LOCAL FLOOD ANALYSIS

EAST BROOK, WEST BROOK, AND THIRD BROOK
VILLAGE AND TOWN OF WALTON
DELAWARE COUNTY, NEW YORK

October 2017
Revised December 2017

MMI #5197-06

Photo Source: Milone & MacBroom, Inc. (2015)

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ABBREVIATIONS/ACRONYMS

BFE	Base Flood Elevation
CFS	Cubic Feet per Second
CWC	Catskill Watershed Corporation
CY	Cubic Yards
DCSWCD	Delaware County Soil and Water Conservation District
DFIRM	Digital Flood Insurance Rate Map
FEMA	Federal Emergency Management Agency
FHMIP	Flood Hazard Mitigation Implementation Program
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FTP	File Transfer Protocol
GIS	Geographic Information System
HEC-RAS	Hydrologic Engineering Center – River Analysis System
HMP	Hazard Mitigation Plan
LFA	Local Flood Analysis
LiDAR	Light Detection and Ranging
LOMR	Letter of Map Revision
MMI	Milone & MacBroom, Inc.
NFIP	National Flood Insurance Program
NRCS	Natural Resource Conservation Service
NYCDEP	New York City Department of Environmental Protection
PMR	Physical Map Revision
SFHA	Special Flood Hazard Area
SMP	Stream Management Plan
STA	River Station
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey

EXECUTIVE SUMMARY

The subject Local Flood Analysis (LFA) was undertaken in partnership with the Walton Flood Commission to evaluate potential flood mitigation options along East Brook, West Brook, and Third Brook within the Village of Walton. Flooding has long been a problem in the community, evidenced most recently by the extensive devastation during floods in 1996, 2006, and 2010. The Walton Flood Commission guided this LFA through a number of commission meetings and two public meetings from September 2015 through July 2016.

The study areas along East Brook, West Brook, and Third Brook were selected to coincide with developed areas in the Village of Walton. The three tributaries flow into the West Branch Delaware River, which discharges into the Cannonsville Reservoir. The Cannonsville Reservoir is a drinking water supply source to the New York City public water system. The study area extends 1.0 stream miles along Third Brook, 0.7 miles along West Brook, and 0.9 mile along East Brook Road within the Village of Walton.

Sources that informed this LFA included the FEMA Flood Insurance Study (FIS), the Third Brook Watershed Management Plan, the West Branch Delaware River Stream Corridor Management Plan, the Delaware County Hazard Mitigation Plan including annex reports for the Village and Town of Walton, the Village of Walton Flood and Hydraulic Study completed in 2010, water quality reports, and accounts of flood events that have impacted Walton.

Two general types of flood mitigation options were considered in Walton – hydraulic and property-specific[1]. Hydraulic options change the water surface elevation and flow velocities during high river flow conditions. Hydrologic alternatives were not a significant consideration for East Brook, West Brook and Third Brook, as there is no feasible method of retaining or detaining significant volumes of water upstream of Walton to reduce flooding.

The primary objective identified by the Walton Flood Commission was to develop a set of flood mitigation alternatives that would eliminate or reduce the risk of flood damage to businesses and homes in Walton. Over the course of conducting the LFA, initial alternatives were modified and adjusted to maximize the reduction of floodwater elevations. The following alternatives were evaluated:

East Brook

- ❑ Alternative 1 – Delaware Street Bridge Replacement and removal of 1 business
- ❑ Alternative 2 – Delaware Street bridge replacement and floodplain bench (FP4)
- ❑ Alternative 3 – Benton Ave bridge replacement (90') and remove 2 homes
- ❑ Alternative 4 – Benton Ave bridge replacement (90') and remove 2 homes + floodplain at school (FP1)
- ❑ Alternative 5 – Benton Ave bridge replacement (120') and remove 4 homes

[1] For the purpose of this document, property specific mitigations are those that are accomplished at the building such as elevation, floodproofing, or acquisition.

- ❑ Alternative 6 – Benton Ave bridge replacement (120') and remove 4 homes + floodplain at school (FP1)
- ❑ Alternative 7 – Benton Ave bridge removal and no replacement
- ❑ Alternative 8 – Benton Ave bridge removal and no replacement + floodplain at school (FP1)
- ❑ Alternative 9 – Griswold Street bridge replacement (includes 2 homes removed)
- ❑ Alternative 10 – Griswold Street bridge replacement and upstream floodplain (FP3) (includes four homes removed)
- ❑ Combination – Combination of East Brook alternatives

West Brook

- ❑ Alternative 1 – Floodplain Downstream of Delaware Street (FP1)
- ❑ Alternative 2 – Floodplains Downstream and Upstream of Delaware Street, (FP 1+2) and Replace Delaware Street Bridge
- ❑ Alternative 3 – Floodplains Upstream and Downstream of Mead Street (FP 3+4) and Replace Mead Street Bridge
- ❑ Alternative 4 – Mead Street Floodplains and Floodplain Between East Street and Mead Street (FP 3+4+5) and Replace Mead Street Bridge
- ❑ Alternative 5 – Replace East Street Bridge
- ❑ Alternative 6 – Floodplain between East Street and park
- ❑ Alternative 7 – Floodplain between East Street and park, and Replace East Street Bridge
- ❑ Combination – Combination of West Brook alternatives

Third Brook

- ❑ Alternative 1 – Lower, Middle, and Upper Floodplains
- ❑ Alternative 2 – Lower, Middle, and Upper Floodplains with Delaware and Ogden Street Bridge Replacements
- ❑ Alternative 3 – Bypass Culvert and Channel by Kraft Building
- ❑ Alternative 4 - Floodplain along Lower Third Brook Road
- ❑ Third Brook Upper Crossings – Lower Third Brook Road and Gosper Road

Hydraulic analysis of East Brook, West Brook, and Third Brook was conducted using the HEC-RAS program. The HEC-RAS software (*River Analysis System*) was written by the United States Army Corps of Engineers (USACE) Hydrologic Engineering Center (HEC) and is considered to be the industry standard for riverine flood analysis. The model is used to compute water surface profiles for one-dimensional, steady-state, or time-varied flow.

In order to develop hydraulic modeling to assess the alternatives, the effective FEMA HEC-RAS models from NYCDEP were obtained. The hydraulic models were used in the June 16, 2016 FEMA Effective FIS to create the regulatory floodplain and floodway boundaries.

A Benefit-Cost Analysis (BCA) was conducted to validate the cost-effectiveness of proposed hazard mitigation projects. A BCA is a method by which the future benefits of a project are estimated and compared to its cost. The end result is a benefit-cost ratio (BCR), which is derived from a project's total net benefits divided by its total project cost. The BCR is a numerical expression of the cost effectiveness of an alternative. An alternative is considered to be cost effective when the BCR is 1.0 or greater, indicating the long-term benefits of the alternative are sufficient to justify the upfront and long-term costs. Alternatives with sufficient flood reduction were advanced to the BCA process. Tables ES-1 to ES-3 summarize the costs and benefits of the alternatives.

TABLE ES-1
Comparison of Costs and Benefits – East Brook

Alternative	Description	Total Benefits	Total Cost	BCR
1	Delaware Street bridge replacement and removal of one business	$1,011,000	$2,848,000	0.35
2	Delaware Street bridge replacement and floodplain bench (FP4)	$1,287,000	$3,317,000	0.39
3	Benton Ave bridge replacement (90') and remove 2 homes	$689,000	$2,165,000	0.32
4	Benton Ave bridge replacement (90') and remove 2 homes + floodplain at school (FP1)	$718,000	$2,347,000	0.31
5	Benton Ave bridge replacement (120') and remove 4 homes	$1,059,000	$2,476,000	0.43
6	Benton Ave bridge replacement (120') and remove 4 homes + floodplain at school (FP1)	$1,065,000	$2,658,000	0.40
7	Benton Ave bridge removal and no replacement	$489,000	$500,000	0.98
8	Benton Ave bridge removal and no replacement + floodplain at school (FP1)	$460,000	$682,000	0.67
9	Griswold Street bridge replacement (includes 2 homes removed)	$1,688,000	$3,275,000	0.52
10	Griswold Street bridge replacement and upstream floodplain (FP3) (includes four homes removed)	$2,473,000	$4,421,000	0.56

TABLE ES-2
Comparison of Costs and Benefits – West Brook

Alternative	Description	Total Benefits	Total Cost	BCR
1	Floodplain Downstream of Delaware Street (FP1)	$3,142,000	$102,000	30.80
2	Floodplains Downstream and Upstream of Delaware Street, (FP 1+2) and Replace Delaware Street Bridge	$4,111,000	$2,882,000	1.43
3	Floodplains Upstream and Downstream of Mead Street (FP 3+4) and Replace Mead Street Bridge	$1,472,000	$3,156,000	0.47
4	Mead Street Floodplains and Floodplain Between East Street and Mead Street (FP 3+4+5) and Replace Mead Street Bridge	$2,100,000	$4,009,000	0.52
5	Replace East Street Bridge	$648,000	$1,100,000	0.59
7	Floodplain between East Street and park, and Replace East Street Bridge	$658,000	$1,207,000	0.55

Along Third Brook, damage is caused only in the most severe floods. This does not allow the BCA program to correctly generate benefits. Therefore, BCA benefits were not calculated for the alternatives along Third Brook. Costs were calculated for Alternatives 1 and 2.

TABLE ES-3
Comparison of Costs – Third Brook

Alternative		Partial Cost Estimate	Total Cost
1	Lower floodplain behind Klinger	$221,000	$662,000
	Remove garages	$10,000	
	Middle floodplain along Del-Ton	$312,000	
	Remove garages	$10,000	
	Upper floodplain project behind Neale	$99,000	
	Remove garages	$10,000	
2	Delaware Street bridge replacement	$1,100,000	$2,862,000
	Ogden Street bridge replacement	$1,100,000	
	Upper, middle and lower floodplains	$632,000	
	Remove garages	$30,000	

The LFA completed for Walton has demonstrated that several flood mitigation projects have merit because they will reduce flood water surface elevations in the village. These projects largely depend on the enhancement of existing floodplains and creation of lower floodplains coupled with a handful of strategic building removals and business relocations.

Based on the BCA conducted for this LFA (and its underlying assumptions), two flood mitigation alternatives (Alternatives 1 and 2 on West Brook) have a BCR above 1.0 and one alternative (Alternative 7 on East Brook) has a BCR of approximately 1.0. If these alternatives are supported by the Village and the Town and there is consensus to pursue their execution, then they may be advanced for further design and funding.

The other projects described in this LFA report are not expected to have BCRs above 1.0. However, many of these are appropriate flood mitigation projects that could be eligible for funding by other State and Federal programs such as the Department of Environmental Conservation Water Quality Improvement Project or the U.S. Army Corps of Engineers Water Resources Development Act.

Tables ES-4 through ES-6 summarize the recommended action for each project. In addition, the following flood mitigation recommendations are offered:

1. Proceed with implementation of West Brook Alternatives 1 or 2 as funding allows. Refer to Section 8.3 below for additional discussion about implementation.
2. Study the feasibility of East Brook Alternative 7 including the viability of not maintaining a crossing of the brook at Benton Avenue and the tools that can be used to bolster the BCR for the alternative.
3. Re-instate the gauging station on East Brook. The data obtained from this gauging station was important in this LFA and will be important in other studies, and the existing data gap is unacceptable.
4. Consider establishing some type of gauging station on West Brook. If this is not a USGS-endorsed or maintained gauging station, a locally-operated informal gauging station may be effective for monitoring conditions during rain events. If discharges at East Brook and West Brook can be shown to be somewhat related or proportional, this information could help future studies.
5. Pursue floodproofing of commercial buildings in Walton. Floodproofing should include sealing of lower portions of buildings including doors and other openings, and elevation of building utilities. Ensure that floodproofing is viable under a set of potential future conditions.
6. Pursue elevation of homes on a case-by-case basis as property owners approach the Walton Flood Commission and/or the Village about mitigation. Ensure that elevations are conducted in accordance with the effective BFE at the time of the work.
7. When opportunities arise for acquisitions where floodplain projects may be effective in the future, support these acquisitions. Examples include the homes adjacent to East Brook at Benton Avenue that are a part of several alternatives evaluated in this LFA.
8. Ensure that future bridge replacements incorporate larger openings to reduce flooding. This is absolutely necessary for East Brook, West Brook, and Third Brook.

The following procedural recommendations are offered:

- ❑ Continue to gather and file revenue information as provided by businesses. This may help improve future BCA determinations.

- ❑ During and after future floods, record and compile municipal, county, and state costs related to clean-up and recovery in Walton. This will help improve future BCA determinations for all three streams, especially given the current situation of bridges and roads overtopping.

- ❑ During and after future floods, record high water marks throughout the village. Track and record flood damage over time for anchor businesses and critical facilities. This will help improve future BCA determinations for Third Brook, especially given the current limitations of the BCA Flood Module for the Third Brook corridor.

TABLE ES-4
Potential Flood Mitigation Alternatives - East Brook

Alternative	Description	BCR	Recommendations
1	Delaware Street bridge replacement and removal of one business	0.35	Consider this alternative when bridge is ready for replacement due to its age.
2	Delaware Street bridge replacement and floodplain bench (FP4)	0.39	Too intrusive relative to the benefits; do not pursue unless opportunities arise to acquire properties.
3	Benton Ave bridge replacement (90') and remove 2 homes	0.32	Too intrusive relative to the benefits; do not pursue unless opportunities arise to acquire properties.
4	Benton Ave bridge replacement (90') and remove 2 homes + floodplain at school (FP1)	0.31	Too intrusive relative to the benefits; do not pursue unless opportunities arise to acquire properties.
5	Benton Ave bridge replacement (120') and remove 4 homes	0.43	Too intrusive relative to the benefits; do not pursue unless opportunities arise to acquire properties.
6	Benton Ave bridge replacement (120') and remove 4 homes + floodplain at school (FP1)	0.40	Too intrusive relative to the benefits; do not pursue unless opportunities arise to acquire properties.

Alternative	Description	BCR	Recommendations
7	Benton Ave bridge removal and no replacement	0.98	Although the BCR is less than 1, consider this alternative as the bridge ages.
8	Benton Ave bridge removal and no replacement + floodplain at school (FP1)	0.67	This alternative does not provide substantial benefits and should not be pursued.
9	Griswold Street bridge replacement (includes 2 homes removed)	0.52	Consider this alternative when bridge is ready for replacement due to its age and opportunities arise to acquire properties.
10	Griswold Street bridge replacement and upstream floodplain (FP3) (includes four homes removed)	0.56	Consider this alternative when bridge is ready for replacement due to its age and opportunities arise to acquire properties.

