant to imply that flood risk outside of the study area do not exist.

Figure 7. Mt. Carmel Levee, Option 1: Natural Valley Procedure

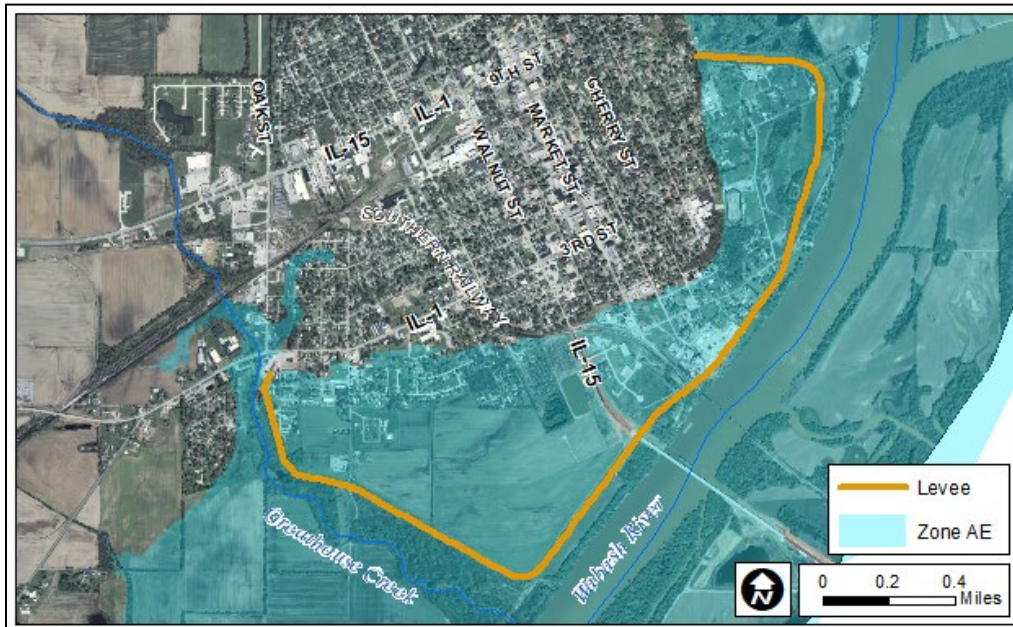
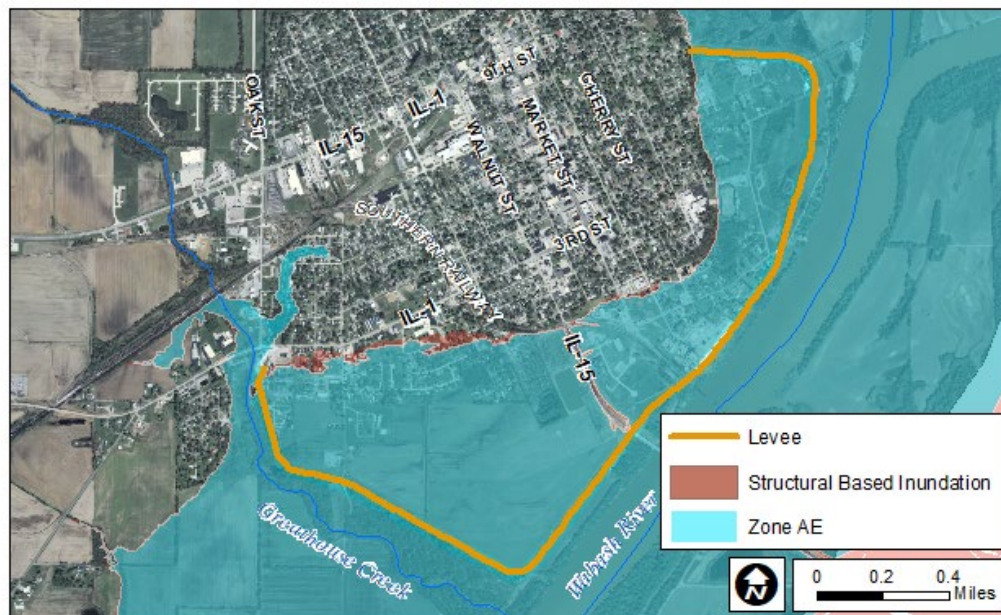


Figure 8: Mt. Carmel Levee, Option 2: Structural-Based Inundation Procedure



Since the Structural-Based Inundation (Simulated Breach Analysis) Procedure yielded increased water surface elevations compared to the Natural Valley Procedure, the Natural Valley Procedure would be used to represent landside flood risk for the levee if incomplete or no additional data is provided for the levee system. The inundated area would be mapped as Zone AE SFHA as shown in Figure 7.