TABLE ES-5
Potential Flood Mitigation Alternatives - West Brook

Alternative	Description	BCR	Recommendations
1	Floodplain Downstream of Delaware Street (FP1)	30.80	Pursue this alternative as funding becomes available unless Alternative 2 is preferred.
2	Floodplains Downstream and Upstream of Delaware Street, (FP 1+2) and Replace Delaware Street Bridge	1.43	Pursue this alternative as funding becomes available unless Alternative 1 is preferred.
3	Floodplains Upstream and Downstream of Mead Street (FP 3+4) and Replace Mead Street Bridge	0.47	Consider this alternative when bridge is ready for replacement due to its age and opportunities arise to acquire properties.
4	Mead Street Floodplains and Floodplain Between East Street and Mead Street (FP 3+4+5) and Replace Mead Street Bridge	0.52	Consider this alternative when bridge is ready for replacement due to its age and opportunities arise to acquire properties.
5	Replace East Street Bridge	0.59	Consider this alternative when bridge is ready for replacement due to its age.

Alternative	Description	BCR	Recommendations
7	Floodplain between East Street and park, and Replace East Street Bridge	0.55	Consider this alternative when bridge is ready for replacement due to its age.

TABLE ES-6
Potential Flood Mitigation Alternatives – Third Brook

Alternative	Description	BCR	Recommendations
1	Lower, Middle, and Upper Floodplains	--	Consider this alternative when opportunities arise to acquire various properties.
2	Lower, Middle, and Upper Floodplains with Delaware and Ogden Street Bridge Replacements	--	Expand the size of the bridges to improve conveyance and continue to follow-up with DOT.
3	Bypass Culvert and Channel by Kraft Building	--	Too costly and intrusive relative to the benefits.
4	Floodplain along Lower Third Brook Road	--	Consider this alternative if funding remains available in connection with other projects on upper Third Brook.

Several funding sources may be available to the Walton Flood Commission, the Town, and Delaware County and its departments for the implementation of recommendations. These are listed in Tables ES-7 and ES-8. Descriptions of funding sources are provided in Section 8.3.

Table ES-7
Potential Funding Sources for Mitigation Projects

		Federal	State	Other
East Brook Alternatives				
1	Delaware Street bridge replacement	None	NYSDOT	SMIP-FHM, CWC
	Excavation	None	NYSDOS	SMIP-FHM, CWC
	Acquisition and removal of business	FEMA	NYSDOS	NYCDFFBO, CWC
2	Delaware Street bridge replacement	None	NYSDOT	SMIP-FHM, CWC
	Floodplain bench (FP4)	USACE	NYSDOS	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC

		Federal	State	Other
3	Benton Ave bridge replacement (90')	None	NYSDOT	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC
	Excavation	None	NYSDOS	SMIP-FHM, CWC
4	Benton Ave bridge replacement (90')	None	NYSDOT	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC
	Floodplain bench at school (FP1)	USACE	NYSDOS	SMIP-FHM, CWC
5	Benton Ave bridge replacement (120')	None	NYSDOT	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC
	Excavation	None	NYSDOS	SMIP-FHM, CWC
6	Benton Ave bridge replacement (120')	None	NYSDOT	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC
	Floodplain at school (FP1)	USACE	NYSDOS	SMIP-FHM, CWC
7	Benton Ave bridge removal and no replacement	None	NYSDOT	SMIP-FHM, CWC
8	Benton Ave bridge removal and no replacement	None	NYSDOT	SMIP-FHM, CWC
	Floodplain at school (FP1)	USACE	NYSDOS	SMIP-FHM, CWC
9	Griswold Street bridge replacement	None	NYSDOT	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC
	Excavation	None	NYSDOS	SMIP-FHM, CWC
10	Griswold Street bridge replacement	None	NYSDOT	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC
	Upstream floodplain (FP3)	USACE	NYSDOS	SMIP-FHM, CWC
West Brook Alternatives				
1	Floodplain Downstream of Delaware Street (FP1)	USACE	NYSDOS	SMIP-FHM, CWC
2	Replace Delaware Street Bridge	None	NYSDOT	SMIP-FHM, CWC

		Federal	State	Other
	Floodplains downstream of Delaware Street (FP 1+2)	USACE	NYSDOS	SMIP-FHM, CWC
3	Replace Mead Street Bridge	None	NYSDOT	SMIP-FHM, CWC
	Floodplains Upstream and Downstream of Mead Street (FP 3+4)	USACE	NYSDOS	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC
4	Replace Mead Street Bridge	None	NYSDOT	SMIP-FHM, CWC
	Mead Street Floodplains and Floodplain between East Street and Mead Street (FP 3+4+5)	USACE	NYSDOS	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC
5	Replace East Street Bridge	None	NYSDOT	SMIP-FHM, CWC
7	Replace East Street Bridge	None	NYSDOT	SMIP-FHM, CWC
	Floodplain between East Street and park (FP 7)	USACE	NYSDOS	SMIP-FHM, CWC
Third Brook Alternatives				
1	Lower, Middle, and Upper Floodplains	USACE	NYSDOS	SMIP-FHM, CWC
	Acquisition and removal of garages	FEMA	NYSDOS	NYCDFFBO, CWC
2	Lower, Middle, and Upper Floodplains	USACE	NYSDOS	SMIP-FHM, CWC
	Acquisition and removal of garages	FEMA	NYSDOS	NYCDFFBO, CWC
	Delaware and Ogden Street Bridge Replacements	None	NYSDOT	SMIP-FHM, CWC
3	Bypass Culvert near Kraft Building	None	NYSDOT	SMIP-FHM, CWC
	Bypass Channel near Kraft Building	USACE	NYSDOS	SMIP-FHM, CWC
4	Floodplain along Lower Third Brook Road	USACE	NYSDOS	SMIP-FHM, CWC

Table ES-8
Potential Funding Sources for Other Mitigation Projects

Option	Federal	State	Other
Floodproofing of individual non-residential buildings	FEMA	NYSDOS	CWC
Elevation of individual non-residential buildings in floodway	None	None	CWC
Elevation of individual residential buildings in floodway	None	None	CWC
Elevation of individual non-residential buildings outside of floodway	FEMA	NYSDOS	CWC
Elevation of individual residential buildings outside of floodway	FEMA	None	CWC
Relocation of anchor businesses and critical facilities	FEMA	NYSDOS	NYCDFFBO, CWC

1.0 INTRODUCTION

1.1 Project Background

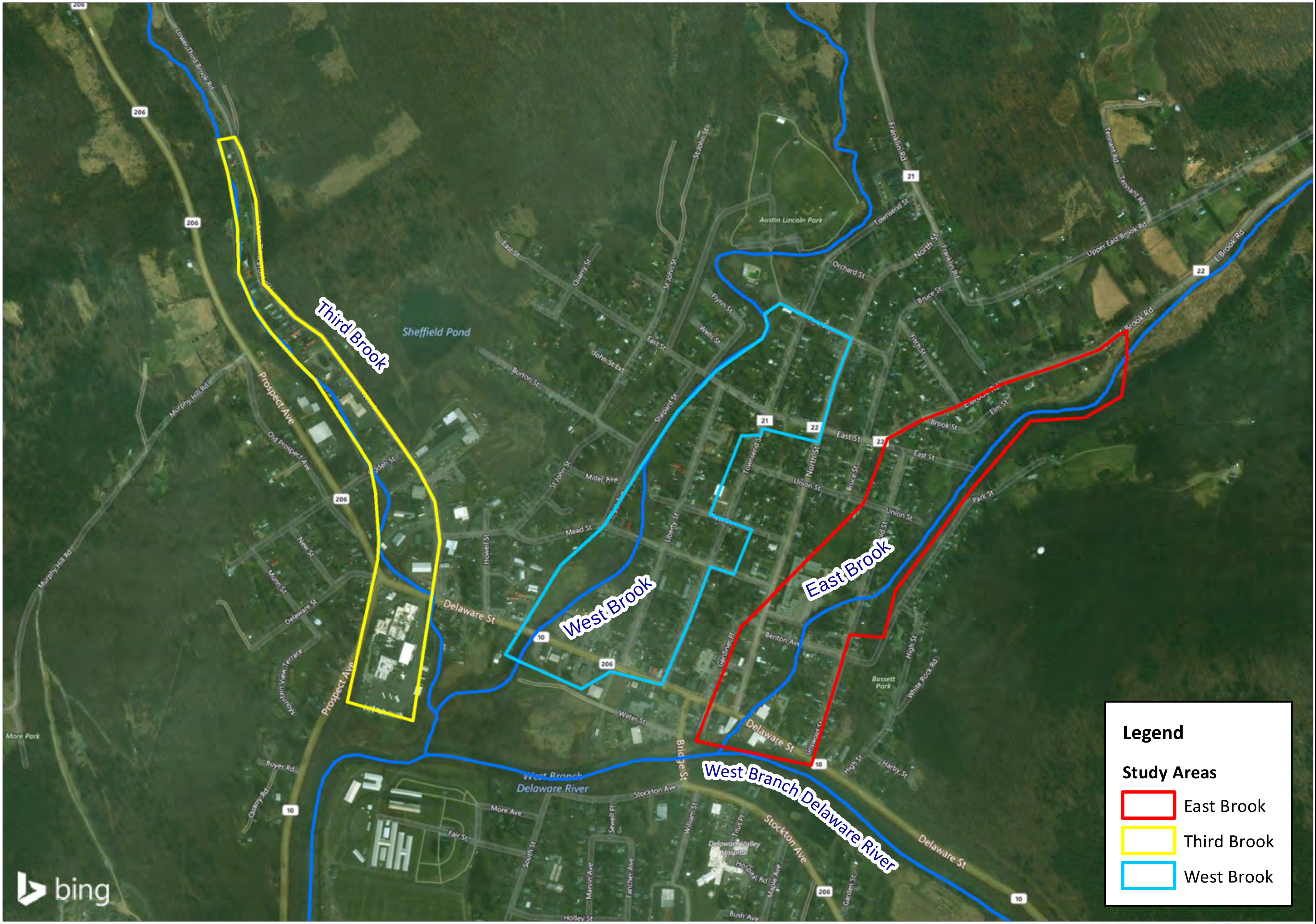
The Walton Flood Commission, utilizing funding provided by NYCDEP through the Delaware County Soil and Water Conservation District (DCSWCD), has retained Milone & MacBroom, Inc. (MMI) to complete a Local Flood Analysis (LFA) in the Village of Walton, New York, along East Brook, West Brook, and Third Brook. The LFA builds upon Federal Emergency Management Agency (FEMA) modeling to evaluate flood risks along East Brook, West Brook, and Third Brook and to assess potential mitigation measures aimed at reducing flood inundation and the associated damages and water quality impairment that may occur due to floods.

The LFA is a program within the New York City water supply watersheds initiated following Tropical Storm Irene to help communities identify long term, cost effective projects to mitigate flood hazards. The DCSWCD is implementing the LFA program in the watershed communities associated with the West Branch and East Branch Delaware River watersheds.

1.2 Study Area

The study areas along East Brook, West Brook, and Third Brook were selected to coincide with developed areas in the Village of Walton. The three tributaries flow into the West Branch Delaware River, which discharges into the Cannonsville Reservoir. The Cannonsville Reservoir is a drinking water supply source to the New York City public water system. The graphic to the right depicts the West Branch and the East Branch relative to Delaware County and adjacent counties.

Figure 1-1 is a location map of the study area. The study area extends 1.0 stream miles along Third Brook, 0.7 mile along West Brook, and 0.9 mile along East Brook within the Village of Walton. The downstream study area boundaries for East Brook, West Brook, and Third Brook are near Delaware Street.



SOURCE(S):
Base Map: © 2017 DigitalGlobe ©CNES (2017) Distribution Airbus DS © 2017 Microsoft Corporation © 2017 HERE

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FIGURE 1-1: LOCATION MAP

MXD: Y:\5197-06\Maps\Figure 1-1 Location.mxd

LOCAL FLOOD ANALYSIS
WEST BRANCH TRIBUTARIES

LOCATION: Walton, NY

Map By:	JCS
MMI#:	5197-06
Original:	7/22/2016
Revision:	10/2/2017
Scale:	1 in = 1,000 ft

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Walton is a key commercial hub within Delaware County and in the Cannonsville watershed of the NYC water supply. According to the Town of Walton Comprehensive Plan (2006), "The Town of Walton is a picturesque rural town where scenic views abound. Commercial life and employment are located primarily in the Village of Walton, with hills, forests and farmlands covering most of the rest of the Town." A brief historical profile of the town and village from the Comprehensive Plan is reprinted in the text box below.

The Comprehensive Plan describes a general decrease in population of the town and village combined from 1990 through 2000. From 2000 to 2010, the population of the village increased from 3,070 to 3,088 while the population of the town (inclusive of the village) decreased slightly from 5,607 to 5,576. As of the 2010 census, 55% of the population in the town resides in the village. Therefore, the town's rural population *outside* the village decreased from 2,537 to 2,488 from 2000 to 2010. Interestingly, this reflects a slight increase in density in the village, potentially coinciding with the area of focus for this LFA.

The Comprehensive Plan speaks of a significant part-time population of second homeowners in the town and village. The part-time residents of Delaware County and Walton are important components of the demographic and economy. As of the 2010 census, 2,958 housing units were located in the town, and 1,514 were located in the village, with 1,444 in the town outside the village. This translates to 51% of the housing units in Walton located in the village. This percentage is slightly lower than the percent of population located in the village, which makes sense because the number of persons per housing unit is likely higher in the village.

Historical profile from Walton Comp Plan

"Early settlers depended on lumbering, logs being transported via the Delaware River downstream to Trenton and Philadelphia. Saw mills and grist mills were also active in the early years, followed by carding and fulling mills as sheep-raising emerged as the major agricultural activity in the 1830s.

With the arrival of the railroad in 1872, dairy production emerged to replace sheep as the primary agricultural activity, leading to the establishment of dairy processing as a major local industry. The Breakstone Company began dairy processing in Walton in 1912 and grew as a producer of condensed milk during World War I. It continues to prosper today even since being purchased by Kraft Foods, which continue to produce under the Breakstone name.

Manufacturing of wood products began to replace shipping of raw timber with the establishment of furniture factories in the 1830s and 1840s. S. J. Bailey & Son moved to Walton in 1939. By 1975, Bailey employed 175 persons in Walton and was the second largest manufacturer of unfinished furniture in the US. In 1999, however, Bailey left Walton. Quarrying of bluestone emerged early as an important component of the local economy and has continued to be active until the present day."

1.3 Community Involvement

The Walton Flood Commission guided the LFA process and advised MMI regarding which mitigation alternatives to evaluate. Table 1-1 lists the members of the Walton Flood Commission. The commission is appointed by the Town and Village Boards, and is comprised of people with technical and non-technical backgrounds and is meant to represent various interests and stakeholders at the village, town, and county levels; as well as NYCDEP. The Walton Flood Commission is the primary pathway for community involvement in the planning process.

TABLE 1-1
Walton Flood Commission

Committee Member	Affiliation
Charles F. Gregory	Walton Town Supervisor
Edward Snow	Walton Village Mayor
Walter Geidel	Town of Walton Highway Department
Roger Hoyt	Village of Walton Highway Department
Len Govern	Town Board, Town of Walton
Carl Fancher	Walton Fire Department
Art Sochia, Sr.	Walton Fire Department
Stephen Dutcher	Village and Town of Walton Code Enforcement Officer
Roger Clough	Walton Central School District
Robert Cairns	Delaware Reporter
Ed Rossley	Delaware County Fair Board
Niles Wilson	Delaware County Fair Board
Gale Sheridan	Walton Planning Board
Graydon Dutcher	Delaware County Soil and Water Conservation District
Rick Weidenbach	Delaware County Soil and Water Conservation District
Jessica Patterson	Delaware County Soil and Water Conservation District
Bill Willis	Delaware County Economic Development Department
Steve Hood	Delaware County Department of Emergency Services
Dean Frazier	Delaware County Watershed Affairs Commissioner
Kevin Charles	Delaware County Department of Public Works
Molly Oliver	Delaware County Planning Department
Kristin Schneider	Delaware County Planning Department
John Mathiesen	Catskill Watershed Corporation
Phil Eskeli	NYCDEP
Nate Henricks	NYCDEP

Table 1-2 lists Walton Flood Commission meeting dates that occurred when this LFA was on the agenda for discussion.

TABLE 1-2
Walton Flood Commission Meeting Dates

Date	Purpose
September 3, 2015	Kick off project and review preliminary model results for East Brook alternatives
October 1, 2015	Continue East Brook alternatives
November 5, 2015	Present West Brook alternatives
January 7, 2016	Present initial Third Brook alternatives and address remaining questions for East Brook and West Brook
February 4, 2016	Present remaining Third Brook alternatives and preliminary BCA for East Brook
March 3, 2016	Discuss damage figures to turn over to consultant for continuing the BCA (meeting held without consultant)
April 7, 2016	Continue BCA discussions

The LFA process included two public meetings. These were held near the end of the analysis phase of the LFA project as noted below.

TABLE 1-3
Public Meeting Dates

Date	Purpose
June 29, 2016	East Brook, West Brook, Third Brook Results
July 19, 2016	East Brook, West Brook, Third Brook Results

Following the two public meetings, DCSWCD engaged in a field reconnaissance-based public engagement process that included walks along East Brook and West Brook. No public field walk was conducted for Third Brook since the 100-year flood waters were contained within the stream channel. The dates of the public field walks are listed below.

TABLE 1-4
Public Field Walk Dates

Date	Tributary
October 29, 2016	East Brook
June 3, 2017	West Brook

Appendix A contains copies of the power point presentations used at meetings listed in Table 1-2 and Table 1-3, along with meeting notes.

1.4 Nomenclature

In this report and associated mapping, stream stationing is occasionally used as an address to identify specific points along the West Branch Delaware River. Stationing is typically measured in feet from downstream to upstream. To simplify the nomenclature, the FEMA cross section stationing was used for the Walton. All references to right bank and left bank in this report refer to "river right" and "river left," meaning the orientation assumes that the reader is standing in the river looking downstream. The datum used throughout this report is NAVD88.

In order to provide a common standard, FEMA's National Flood Insurance Program (NFIP) has adopted a baseline probability called the base flood. The base flood has a one percent (one in 100) chance of occurring in any given year, and the base flood elevation (BFE) is the elevation of this level. For the purpose of this report, the one percent annual chance flood is referred to as the ***100-year flood event***. Other reoccurrence probabilities used in this report include the ***2-year flood event*** (50 percent annual chance flood), the ***10-year flood event*** (10 percent annual chance flood), the ***25-year flood event*** (4 percent annual chance flood), the ***50-year flood event*** (2 percent annual chance flood), and the ***500-year flood event*** (0.2 percent annual chance flood). The Special Flood Hazard Area (SFHA) is the area inundated by flooding during the 100-year flood event. The floodway is a portion of the SFHA that must be reserved in order to discharge the base flood without increasing the water surface elevation more than a designated height.

2.0 WATERSHED FACTS AND CHARACTERISTICS

2.1 Initial Data Collection

Initial data collected for this study and analysis included publicly available data as well as input from DCSWCD representatives. Chapter 7.0 includes a full listing of resource material gathered. A brief summary of key documents follows.

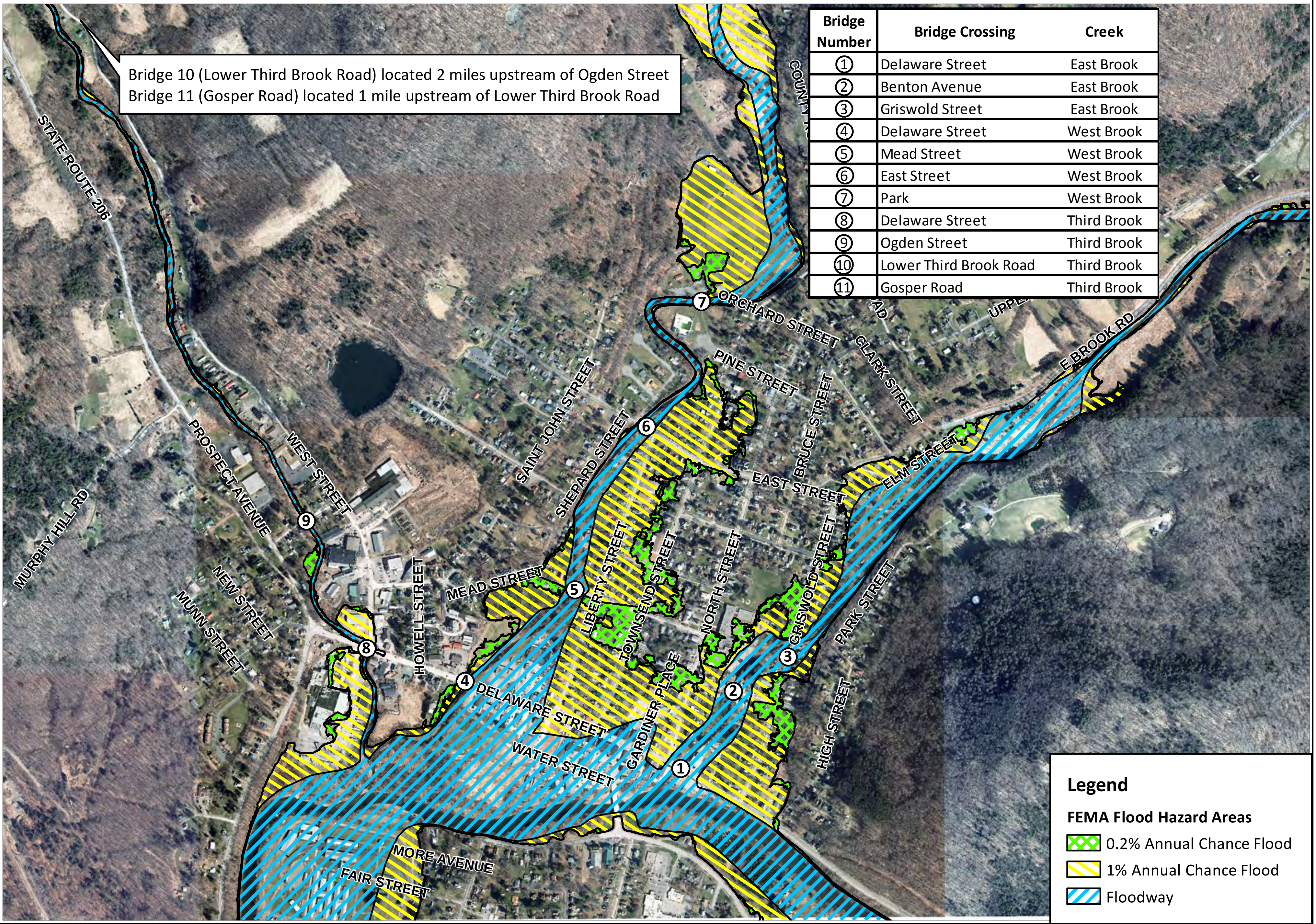
Flood Insurance Study (FIS)

The current Flood Insurance Study (FIS) for Delaware County became effective on June 16, 2016. The FIS covers all jurisdictions in the county, inclusive of the village and town of Walton. The first county wide FIS was published June 19, 2012, at which time all three study reaches were included as new detailed studies based on 2009 hydraulic modeling. No changes were made to the lower portions of the study reaches in the 2016 update, although Third Brook modeling was extended upstream based on 2013 modeling to include the upper crossings we discuss in this report. The previous FIS covering Walton resulted in FIRM panels that were effective on April 2, 1991 (village) and September 2, 1988 (town). A copy of the FIRM is presented on the next page as Figure 2-1.

Stream Management Plan

Central to maintaining NYCDEP's FAD is a series of partnership programs between New York City and the upstate communities along with the set of rules and regulations administered by the NYCDEP. As required in the FAD, Stream Corridor Management Plans are developed and implemented under the Stream Management Program (SMP). The West Branch Delaware River Stream Corridor Management Plan (SCMP) was developed by DCSWCD and the DCPD under contract with NYCDEP. One component of the SMP is the preservation of water quality through effective management of the streams and associated floodplains that feed water supply reservoirs.

According to the Executive Summary of the West Branch Delaware River SCMP, the plan "provides a foundation for local residents, municipalities, interested organizations and cooperating agencies to enhance stewardship of the West Branch Delaware River and its tributaries…. this Stream Corridor Management Plan is representative of how both upstate and downstate stakeholders can work in partnership to protect and enhance a mutually beneficial resource."



Bridge Number	Bridge Crossing	Creek
1	Delaware Street	East Brook
2	Benton Avenue	East Brook
3	Griswold Street	East Brook
4	Delaware Street	West Brook
5	Mead Street	West Brook
6	East Street	West Brook
7	Park	West Brook
8	Delaware Street	Third Brook
9	Ogden Street	Third Brook
10	Lower Third Brook Road	Third Brook
11	Gosper Road	Third Brook

SOURCE(S):
FEMA Delaware County FIRM April 15, 2014
Base Map:

N

FIG. 2-1: FEMA FLOOD ZONES

MXD: Y:\5197-06\Maps\Report Figures\Figure 2-1 FEMA Flood Zones.mxd

LOCAL FLOOD ANALYSIS
WEST BRANCH TRIBUTARIES

LOCATION: Walton, New York

Map By: JCS
MMI#: 5197-06
Original: 8/27/2015
Revision: 12/8/2017
Scale: 1 in = 1,000 ft

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The SCMP states that "West Branch Delaware River has a tendency to become shallower and wider than is desirable due to increased sediment supply from excessive bank and bed erosion in the main river and its tributaries. While erosion and deposition are natural processes, many management activities can significantly increase erosion rates that in turn contribute to increases in sediment supply."

The erosion and deposition problems articulated in the SCMP are not new phenomena. Interest in developing a coordinated management strategy for the West Branch of the Delaware River and its tributaries emerged after the January 19, 1996 flood event described in Chapter 3.0. After the dramatic stream and infrastructure damages and subsequent emergency repair work that resulted from this flood, it was apparent that stream-related activities in certain areas were well intentioned but had set the stage for excess damages during a flood. As a result, the condition of East Brook, West Brook, and Third Brook significantly changed in many areas. Small instability and erosion problems worsened, small eroding banks became larger failures, and some stream courses were significantly altered.

It is important to note that the current version of the West Branch Delaware River SCMP was published in May 2006, only a month before the devastating flood of June 2006. Recommendations of the West Branch Delaware River SCMP include the following (with **bold text** added for emphasis relative to this LFA):

- Integration of the Stream Corridor Management Program and Watershed Agricultural Program
- Provide Technical Support to the USDA Conservation Reserve Enhancement Program (CREP)
- Enhance the Implementation of CREP on New York City Watershed Cropland and Explore Long-Term CREP Contracts
- Implement a Variable Width Riparian Buffer Pilot Program
- Participation with the Catskill Watershed Corporation
- Stream Corridor Management Plans for Non-Agricultural Riparian Landowner Stewardship
- Stream Gravel Deposition Issues
- Streamline Stream Work Permitting
- Assist Municipalities with Culvert Sizing and Design
- Participation with the DCAP
- **Expand Public Education and Outreach Efforts**
- Geomorphic Assessments at Bridges and Culverts
- **Flood Hazard Mitigation and Flood Recovery**
- Continuation of Geomorphic Research/Assessments
- Seek Funds Necessary for Construction of Walton Stream bank Stabilization Projects
- Prioritization of Identified Stream Intervention Projects
- Develop a Process for Updating the West Branch Delaware River Stream Corridor Management Plan

The SCMP provides a framework for general stream management decision making in the watershed. The plan provides documentation of current stream conditions and a broad assessment of the condition of existing infrastructure.

Third Brook Watershed Management Plan

The Third Brook Watershed Management Plan (September 2013) includes many specific flood, bank, and slope mitigation recommendations along Third Brook. Several of the recommendations in the Third Brook Watershed Management Plan are investigated further in this report. In particular, the floodplain enhancement and creation alternatives mapped out in the watershed management plan were hydraulically evaluated in this LFA; as such, this LFA furthers the implementation of the Third Brook Watershed Management Plan.

One of the key findings of the Third Brook Watershed Management Plan recognizes that flooding along Third Brook cannot be prevented. A recommendation that addresses this finding was:

> *"As funding allows, consider elevating on piers the homes located from 67 West Street to 757 Lower Third Brook Road. This will accomplish two things: the living spaces can be raised above potential future flood elevations, and the spaces beneath the homes will be able to convey floodwaters. Outbuildings and garages should be removed or relocated closer to the road, away from the brook…."*

LFA reports typically include similar recommendations for buildings that will remain in zones of flood risk despite hydrologic and hydraulic projects that may be undertaken such as bridge replacements and floodplain enhancements. Therefore, this LFA report incorporates the above action from the Third Brook Watershed Management Plan. One example of buildings that may be candidates for removal are the barn and home located immediately downstream of the dam on Third Brook.

Multi-Jurisdiction Hazard Mitigation Plan

The Delaware County Hazard Mitigation Plan Update was developed in 2012 by Tetra Tech and became effective March 2013. The plan includes annex reports for the Town and Village of Walton. The following discussions are taken from the hazard mitigation plan annexes.