3.4.2 Additional Data Provided for 44 CFR 65.10

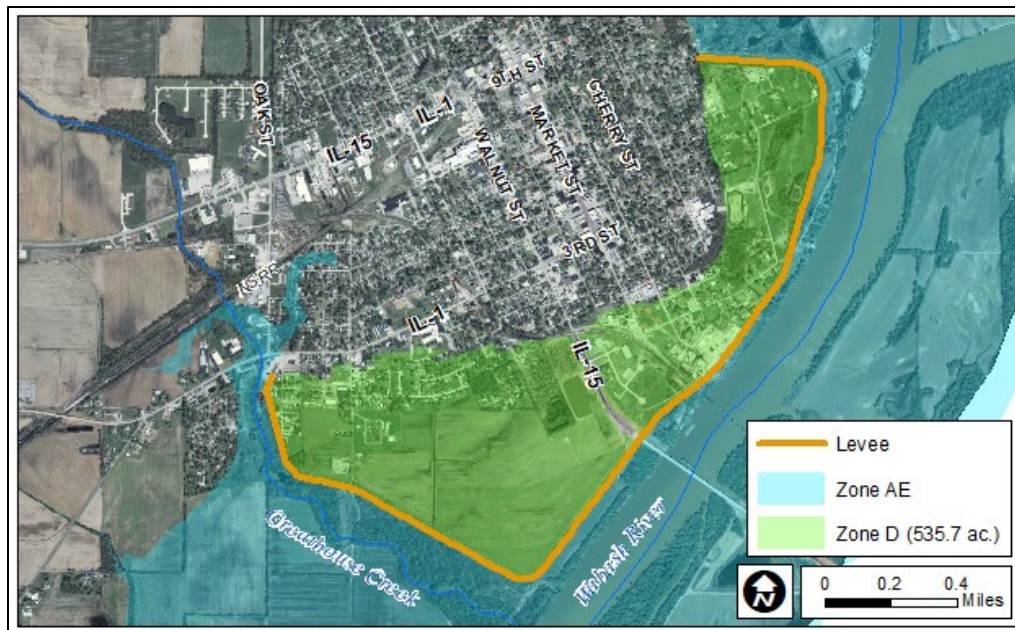
Figure 9 shows the landside flood risk for the Freeboard Deficient Procedure (Option 3). The flood risk areas would be mapped using the inundation area from the Natural Valley Procedure; however, the landside flood risk for Options 3 would be mapped as Zone D.

For the levee system to be considered Freeboard Deficient, certified documentation will be required to demonstrate that the levee system meets all minimum requirements of 44 CFR 65.10 with the exception of freeboard; however, the levee crest will need to be elevated above the 1-percent-annual-chance flood elevation at all locations along the levee.

Areas of residual interior drainage or ponding with average depths greater than 1 foot will need to be identified and mapped as Zone AE SFHA.

FEMA understands the levee owner and community are beginning to consider levee improvements that may allow the levee to meet the full requirements of 44 CFR 65.10. If this is accomplished, the impacted area in Figure 7 may be shown as a Zone X floodplain.

Figure 9: Mt. Carmel Levee, Option 3 Freeboard Deficient Procedure



4 Schedule and Path Forward

Based on the data collected and discussions during LLPT meetings, FEMA understands that the Mt. Carmel Levee stakeholders have an ultimate goal of initiating levee improvements and providing 44 CFR 65.10-compliant data and documentation for the Mt. Carmel levee system to show the system as accredited on future FIRMs. Documentation to support this goal would need to be submitted and accepted by FEMA during the Additional Data Collection phase ending May 30, 2020 (see Figure 10).

Based on the existing levee crest elevation data provided by the USACE – Louisville District, the levee crest is elevated at or above the 1-percent-annual-chance flood elevation for the entire levee system but does not have the required freeboard for accreditation along the entire system. If 44 CFR 65.10 documentation is submitted for the levee system, and the levee remains freeboard deficient, the flood risk could be mapped using the Freeboard Deficient Procedure (Option 3) and the landside areas could be depicted as Zone D.

If no or insufficient documentation is provided by May 30, 2020, FEMA will proceed with Option 1 (Natural Valley), resulting in the landside flood risk being depicted as Zone AE.

Should 44 CFR 65.10-compliant data become available during the production of the FIRMs, it may be incorporated if it is received by FEMA and deemed complete prior to the end of the appeal period date for the mapping project. The appeal period occurs after production of the Preliminary Map and approximately nine months prior to issuance of the effective maps. It is also important to note that 44 CFR 65.10-compliant data may be submitted at any time in the future through the Letter of Map Revision (LOMR) process.

During the period of the Additional Data Collection phase ending May 30, 2020, while FEMA’s work related to the Mt. Carmel Levee will be suspended, hydraulic data development work will continue related to revised mapping of the Wabash River. FEMA will remain in contact with the community during this period of parallel work. As it becomes available, FEMA will provide data developed in support of the work on the Wabash River during the Additional Data Collection phase which may have bearing on the community’s work. At least one meeting is planned around October or November of 2019 to provide coordination and assess the status of progress.

Currently FEMA has contracted the hydraulic data development and preliminary mapping work for the Middle and Lower Wabash River Watersheds. The work to finish maps and FIS Reports for the Middle and Lower Wabash River Watersheds through Post Preliminary phases required to produce **new effective Digital Flood Insurance Rate Maps is contingent on FY 2021 funding. As a result the start date for the Mapping and Post Preliminary task is approximate.**

The anticipated project schedule is shown in Figure 10.

5 Appendix – Associated Files

The appendices are stored digitally under their respective folders on the CD that accompanies this report.

Appendix A – Initial Stakeholder Engagement Meeting Data

- Meeting Agenda
- Meeting Notes
- Meeting Presentation

Appendix B – Collected Data

- Supplemental Data from IDNR-OWR
- Supplemental Data from STARR, FEMA Region 5
- Supplemental Data from USACE, Louisville and Chicago Districts
- Effective FIS and FIRM, 2011

Appendix C – Initial Data Analysis

- Hydraulic Analysis Data from ISWS

Appendix D – Local Levee Partnership Meeting Data

- Local Levee Partnership Team
- Meeting Agenda and Minutes
- Meeting Presentation Material

Appendix E – Figures

- Levee System General Overview
- Levee Alignment & Stationing
- LAMP Profiles
- Levee System Freeboard Deficient Overview
- Option 1: Natural Valley Procedure
- Option 2: Structural Based Inundation Procedure
- Landside Identified Flood Risk: Option 3
- Project Path Forward - Schedule