Town of Walton – It is estimated that in the town of Walton, 76 residents live within the 1% annual chance (100-year) and 0.2% chance (500-year) floodplains. Of the town's total land area, 3.2 square miles are located within the 1% annual chance flood boundary, and 3.3 square miles are located within the 0.2% annual chance flood boundary.

The computer model HAZUS-MH 2.0 estimates that for a 1% annual chance flood event 120 people may be displaced, and 15 people may seek short-term sheltering, representing 4.7% and 0.6% of the town's population, respectively. For the 0.2% annual chance event, it is estimated that 120 people may be displaced, and 17 people may seek short-term sheltering, representing 4.7% and 0.7% of the town's population, respectively.

The town of Walton has a total of 256 properties located within the 1% annual chance flood boundary and 258 properties located within the 0.2% annual chance flood boundary. There is $20,666,816 of total assessed property (structure and land) exposed to the 1% annual chance flood in the town of Walton. For the 0.2% annual chance event, it is estimated that $20,728,732 of total assessed property is exposed in the town of Walton.

The program calculates the estimated potential damage to the general building stock inventory associated with the 1% annual chance and 0.2% annual chance flood events. HAZUS-MH 2.0 estimates approximately $5,321,000 and approximately $5,381,000 of potential general building stock loss as a result of the 1% and 0.2% annual chance mean return period (MRP) events, respectively.

The plan notes that the town has zoning, subdivision, and flood damage prevention ordinances as well as a comprehensive plan and a highway management plan. Two feet of freeboard is required for new construction in flood zones per the New York State Building Code. **Recommendations of the annex that are consistent with the focus of this LFA include:**

- "Retrofit structures located in hazard-prone areas to protect structures from future damage."
- "Acquire and demolish or relocate structures located in hazard-prone areas to protect structures from future damage."

<u>Village of Walton</u> – It is estimated that in the village of Walton, 770 residents live within the 1% annual chance floodplain, and 864 residents live within the 0.2% chance floodplain. Of the village's total land area, 0.5 square miles are located within the 1% annual chance flood boundary, and 0.5 square miles are located within the 0.2% annual chance flood boundary.

HAZUS-MH 2.0 estimates that for a 1% annual chance event 801 people may be displaced and 663 people may seek short-term sheltering, representing 26.1% and 21.6% of the village's population, respectively. For the 0.2% annual chance event, it is estimated that 808 people may be displaced, and 697 people may seek short-term sheltering, representing 26.3% and 22.7% of the village's population, respectively.

The village of Walton has a total of 276 properties located within the 1% annual chance flood boundary and 311 properties located within the 0.2% annual chance flood boundary. There is $14,196,798 of total assessed property (structure and land) exposed to the 1% annual chance flood in the village of Walton. For the 0.2% annual chance event, it is estimated that there is $15,171,940 of total assessed property exposed in the village.

HAZUS-MH 2.0 calculates the estimated potential damage to the general building stock inventory associated with the 1% annual chance and 0.2% annual chance flood events. HAZUS-MH 2.0 estimates approximately $33,001,000 and approximately $33,406,000 of potential general building stock loss as a result of the 1% and 0.2% annual chance MRP events, respectively.

The plan notes that the village has zoning, subdivision, and flood damage prevention ordinances as well as a comprehensive plan. Two feet of freeboard is required for new construction in flood zones per the New York State Building Code. **Recommendations of the village's annex are similar to those listed in the town's annex.**

Water Quality Reports

In order to fulfill requirements of the Federal Clean Water Act, the NYSDEC must provide periodic assessments of the quality of the water resources in the state and their ability to support specific uses. These assessments reflect monitoring and water quality information drawn from a number of programs and sources both within and outside the Department. This information has been compiled by the NYSDEC Division of Water and merged into an inventory database of all water bodies in New York State. The database is used to record current water quality information, characterize known and/or suspected water quality problems and issues, and track progress toward their resolution.

Biological (macroinvertebrate) assessments of East Brook, West Brook, and Third Brook were conducted in 1999. Field sampling results indicated non-impacted water quality conditions. The samples satisfied field screening criteria and were returned to the stream.

All three tributaries are located within the New York City Water Supply system watershed. As a result many water quality concerns are being actively monitored and managed by NYCDEP in cooperation with watershed communities, as set forth in the NYC Watershed Agreement.

This inventory of water quality information is the division's Waterbody Inventory/Priority Waterbodies List (WI/PWL). The Delaware River Basin WI/PWL was last published in December 2002. **East Brook, West Brook, and Third Brook are listed as having "No Known Impacts."** The discussion in the text box to the right is adapted from the WI/PWL report.

NYSDEC has been working on an update to the WI/PWL, but a formal draft has not been published as of the date of this plan.

The New York State Section 303(d) List of Impaired Waters (2016) identifies those waters that do not support appropriate uses and that may require development of a Total Maximum Daily Load (TMDL). **East Brook, West Brook, and Third Brook are not listed in this document.**

The NYSDEC Water Quality Standards and Classifications program is responsible for setting New York State ambient water quality standards and guidance values for surface water and groundwaters. The program is also responsible for the classification of surface waters for their best usage. The water quality standards program is a state program with EPA oversight. New York's longstanding water quality standards program predates the federal Clean Water Act and protects both surface waters and groundwaters. All waters in New York State are assigned a letter classification that denotes their best uses. Letter classes such as A, B, C, and D are assigned to fresh surface waters. This section of the West Branch is Class B.

Village of Walton Flood and Hydraulic Study

From 2008 through 2010, Woidt Engineering and FIScH Engineering conducted a flood and hydraulic study for the Village of Walton using a grant from the Catskill Watershed Corporation (CWC). The study included the development of a hydraulic model in parallel with the FEMA FIS effort that was underway at the same time and later became effective in May 2012. The study included Third Brook, West Brook, East Brook, and the West Branch Delaware River.

The flood study noted that flood mitigation options were limited in Walton. Attenuation of peak flows would be challenging due to high costs and limited space in the valley. Miles of levees and floodwalls would likewise be expensive and would exacerbate sediment and debris transport. Recommendations of the flood study included the adoption of more restrictive floodplain regulations, development of flood evacuation routes, reclamation of floodplains, floodproofing of residential and commercial structures, implementation of an early warning system, stream maintenance through debris removal, debris management, stormwater management, bridge capacity improvements, and slope stabilization where applicable.

Flood Damage Prevention Codes

Town of Walton – The Town of Walton has adopted a local law for flood damage prevention. Revisions were adopted in 2012 to be consistent with the guidance provided by the state in 2007 for counties where new FEMA studies were being conducted. The town adopted the recommended revisions. These are identical to the revisions adopted in the village, as described below.

Village of Walton – The Village of Walton has adopted a local law for flood damage prevention. Chapter 25 of the municipal code is the Flood Damage Prevention code. Revisions were adopted in 2012 to be consistent with the guidance provided by the state in 2007 for counties where new FEMA studies were being conducted.

The stated purposes of this local law are to:

- Regulate uses that are dangerous to health, safety, and property due to water or erosion hazards, or that result in damaging increases in erosion or in flood heights or velocities;
- Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;
- Control the alteration of natural floodplains, stream channels, and natural protective barriers that are involved in the accommodation of flood waters;
- Control filling, grading, dredging and other development that may increase erosion or flood damages;
- Regulate the construction of flood barriers that will unnaturally divert flood waters or that may increase flood hazards to other lands, and;
- Qualify and maintain for participation in the National Flood Insurance Program.

The stated objectives of the local law are:

- To protect human life and health;
- To minimize expenditure of public money for costly flood control projects;
- To minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
- To minimize prolonged business interruptions;

- To minimize damage to public facilities and utilities such as water and gas mains, electric, telephone, sewer lines, streets and bridges located in areas of special flood hazard;
- To help maintain a stable tax base by providing for the sound use and development of areas of special flood hazard so as to minimize future flood blight areas;
- To provide that developers are notified that property is in an area of special flood hazard; and,
- To ensure that those who occupy the areas of special flood hazard assume responsibility for their actions.

The Code Enforcement Officer or the Building Inspector is empowered as the Local Administrator for administering and implementing the Flood Damage Prevention local law. The primary responsibility of the Local Administrator is the granting or denying of floodplain development permits. The Local Administrator must conduct a thorough permit application review prior to approval and must make periodic inspections during the construction phase of a project after permit approval. Finally, upon completion of a project, the Local Administrator must issue a Certificate of Compliance stating that the project conforms to all requirements of the local law.

The local law identifies a series of Construction Standards for development in the floodplain, broken down into General Standards, Standards for All Structures, Residential Structures, Non-Residential Structures, and Manufactured Homes and Recreational Vehicles.

The General Standards section is broken down into standards for subdivision proposals and encroachments. All new subdivision proposals and other development proposed in a SFHA must be consistent with the need to minimize flood damage, minimize flood damage to utilities, and provide adequate drainage. When encroaching on zones A1-A30 and AE along streams without a regulatory floodway, development must not increase the base flood elevation by more than one foot. Along streams with a regulatory floodway, development must not create any increase in the base flood elevation.

Standards for All Structures include provisions for anchoring, construction materials and methods, and utilities. New structures must be anchored so as to prevent flotation, collapse, or lateral movement during the base flood. Construction materials must be resistant to flood damage, and construction methods must minimize flood damage. Enclosed areas below the lowest floor in zones A1-A30, AE and AH, and, in some cases, Zone A must be designed to allow for the entry and exit of floodwaters. Utility equipment such as electrical, HVAC and plumbing connections must be located at a minimum of two feet above the base flood elevation. Water supply and sanitary sewage systems must be designed to minimize or eliminate the infiltration of floodwaters.

The elevation of residential and nonresidential structures is required in areas of special flood hazard. **In zones A1-A30, AE and AH, and, in some cases, Zone A, new residential construction and substantial improvements must have their lowest floor elevated at or above two feet above the base flood elevation.** In cases where base flood elevation data is not known for Zone A, new residential construction and substantial improvements must have their lowest floor elevated at or above three feet above the highest adjacent grade.

For nonresidential structures in zones A1-A30, AE and AH, and, in some cases, Zone A, developers have the option of either elevating the structure or improvements by a minimum of two feet above the base flood elevation or floodproofing the structure so that it is watertight below two feet above the base flood elevation. In cases where base flood elevation data is not known for Zone A, new construction and substantial improvements must have their lowest floor elevated at or above three feet above the highest adjacent grade.

Recreational vehicles are only allowed in zones A1-A30, AE, and AH if they are on site fewer than 180 consecutive days and are licensed and ready for highway use, or meet the construction standards for manufactured homes. Manufactured homes in the A1-A30, AE, and AH zones must be placed on a permanent foundation with the lowest floor elevated at or above two feet above the base flood elevation. In Zone A, such structures must be placed on reinforced piers or similar elements that are at least three feet above the base flood elevation.

2.2 Watershed and Stream Characteristics

The West Branch Delaware River watershed is underlain by sandstone, siltstone, and shale formed by deposition during the Devonian period about 370 million years ago. The mountains of the Catskill region are an erosional feature. As mountain-building forces raised the Appalachian mountain chain to the south, uplift of the Catskill region allowed sustained erosion that created the stream valleys of today. Multiple periods of glaciation have more recently shaped the topography of New York, and glacial rivers deposited much of the sediment in the valleys. The Village of Walton is believed to be developed on an alluvial fan that formed during the melting of glacial ice and associated deposition of sediments.

A dam is located 23 miles downstream of Walton on West Branch Delaware River and impounds the 12-mile long Cannonsville Reservoir. The backwater influence of the dam's impoundment is quite distant from the LFA project area and does not affect hydrology or hydraulics in Walton.

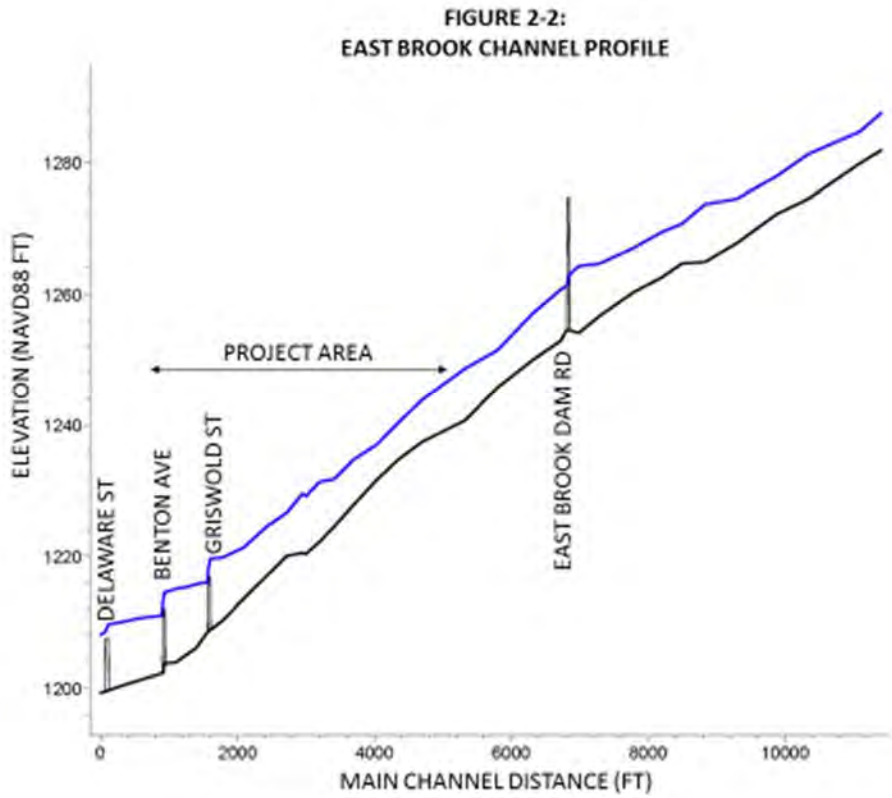
The following sections describe the watershed and stream characteristics of the three tributaries included in this study: East Brook, West Brook, and Third Brook.

2.2.1 East Brook

East Brook has a watershed area of 25.0 square miles at the confluence with the West Branch Delaware River, dominated by steep rural mountains and narrow, flat-floored, valleys. The general flow path is from northeast to southwest toward the West Branch Delaware River.

The total length of East Brook from its headwaters to the West Branch Delaware River is about 9.8 miles. Within the project area, the channel slope is approximately 0.9%, while the average basin slope is 17%. Figure 2-2 presents a profile of East Brook showing its elevation versus linear distance from its outlet.

Within the project area, East Brook flows near East Brook Road and Griswold Street through residential neighborhoods and past Townsend Elementary School.

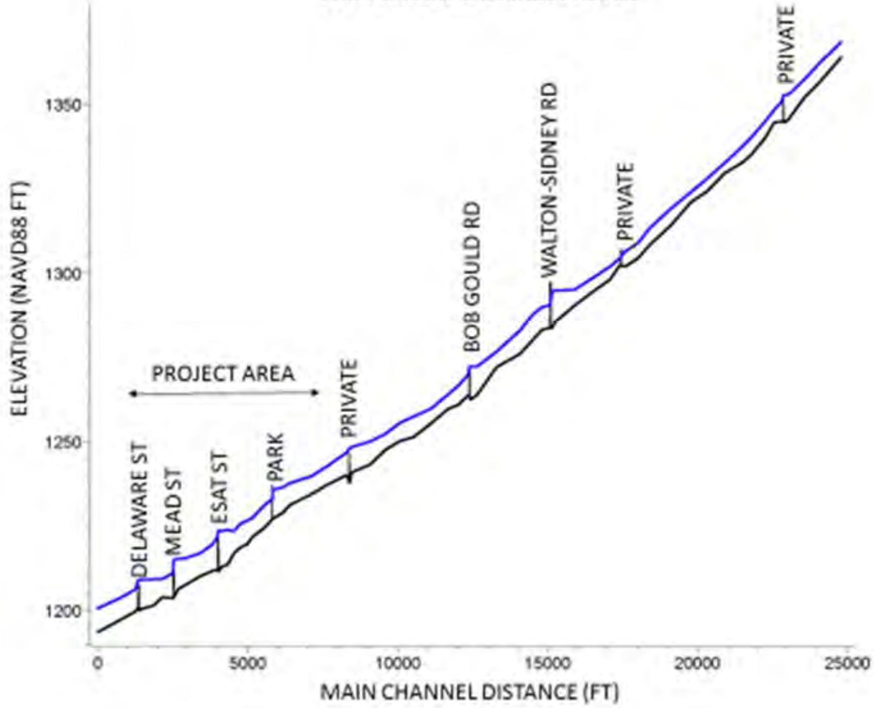


2.2.2 <u>West Brook</u>

West Brook has a watershed area of 28.1 square miles at the confluence with the West Branch Delaware River. The West Brook watershed includes the Third Brook watershed, which flows into West Brook near the confluence with the West Branch Delaware River. The general flow path is from northeast to southwest toward the West Branch Delaware River. West Brook flows through the center of Walton near Liberty Street. It also flows past Austin Lincoln Park, which is in the FEMA 100-year floodplain.

The total length of West Brook from its headwaters to the West Branch Delaware River is about 9.82 miles. The river has an average slope of 0.57%, while the average basin slope is 17 %. Figure 2-3 presents a profile of West Brook showing its elevation versus linear distance from its outlet.

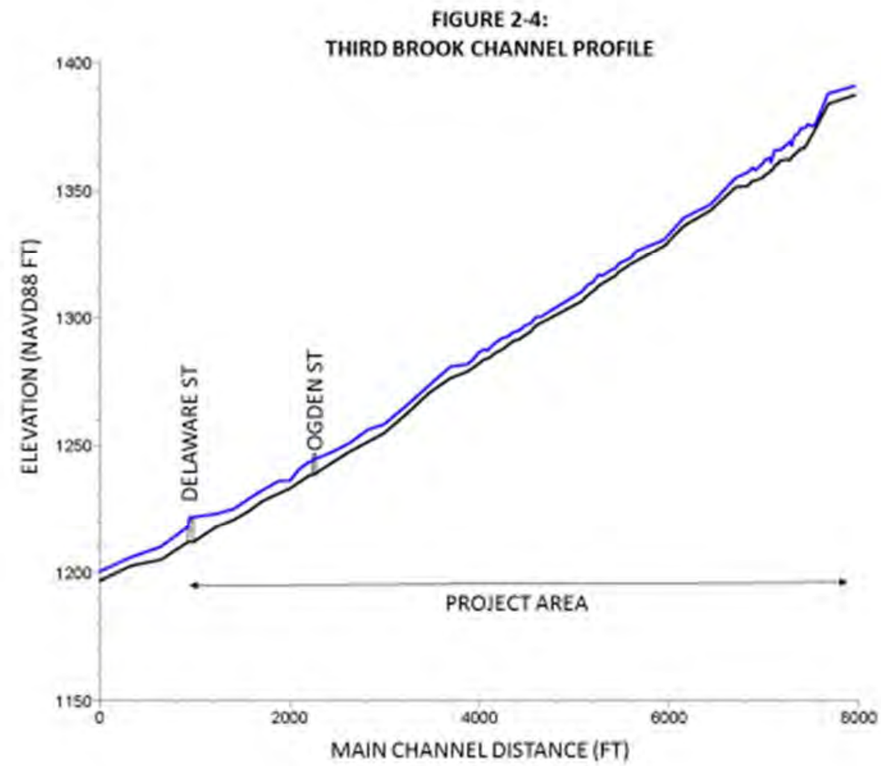
FIGURE 2-3:
WEST BROOK CHANNEL PROFILE



2.2.3 Third Brook

Third Brook has a watershed area of 5.4 square miles at the confluence with West Brook. The general flow path is from northwest to southeast toward the West Branch Delaware River. Third Brook flows through the western side of Walton near the Kraft factory, commercial buildings, and residential neighborhoods.

The total length of West Brook from its headwaters to the West Branch Delaware River is about 9.82 miles. From the confluence with West Branch Delaware River to the Ogden Street Bridge, the slope of the channel is approximately 1.8%. The average basin slope is 18%. Figure 2-4 presents a profile of Third Brook showing its elevation versus linear distance from its outlet.



2.3 Field Assessment

MMI staff conducted visual inspections of East Brook, West Brook, and Third Brook as well as their floodplains in the Village of Walton. In general, the inspections were focused on (1) the stream channels and banks (bank and channel conditions, sediment bars, vegetation along the stream corridor) and (2) development in the floodplains.

Channel reaches along the tributaries were photo-documented. Visual inspections were conducted throughout spring 2015, with follow-up observations of specific areas often coinciding with Walton Flood Commission meetings dates. The iterative nature of the inspections was necessary to help refine and reality-check the modeling of alternatives and the BCA.

When observing the stream channel and adjacent floodplains, the following were noted:

- ❑ Does the stream profile match the profile in the FIS and model?
- ❑ Do stream cross sections match the cross sections in the model?
- ❑ Do the manning n values in the model represent current riverbank and floodplain conditions?
- ❑ Do hydraulic variances in the model make sense relative to the field conditions, such as channel restrictions and bridges?

When observing structures located along the streams, the following were noted:

- ❑ Do the property and building(s) match the parcel data provided by the Delaware County Planning Department?
- ❑ Is the property in the SFHA or 500-year flood zone? Is the structure in the SFHA or 500-year flood zone?
- ❑ What is the current land use and building use?
- ❑ Does the building have a basement?
- ❑ Is the building vacant or occupied?
- ❑ What is the elevation of the first floor in relation to adjacent grade?
- ❑ For single-family homes, how many feet (vertical) above the adjacent grade is the first floor?
- ❑ Are any unique features present in the building or property that would increase or decrease vulnerability to flooding?
- ❑ Is there any direct evidence of past flooding?

Information gathered from field inspections was invaluable for aiding the modeling of alternatives and the BCA.

2.4 Infrastructure

The three streams included in this study are crossed by eight bridges. Flood profiles published in the FEMA FIS indicate that most of the bridges cannot pass the 100 year storm event. In the worst case, the bridge at Mead Street which spans West Brook is overtopped even by the 10 year storm event.

Table 2-1 lists the bridges in the project area and the streams they are located on. The water surface elevations were taken from the existing conditions HEC-RAS model and do not include backwater from the West Branch Delaware River. The bridges are listed from downstream to upstream and their locations are shown on Figure 2-1.

TABLE 2-1
Bridges on East Brook, West Brook, and Third Brook within LFA Study Area

Bridge Number on Figure 2-1	Bridge Crossing	Creek	Predicted 100-Year WSEL at Upstream Face	Bridge Deck Elevation*
1	Delaware Street	East Brook	1209.73	1209.17
2	Benton Avenue	East Brook	1214.53	1214.58
3	Griswold Street	East Brook	1219.62	1219.89
4	Delaware Street	West Brook	1209.10	1208.70
5	Mead Street	West Brook	1215.10	1213.97
6	East Street	West Brook	1223.66	1222.45
7	Park	West Brook	1235.68	1238.50
8	Delaware Street	Third Brook	1221.77	1221.54
9	Ogden Street	Third Brook	1244.79	1247.82
10	Lower Third Brook Road	Third Brook	1480.20	1483.62
11	Gosper Road	Third Brook	1597.78	1597.5

*Elevation from HEC-RAS model

2.5 Hydrology

Surface water hydrologic studies are conducted to understand historic and potential future river flow rates using data measured at stream gauging stations and those developed from predictive models. They inform communities of how much water flows in the river at a specific time and place.

Hydrologic data on peak flood flow rates for East Brook, West Brook, and Third Brook is available from FEMA, *StreamStats* regional data, and can be estimated from nearby USGS gauging stations on West Branch Delaware River and East Brook. *StreamStats* is a USGS website that uses Geographic Information System (GIS) data and regional regression equations to predict peak flood flow rates (Lumia, et al, 2006 & Mulvihill et al, 2009).

The FEMA FIS of Delaware County was published in 2012, with an update to other areas in 2016, and included discharge information for the study reaches. Discharges were calculated for all three streams using USGS *StreamStats*. The current study used the FEMA published flows for the 10-year, 50-year, 100-year, and 500-year flow profiles (Table 2-1).

TABLE 2-2
FEMA Published Discharge Data

Flooding Source	Location	Drainage Area (sq. miles)	Peak Discharge (cfs)			
			10-yr	50-yr	100-yr	500-yr
East Brook	140 feet upstream of the confluence with the West Branch Delaware River	25.03	1,980	3,300	3,720	4,270
West Brook	0.45 mile upstream of Bob Gould Road	13.44	1,150	1,690	1,930	2,510
West Brook	220 feet upstream of confluence of Third Brook	22.68	2,000	2,920	3,330	4,310
West Brook	360 feet upstream of the confluence with West Branch Delaware River	28.11	2,480	3,600	4,110	5,320
Third Brook	420 feet upstream of the confluence with West Brook	5.43	549	831	961	1,280

The bankfull, 2-year, 25-year, and estimate of the June 28, 2006 flood flow profiles were estimated for use in the hydraulic model. These flows were not included in the FEMA model. Bankfull, 2-year, and 25-year flow profiles were calculated using *StreamStats*.

In June of 2006 Walton experienced the worst flooding in its history. According to the USGS (2009), 13.36 inches of rain were recorded at Walton from June 26 through 29, 2006. The USGS determined that this four-day total precipitation had a recurrence interval *exceeding* the 100-year storm. A state of emergency was declared in Delaware County. The town and village of Walton experienced significant damage and property loss including road and bridge failures, mass failures at adjacent hillsides, bank erosion, channel migration and instability, and gravel deposition.

The flood discharge of June 2006 was measured on the East Brook and West Branch, but not on West Brook or Third Brook because they are not gauged streams. A discharge of 7,110 cfs was measured on East Brook in Walton, and a flood discharge of 28,600 cfs was measured on the West Branch Delaware River in Walton.

The estimate of the June 28, 2006 flood used the peak flow measured at the USGS Gauge #01422747 East Brook east of Walton, NY and scaled the flow values by drainage area. Gauged flows from East Brook provide a suitable substitute for Third Brook and West Brook as all three streams are tributaries to the West Branch, have similarly oriented watersheds, and have relatively similar watershed composition. The size of the East Brook watershed is not ideal for transfer of discharge to Third Brook because it is larger than the Third Brook watershed at 24.7 square miles compared to 5.43 square miles, but the other similarities make it a good surrogate.

Flows for the 2006 flood were estimated on West Brook and Third Brook using a watershed drainage area ratio with a scaling exponent equal to the area component exponent in the 500-year Region 4 full-regression equation (Lumia, 2006).

Estimated 2006 flood discharge on West Brook and Third Brook are larger than the FEMA 500-year discharge (Table 2-1). This is consistent with observations; the tributaries were flowing out of banks and exceeded the estimated base flood width depicted on the FIRM.

TABLE 2-3
Additional Modeled Flows

Flooding Source	Location	Drainage Area (sq. miles)	Peak Discharge (cfs)			
			Bankfull	2-yr	25-yr	2006
East Brook	140 feet upstream of the confluence with the West Branch Delaware River	25.03	712	1,050	2,480	7,200
West Brook	0.45 mile upstream of Bob Gould Road	13.44	418	613	1,460	3,998
West Brook	220 feet upstream of confluence of Third Brook	22.68	653	966	2,270	6,559
West Brook	360 feet upstream of the confluence with West Branch Delaware River	28.11	787	1,200	2,810	8,035
Third Brook	420 feet upstream of the confluence with West Brook	5.43	192	272	696	1,696

The timing of the peak discharge of the tributaries was not found to be significantly different than the timing of the peak discharge in the West Branch Delaware River. In some cases the peak of a storm is not coincident on a mainstem and tributary, allowing the water from one source to recede from the floodplain prior to the peak arriving from the other flood source. This was not the case during the 2006 flood in Walton. The timing of the peak during the 2006 flood on the West Branch Delaware River at Walton (USGS 01423000) was 28,600 cfs at 6/28/06 at 0330. The timing of the peak at East Brook east of Walton (USGS 01422747) was 7,110 cfs at 6/28/06 at 0315, only 15 minutes before the peak on the West Branch. The difference in discharge during those 15 minutes is 280 cfs (4%) on East Brook and 500 cfs (2%) on the West Branch. A 15 minute difference in timing is negligible and would not allow the water to recede from one floodplain prior to the peak arriving from the other source.

3.0 DESCRIPTION OF FLOOD HAZARDS

3.1 Flood History Along East Brook, West Brook, and Third Brook

Walton typically experiences mild summers and cold winters with precipitation occurring year-round. The long-term mean annual precipitation in the watershed is reported to be 46.7 inches per year (DCSWCD, 2006). However, precipitation is not always distributed uniformly throughout the year, and several significant and devastating floods have occurred. Beginning with the flood of 1996, these are described below.

Flood of 1996 – On January 19 and 20, 1996, the town and village of Walton suffered a devastating flood. Under nearly five feet of water, businesses along Delaware Street sustained severe damage including a fire that destroyed two buildings during the peak of the flood. Several Walton residents reportedly indicated that this flood was the highest since the flood of July 1935.

West Branch Delaware River at Delaware Street on January 19, 1996 (Photograph courtesy of the Walton Reporter, reprinted by USGS)

Flood of 2006 – In June 2006, Walton experienced the worst flood in its history. According to the USGS (2009), 13.36 inches of rain were recorded at Walton from June 26 through 29, 2006. The USGS determined that this four-day total precipitation had a recurrence interval *exceeding* the 100-year storm. East Brook east of Walton, NY had a discharge of 7,111 CFS on June 28, 2006. Discharges were not recorded on Third Brook or West Brook, however based on discharges recorded on East Brook and the West Branch Delaware River, discharges on Third Brook and West Brook were greater than a 100-year event.

Photograph courtesy of the Town of Walton web site

A state of emergency was declared in Delaware County and many others. The town and village of Walton experienced significant damage and property loss including road and bridge failures, mass failures at hillsides, bank erosion, channel migration and instability, and gravel deposition.

Along East Brook, the East Street Bridge failed and water flowed from the channel across East Street and onto Griswold Street. Residents living on Union Street and Benton Avenue reported flooding in their basements. On Third Brook, the Delaware Street Bridge became blocked and contributed to upstream flooding. Numerous photographs of flood damage along Third Brook can be found in the Third Brook Watershed Management Plan (December 2013). On West Brook residents reported that water left the channel upstream of the East Street Bridge.

Flood of 2010 – Heavy rain from Tropical Storm Nichole fell on Walton totaling 5.16 inches (USGS, 2010) on September 30 and October 1, 2010. The USGS (2010) computed that the 24-hour precipitation total of five inches had a recurrence interval of 25 years. Walton was placed under a state of emergency, and the West Branch Delaware River flooded areas of downtown along Delaware Street. According to USGS, flood recurrence intervals were in the 10-year to 100-year range for the region, which is generally consistent with the 25-year recurrence interval of the precipitation event. A recurrence interval of 15 years was later cited by USGS for the Walton gauge on West Branch Delaware River.

Floods of 2011 – In August and September 2011, Hurricane Irene and the remnants of Tropical Storm Lee resulted in record flooding in much of the Catskills. Walton was again placed under a state of emergency when the West Branch Delaware River flooded areas of downtown including Breakey Motors and McDonalds. However, flooding was not as severe along East Brook, West Brook, and Third Brook as compared to the floods of 1996 and 2006.

A summary of the peak discharges on East Brook and associated stages is provided in Table 3-1. Peak discharges were not available for West Brook and Third Brook. The recurrence intervals listed in the table were published by USGS at the time of each flood and do not necessarily represent a continuous updating of the hydrologic record with calculation of new recurrence intervals.

TABLE 3-1
Recent Flood Discharges at Gauge #01422747 on East Brook in Walton

Date	Discharge	Stage*	RI** (years)
June 28, 2006	7,110 cfs	9.95	Not reported
October 1, 2010	804 cfs***	Not reported	Not reported
August 29, 2011	1,900 cfs	5.88	3
September 8, 2011	2,750 cfs	6.75	7

*Flood stage = 7.5 feet
**RI as reported by USGS for the period of record available at the date of the flood
***Mean daily discharge

3.2 FEMA Mapping

FEMA Flood Insurance Rate Maps are available for the study area and depict the SFHA. The maps also depict the FEMA designated floodway, which is the stream channel and that portion of the adjacent floodplain that must remain open to permit passage of the base flood. Floodwaters are typically deepest and swiftest in the floodway, and anything in this area is in the greatest danger during a flood (FEMA, 2008).

FEMA mapping indicates that during a 100-year frequency event, waters from East Brook and West Brook will inundate much of the downtown area and upstream residential neighborhoods. Flooding from Third Brook will affect the Kraft factory and buildings immediately upstream of Delaware Street. This was verified during some of the recent floods, and especially in 1996 and 2006.

4.0 FLOOD MITIGATION ANALYSIS AND ALTERNATIVES

The purpose of a hydraulic assessment is to evaluate historic and predicted water surface elevations, identify flood prone areas, and help develop mitigation strategies to minimize future flood damages and protect water quality. Hydraulic analysis techniques can also help predict flow velocities, sediment transport, scour, and deposition if these outcomes are desired.

Specific risk areas along East Brook, West Brook, and Third Brook have been identified as being prone to flooding during severe rain events. Numerous alternatives were developed and assessed at each area where flooding is known to have caused extensive damage to infrastructure, homes, and businesses. Alternatives were assessed with hydraulic modeling to determine their effectiveness. In the LFA report for the West Branch Delaware River (2015), specific results were presented in Section 4. Because this LFA addresses three watercourses, general information is provided in Section 4 whereas specific results are separated into Sections 5, 6, and 7.

4.1 Analysis Approach

Hydraulic analysis of the three tributaries to the West Branch Delaware was conducted using the HEC-RAS program. The HEC-RAS software (*River Analysis System*) was written by the United States Army Corps of Engineers (USACE) Hydrologic Engineering Center (HEC) and is considered to be the industry standard for riverine flood analysis. The model is used to compute water surface profiles for one-dimensional, steady-state, or time-varied flow. The system can accommodate a full network of channels, a dendritic system, or a single river reach. HEC-RAS is capable of modeling water surface profiles under subcritical, supercritical, and mixed-flow conditions.

The FEMA FIS (see Section 2.0) was based on a detailed study utilizing the HEC-RAS computer software. In order to develop hydraulic modeling to assess the alternatives, MMI obtained the effective FEMA HEC-RAS models from NYCDEP including lower Third Brook on April 14, 2014, lower sections of East Brook and West Brook on August 18, 2015, and upper Third Brook on February 3, 2016. These models were used in the FEMA Effective FIS to create the regulatory floodplain and floodway boundaries. Although the three tributaries and the West Branch Delaware River interact, with water flowing between them, the FEMA Effective models consider them four separate rivers, each modeled separately. It is important to note that the FEMA Effective models were developed before the relatively less severe flooding of 2010 and 2011, using detailed topography data collected in 2009, and therefore does not include any changes to the river and floodplain that may have occurred during recent floods.

Water surface profiles are computed by HEC-RAS from one cross section to the next by solving the one-dimensional energy equation with an iterative procedure called the standard step method. Energy losses are evaluated by friction (Manning's Equation) and the contraction/ expansion of flow through the channel. The momentum equation is used in situations where the water surface profile is rapidly varied, such as hydraulic jumps, mixed-flow regime calculations, hydraulics of dams and bridges, and evaluating profiles at a river confluence.

4.2 Existing Conditions Analysis

FEMA "Duplicate Effective" models were created by importing the FEMA Effective model into HEC-RAS. The models were run in HEC-RAS with no changes to the received models. The floodplain and floodway runs were completed in two different plans. Comparisons to the data listed in the Effective FIS confirmed that the received models match the published FIS data.

The Duplicate Effective models were checked for correct manning's n-values, site conditions, and expansion/contraction coefficients to ensure that the information in the models accurately reflect river and floodplain conditions. Some n-values in the overbank areas did not adequately represent site conditions. A "Corrected Effective Model" was created[2] by copying the Duplicate Effective model and making necessary changes. Minor n-value changes were included in the Corrected Effective Model to more appropriately represent overbank conditions.

Gaps were identified between cross section locations in the Corrected Effective models in areas where the Walton Flood Commission desired evaluation of alternatives for flood mitigation. Additional cross sections were deemed necessary to better represent these possible future mitigation project areas or to add a landscape feature not previously included in the modeling. An "Existing Conditions" model was created for each stream by saving a copy of the Corrected Effective Model and adding cross sections in necessary locations.

New cross sections relied upon overbank geometry from the 2009 1-meter resolution LiDAR data collected by NYCDEP. Elevations were sampled from the LiDAR elevation data using HEC-GeoRAS GIS extension software. No new survey data were collected as part of this model update. The wet channel sections were taken from the next closest cross section that was included in the FEMA model because the LiDAR data does not penetrate the water surface and therefore underestimates the depth of the channel bottom. The wet section shape was transferred and height adjusted to match the channel slope of the FEMA model in these new cross section locations. Manning's n-values were assigned using field observations and aerial photos.

Changes have occurred along the streams since survey was completed in 2009 under the FEMA FIS contract. Model geometry was altered to bring the model to current conditions. Specific changes that were made are listed below and shown on Figures 4-1, 4-2, 4-3:

East Brook

- Four cross sections were added to reflect existing conditions and evaluation of alternatives at River Stations 863, 1443, 2628, and 2289.
- The East Street Bridge was removed from the model because it is no longer present.

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[2] Changes made to the FEMA model geometry were noted in the comments section in HEC-RAS. N-values for some cross sections were updated from the FEMA model in the Corrected Effective model. If a change was made, notes were added to the Cross Section Data Editor Description box where comments can be written for each cross section.

- Channel sections were updated at the floodplain restoration project between East Street and East Brook Dam Road based on *Plans for DSR-D-TW-05 Town of Walton, East Brook at County Rt. 22, Delaware County SWCD November 2013 As-Built plans.*

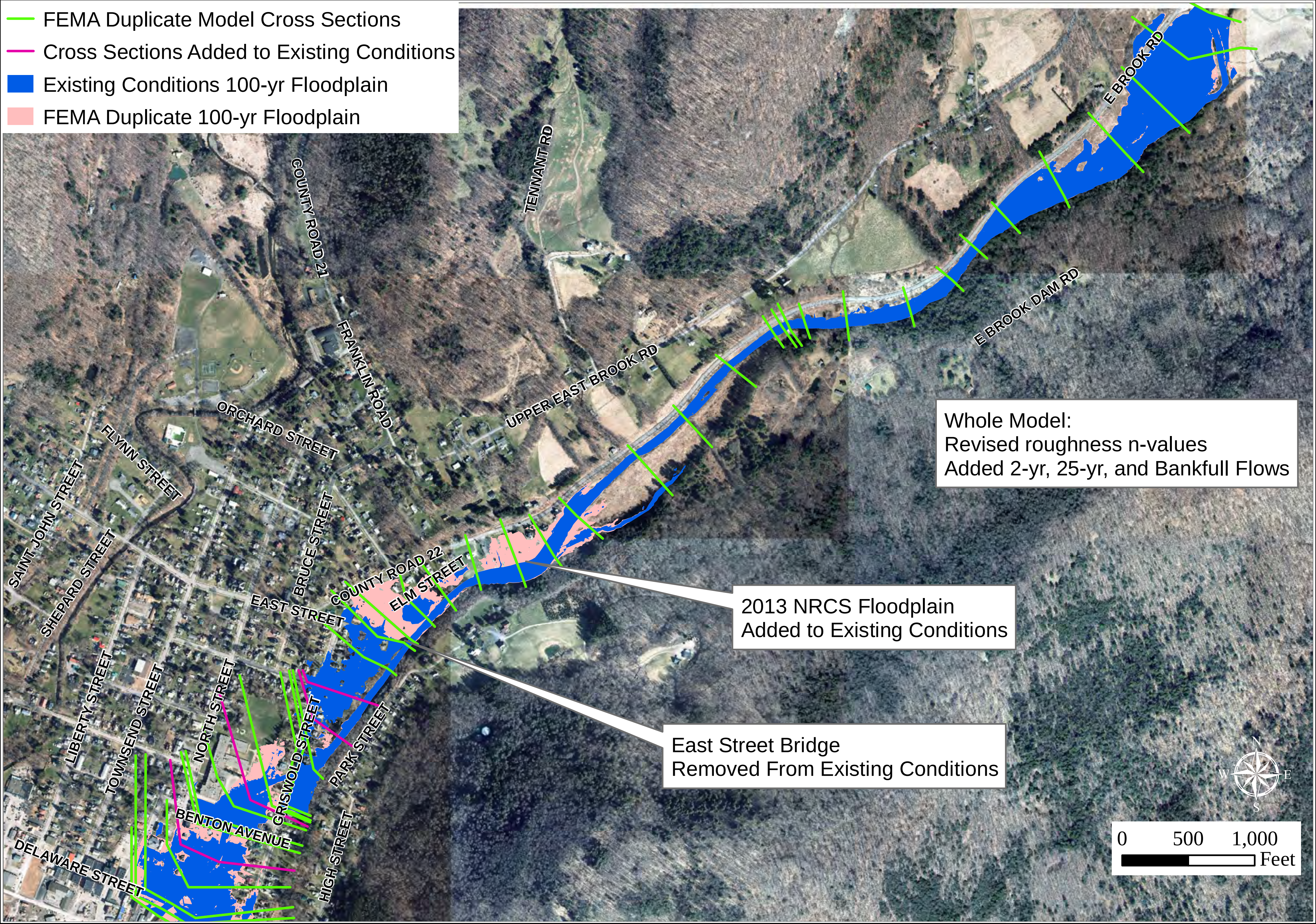
West Brook

- Eight cross sections were added to reflect existing conditions and evaluation of alternatives at River Stations 1825, 2096, 3137, 4553, 4781, 5214, 6027, and 6400.
- The new pedestrian bridge in Austin Lincoln Park (FEMA DR NY 1650- PW#4619, Contract No. VW1-G-07) was added based on May 2008 As-Built plans.
- A new floodplain restoration project was added upstream of Delaware Street near the school maintenance facility based on *Stream Corridor Management Program, Delaware County SWCD, Village of Walton Floodplain Restoration at West Brook, WBDR Demonstration Project, December 2011 As-Built plans.*
- Channel sections were updated downstream of the park based on *USDA Natural Resource Conservation Service Emergency Watershed Protection Program project D-VW-210 May 2007* design plans.

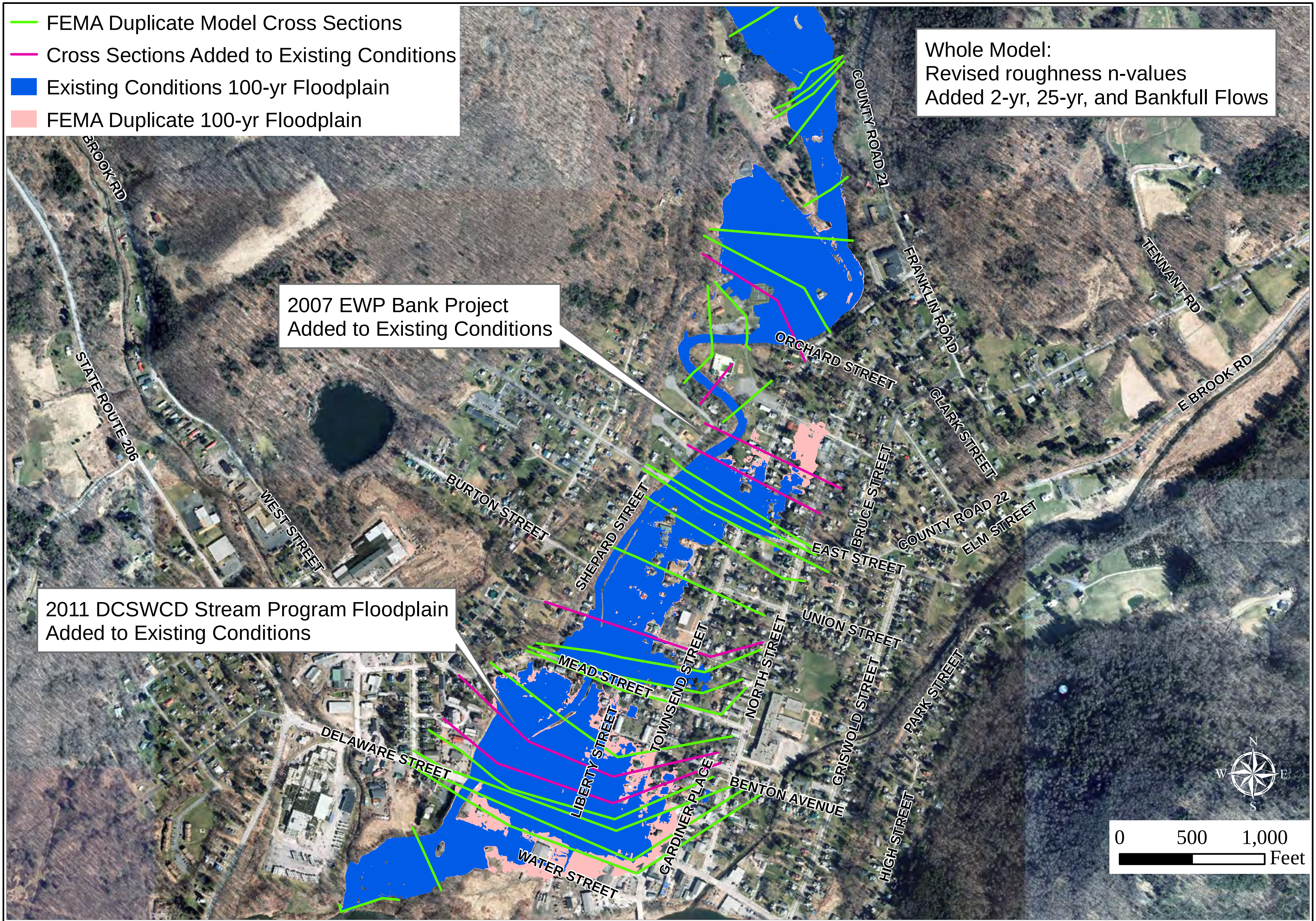
Third Brook

- Seven cross sections were added to reflect existing conditions and evaluation of alternatives at River Stations 1434, 1595, 1904, 2120, 2473, 2849, and 3245.
- Channel sections were updated at Emergency Watershed Protection projects using As-Built model cross sections for “sites 2-6” and proposed conditions model cross sections for “sites 8-9” completed by Milone & MacBroom.

Additional flow profiles were added for the bankfull flow, 2-year, 25-year recurrence intervals, and an estimate of the 2006 flood. Calculation of these flows was described above in the Hydrology section of this report.



SOURCE(S): BING MMI HECRAS	FIG. 4-1: FEMA DUPLICATE COMPARED TO EXISTING CONDITIONS	LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES	Map By: JCL MMI#: 5197-06 Original: 12/12/2017 Revision: Scale: 1 in = 940 ft	MILONE & MACBROOM 99 Realty Drive Cheshire, CT 06410 (203) 271-1773 Fax: (203) 272-9733 www.miloneandmacbroom.com
	MXD: Y:\5197-06\Maps\Report Figures\Fig 4-1 DuplicateVsExisting.mxd	LOCATION: WALTON, DELAWARE COUNTY, NY		



SOURCE(S):

BING
MMI HECRAS

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FIG. 4.2: FEMA DUPLICATE COMPARED TO EXISTING CONDITIONS

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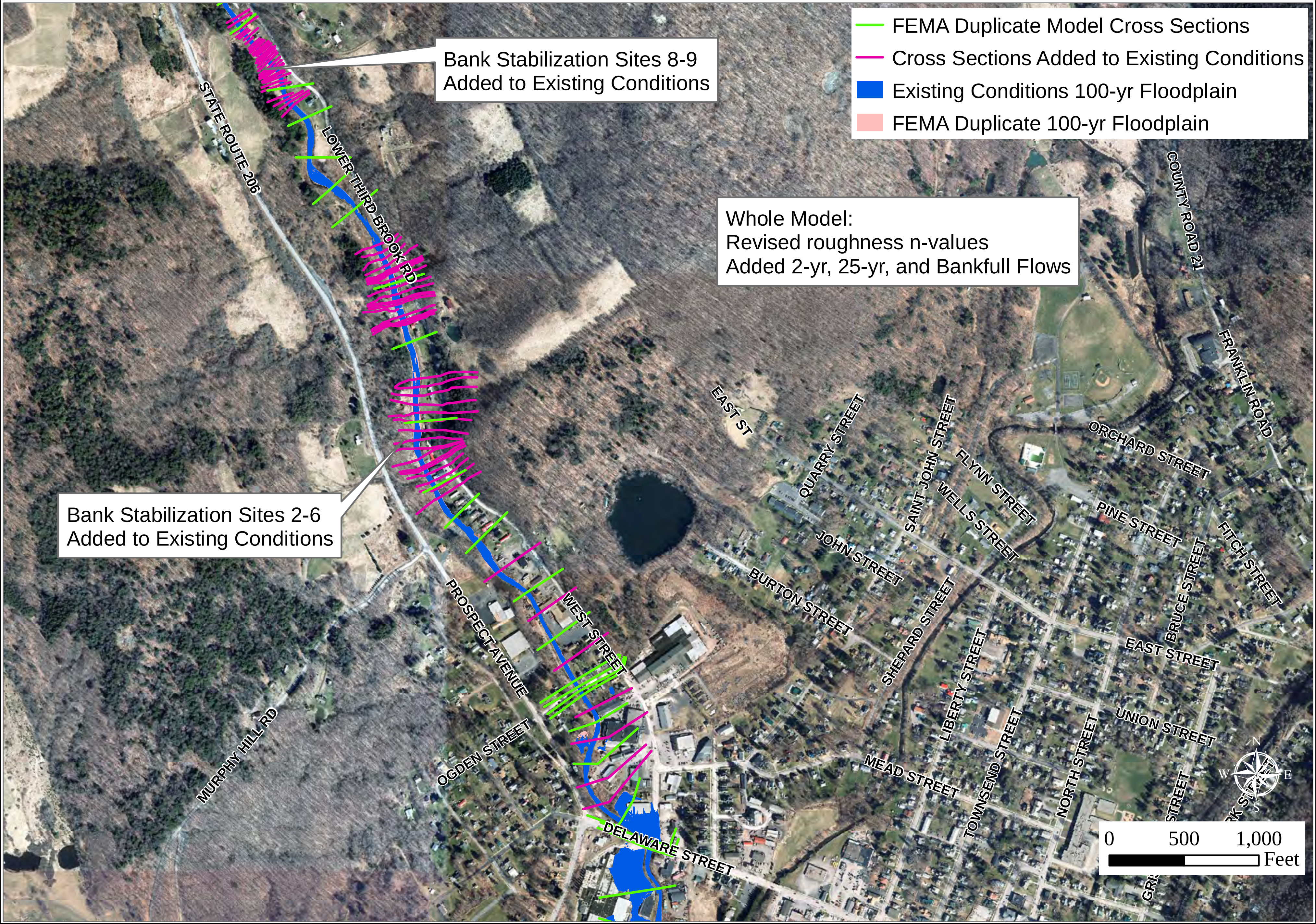
LOCAL FLOOD ANALYSIS
WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By:	JCL
MMI#:	5197-06
Original:	11/2/2015
Revision:	
Scale:	1 in = 855 ft

MILONE & MACBROOM
99 Realty Drive Cheshire, CT 06410
(203) 271-1773 Fax: (203) 272-9733
www.miloneandmacbroom.com



SOURCE(S):	FIG. 4-3: FEMA DUPLICATE COMPARED TO EXISTING CONDITIONS	LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES	Map By: JCL	MILONE & MACBROOM
BING			MMI#: 5197-06	99 Realty Drive Cheshire, CT 06410
MMI HECRAS			Original: 12/3/2015	(203) 271-1773 Fax: (203) 272-9733
	MXD: Y:\5197-06\Maps\Report Figures\Fig 4-3 ThirdDuplicateVsExisting.mxd	LOCATION: WALTON, DELAWARE COUNTY, NY	Revision:	www.miloneandmacbroom.com
			Scale: 1 in = 833 ft	

For purposes of water surface elevation computations, the models were run in the same flow regime used in the received FEMA Effective models. East Brook and West Brook were run in Subcritical Flow Regime and Third Brook was run in Mixed Flow Regime. All of the models were run with a downstream boundary condition of normal depth, no change from the FEMA Effective model.

The new Existing Conditions models were the baseline models used to evaluate flood mitigation alternatives.

4.3 Channel and Floodplain Mitigation Approaches

A number of mitigation approaches have been evaluated for East Brook, West Brook, and Third Brook within the study area. These are introduced in a global manner in this section.

4.3.1 Sediment Management

A common sentiment in the Catskills region is that dredging, more broadly defined as removal of sediment from river channels, will alleviate flooding and should be pursued. The need for dredging can be minimized by reducing the sediment load at its source and by improving sediment transport through reaches that are at risk to deposition. Natural sediment transport is often disrupted by constrictions holding back sediment or channelization causing increased sediment transport, causing abnormal deposition that can be addressed in the long term by removal of constrictions and naturalization of channel and floodplain capacity.

Dredging is often the first response to flooding. However, over-widening or over-deepening through sediment removal can initiate instability (including bed and bank erosion), foster poor sediment transport, and not necessarily provide significant flood mitigation. Sediment removal can further isolate a stream from its natural floodplain, disrupt sediment transport, expose erodible sediments, cause upstream bank/channel scour, and encourage additional downstream sediment deposition. These are problems that have been observed along Third Brook as explained in the Third Brook Watershed Management Plan (2013). Improperly dredged stream channels often show signs of severe instability, which can cause larger problems after the work is complete. Such a condition is likely to exacerbate flooding on a long-term basis.

4.3.2 Levee Construction

Under certain circumstances, levees can be constructed for the purpose of protecting properties and structures from flood damage. Levees often require interior drainage pump stations, use of removable panels at road crossings, and considerable maintenance. Use of such measures requires careful consideration and risk assessment, engineering design, and ongoing monitoring and maintenance.

Risks associated with levees include the potential to increase water surface elevations in the channel by cutting off the floodplain, and the danger of a flood event that exceeds the design storm and overtops or breaches the levee. As an example, peak flood stage on the West Branch

Delaware River in Walton exceeded the 100-year flood stage during the 2006 flood. Under this scenario, it is likely that floodwaters would have overtopped a levee designed to protect structures and properties from flooding during the 100-year flood event.

Once a levee has been overtopped, floodwaters can become trapped behind the levee, exacerbating flooding problems. This phenomenon occurs to some extent already in Walton. When floodwaters enter the business district near Breakey Motors and travel downstream along Delaware Street, the ground surface elevations along the south side of Delaware Street near McDonalds make it difficult for floodwaters to re-enter the river. This also happened to some degree along East Brook near Griswold Street and along Third Brook when water left the channel at Ogden Street and flowed down West Street. These were cases where natural grade caused the separation of floodwaters; a levee would have worsened this type of problem.

Finally, levees need to be certified by FEMA and maintained according to FEMA requirements in order for any flood mitigation benefits to be recognized on the FIRM. A lapse in maintenance or certification can lead to sharp flood insurance increases for properties believed protected by the levee system.

4.3.3 Bridge Replacement or Modifications

In some cases, bridges cause lateral or vertical restrictions that increase flood velocities and/or water surface elevations. The replacement of a bridge with a new structure that has a longer span will often remove the lateral constrictions, while a higher structure will remove vertical restrictions and often reduce water surface elevations on the upstream side. Bridge replacement must be carefully evaluated in combination with other alternatives, because other flood mitigation projects could change the velocity or height of flows approaching and passing under bridges.

Eleven bridges are located within the project area on East Brook, West Brook, and Third Brook. On East Brook, the Delaware Street, Benton Avenue, and Griswold Street bridges were evaluated. Public comments noted that the sizing of the Griswold Street Bridge on East Brook is a concern. On West Brook, bridge replacements at the Delaware Street, Mead Street, and East Street bridges were modeled. Delaware Street Bridge, Ogden Street Bridge, Lower Third Brook, and Gosper Road over Third Brook were also evaluated. The Ogden Street Bridge became blocked in the 2006 flood.

4.3.4 Natural Channel Design and Floodplain Enhancement

Historic settlement and human desire to build near water has led to centuries of development clustered along the banks of rivers all over the nation. Dense development and placement of fill in the natural floodplain of a river can severely hinder a river's ability to convey flood flows without overtopping its banks and/or causing heavy flood damages.

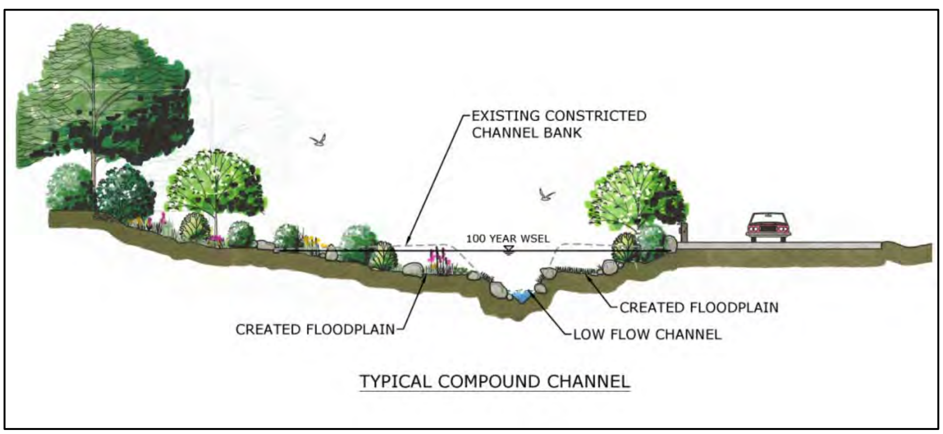
A river in flood stage must convey large amounts of water through a finite floodplain. When a channel is constricted or confined, velocities can become destructively high during a flood, with dramatic erosion and damage. When obstructions are placed in the floodplain, whether they are in the form of structures, infrastructure, or fill, they are vulnerable to flooding and damage. Reducing floodplain capacity also disrupts natural sediment deposition and may cause that sediment to accumulate elsewhere, causing a transfer of problems.

Natural channels are typically comprised of a compound channel whereby normal flow is conveyed in a low flow channel that is flanked by active floodplain, which is ideally a vegetated, undeveloped corridor at a slightly higher elevation that is able to convey high flows. Although rivers in their natural setting seem to be at their low-flow stage most often, the entire flood-prone corridor is part of the river, and the importance of the floodplain only becomes evident on rare, but extreme occasions.

The natural floodplains along East Brook, West Brook, and Third Brook, in some locations, have been built upon and in other locations have been filled. In certain instances, an existing floodplain can be altered through reclamation, creation, or enhancement, to increase flood conveyance capacity. Floodplain *reclamation* can be accomplished by excavating previously filled areas, removing berms or obstructions from the floodplain, or removal of structures. Floodplain *creation* can be accomplished by excavating land to create new floodplain where there is none today. Finally, floodplain *enhancement* can be accomplished by excavating within the existing floodplain adjacent to the river to increase flood flow conveyance. These excavated areas are sometimes referred to as floodplain benches. Floodplain reclamations have been conducted along sections and West Brook and East Brook.

Figure 4-4 shows a typical cross section of compound channel with excavated floodplain benches on both banks. The graphic shows flood benches on both banks; however, flood benches can occur on either or both banks of a river.

FIGURE 4-4
Typical Cross Section of a Compound Channel



The Walton Flood Commission has provided evidence that filling of floodplains has occurred along the tributaries evaluated in this study. When considering areas for floodplain reclamation, enhancement, or creation, it may make sense to target areas that were formerly providing better floodplain functions.

A review of historical topographic mapping is also beneficial in providing clues about prior floodplain conditions. For example, the topographic map from 1925 (pictured to the right) shows populated areas located close to the tributaries, however there appear to have been fewer buildings in 1925. Increased development within the floodplains has encroached onto the historical floodplains.

1925 USGS Quad

4.4 Individual Property Flood Mitigation

A variety of measures are available to protect existing public and private properties from flood damage. While broader mitigation efforts are desirable such as those described above, they often take time and significant funding to implement. On a case-by-case basis, individual floodproofing should be explored where structures are at risk. Potential measures for property protection include the following:

Elevation of the structure. Home elevation involves the removal of the building structure from the basement and elevating it on piers to a height such that the first floor is located above the level of the 100-year flood event. The basement area is abandoned and filled to be no higher than the existing grade. All utilities and appliances located within the basement must be relocated to the new elevated first-floor level. Elevations are not recommended within the floodway.

Dry floodproofing of the structure to keep floodwaters from entering. Dry floodproofing refers to the act of making areas below the flood level watertight. Walls may be coated with compound or plastic sheathing. Openings such as windows and vents would be either permanently closed or covered with removable shields. Flood protection should extend only 2 to 3 feet above the top of the concrete foundation because building walls and floors cannot withstand the pressure of deeper water. Dry floodproofing is not appropriate for residential structures but is permissible for non-residential structures.

Wet floodproofing of the structure to allow floodwaters to pass through the lower area of the structure unimpeded. Wet floodproofing refers to intentionally letting floodwater into a building to equalize interior and exterior water pressures. Wet floodproofing should only be used as a last resort. If considered, furniture and electrical appliances should be moved away or elevated above the 100-year flood elevation. Wet floodproofing is not appropriate for residential structures unless accomplished by elevating the structure as described above, but is permissible for non-residential structures.

Construction of property improvements such as barriers, floodwalls, and earthen berms. Such structural projects can sometimes be used to prevent flooding. There may be properties within Walton where implementation of such measures will serve to protect structures. For example, the Third Brook Watershed Management Plan discusses the merits of constructing a flood wall on the Kraft property to protect the building and some of the exterior assets from flooding.

Performing other home improvements to mitigate damage from flooding. The following measures can be undertaken to protect home utilities and belongings:

- ❑ Relocate valuable belongings above the 100-year flood elevation to reduce the amount of damage caused during a flood event.
- ❑ Elevate the electrical box or relocate it to a higher floor and elevate electric outlets to at least 12 inches above the high water mark.
- ❑ Relocate or elevate water heaters, heating systems, washers, and dryers to a higher floor or to at least 12 inches above the high water mark (if the ceiling permits). A wooden platform of pressure-treated wood can serve as the base.
- ❑ Anchor a fuel tank to the wall or floor with noncorrosive metal strapping and lag bolts.
- ❑ Install a backflow valve to prevent sewer backup into the home.
- ❑ Install a floating floor drain plug at the lowest point of the lowest finished floor.

Encouraging property owners to purchase flood insurance under the National Flood Insurance Program (NFIP) and to make claims when damage occurs. While having flood insurance will not prevent flood damage, it will help a family or business put things back in order following a flood event. Property owners should be encouraged to submit claims under the NFIP whenever flooding damage occurs in order to increase the eligibility of the property for projects under the various mitigation grant programs.

4.5 Hydrologic Alternatives Analysis

Hydrologic alternatives were not a significant consideration for the Walton Tributaries LFA, as there is no feasible method of retaining or detaining significant volumes of water upstream of the Village of Walton to reduce flooding in the Village.

However, a specific hydrologic flood problem is of great interest to the Walton Flood Commission and repeated here as it was covered in the West Branch Delaware River LFA because it is also of importance to the flow out of the tributaries. Concentrated flows down the side streets (Liberty Street, Townsend Street, Gardiner Place, and North Street) toward Delaware Street are a considerable problem during certain flood events, and especially when the tributaries are in flood stage and overflowing. In addition, water from the overflowing main stem of the river becomes trapped along Delaware Street by the grade and topography. Conveyance of the water from roadways to the West Branch Delaware River could be facilitated by removing some of the buildings in the path of this water, such as the 181 Delaware Street building. If this building were removed, it may be possible to create a conveyance channel in its footprint.

The conveyance of tributary floodwaters and main stem floodwaters back to the river were not addressed using modeling. This is because the steady-state 1-dimensional HEC-RAS model used for this study creates a water surface profile along the West Branch Delaware River but does not track and account for water trapped along Delaware Street as floodwaters recede. Nevertheless, observations from the community support the need to address the contributions to flooding that are not directly addressed by the modeling. The flood mitigation alternatives for the tributary streams should include project components to facilitate conveyance back to the tributary streams if appropriate.

4.6 Property-Specific Building Flood Mitigation

A number of residential properties may be removed from the 1% annual chance flood risk zone if the alternatives along East Brook, West Brook, and Third Brook are constructed. These properties are visible on the depth grid figures in sections 5, 6, and 7 in the margin between the thin orange line and the edge of the light blue depth mapping.

Many of the properties in the Walton study that are currently in the SFHA associated with East Brook, West Brook, and Third Brook *will remain* in the SFHA, and therefore will be subject to continued flood risk and flood insurance coverage requirements[3]. However, the reduction of flood water surface elevations has two benefits:

1. Depth of actual flooding may decrease in future floods, leading to reduced damages and reduced time and costs for clean-up and recovery.
2. Reduced water surface elevations can be used to support a Letter of Map Revision (LOMR[4]) or physical map revision (PMR[5]), which would formally reduce the BFE and may reduce flood insurance premiums for some properties.

> *The discussion in this section provides a reasonable description of the options that may be available to property owners under current conditions and potential future conditions if bridge replacement and floodplain enhancement projects are pursued. However, individual property owners should always work with the Code Enforcement official to determine what is legally required when an improvement is planned.*

[3] Flood insurance requirements are dependent on status of the property relative to loans, mortgages, or other factors that are outside the scope of this plan.

[4] A LOMR is FEMA's modification to a FIRM. LOMRs are generally based on the implementation of measures that affect the hydrologic or hydraulic characteristics of a flooding source and thus result in the modification of the existing regulatory floodway, the effective BFEs, or the SFHA. The LOMR officially revises the FIRM without causing FEMA to re-publish the FIRM. The LOMR is generally accompanied by an annotated copy of the affected portions of the FIRM.

[5] A PMR is an action whereby one or more FIRM or DFIRM map panels are physically revised and republished. A PMR is used to change flood risk zones, floodplain and/or floodway delineations, flood elevations, and/or planimetric features. A LOMR accomplishes some of the same changes as the PMR, but the FIRM or DFIRM panels are not republished with the LOMR.

At properties that remain in the SFHA, property owners may wish to conduct site-specific mitigation actions to reduce flood risks. The basic choice is to determine whether a building should be removed and the parcel converted to open space; or mitigated through elevation, floodproofing, elevating utilities, etc. as described in Section 4.4 of this document[6].

If homes are elevated, they will need to be elevated two feet above the BFE. However, this will present an important question to property owners as they work with local authorities – should the current BFE be applied, or should the work be postponed to take advantage of a future (and lower) BFE defined by a LOMR or PMR? In many cases a property owner may not have time available to delay a building elevation, floodproofing project, or utility elevation. However if the property owner can delay a mitigation project until after the Village of Walton has secured a LOMR or PMR, then the design elevation may be lower. Other important considerations include the following:

- FEMA and many other grant funds will allow elevations in SFHAs but will not allow elevations in floodways.
- If mitigation is funded by the property owner then an elevation in a floodway is acceptable as long as the footprint of the structure is not expanded.
- If building elevation or floodproofing is not a substantial improvement or is not the result of substantial damage, then it can be allowed in a floodway; however, the owner will see no benefit on flood insurance premiums.

4.7 Relocations

The alternatives along East Brook and West Brook all involve property acquisitions or relocations in order to execute the various floodplain projects. These acquisitions and relocations are discussed further in sections 5.2, 6.2, and 7.2.

In addition to the relocations necessary to accomplish some of the modeled alternatives, there may be other anchor businesses or critical facilities in Walton that can be relocated from the zone of flood risk but remain within the Village. . Anchor businesses like CVS and the Big M supermarket are examples of buildings that will remain at risk for flooding, and the property owners may one day determine that relocation is prudent.

If property owners are interested, the Walton Flood Commission should help facilitate relocations that are not part of the analyzed alternatives. These may include critical facilities such as the school bus maintenance facility and key businesses.

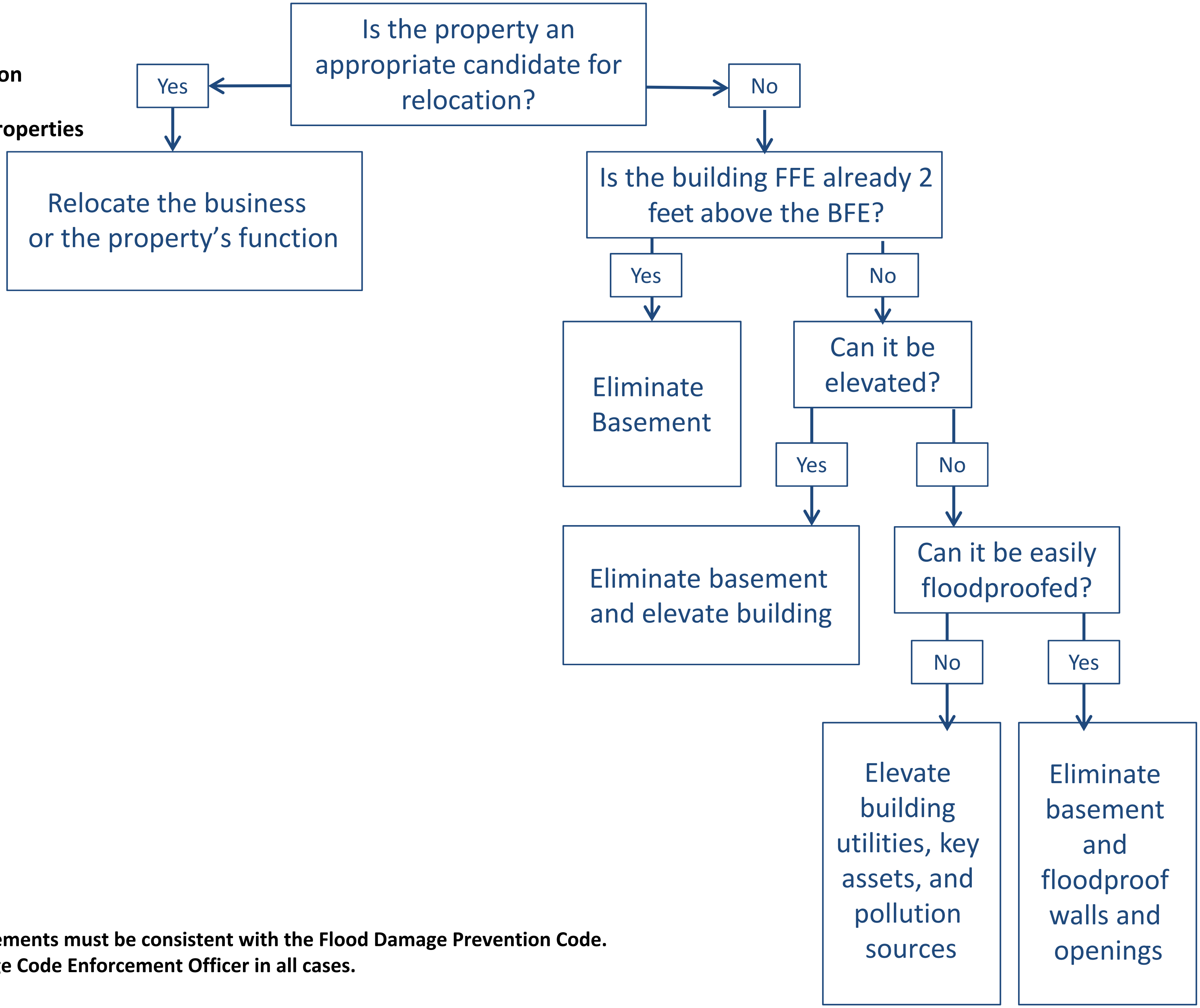
[6] Substantial damage or a substantial improvement will trigger elevation of residential buildings and either dry floodproofing or elevation of non-residential buildings.

4.8 Decision Support for Property-Specific Building Flood Mitigation and Relocations

To aid the selection of future property-specific mitigation actions such as elevations and relocations, two decision support flowcharts are offered. The first chart (Figure 4-5) is applicable to non-residential properties and the second (Figure 4-6) is applicable to residential properties. In both cases, the underlying assumption is that properties are located in the SFHAs associated with East Brook, West Brook, and Third Brook. The specific design elevation (for example, the height of floodproofing) should always be determined on a case-by-case basis with reference to the BFE.

Figure 4-5

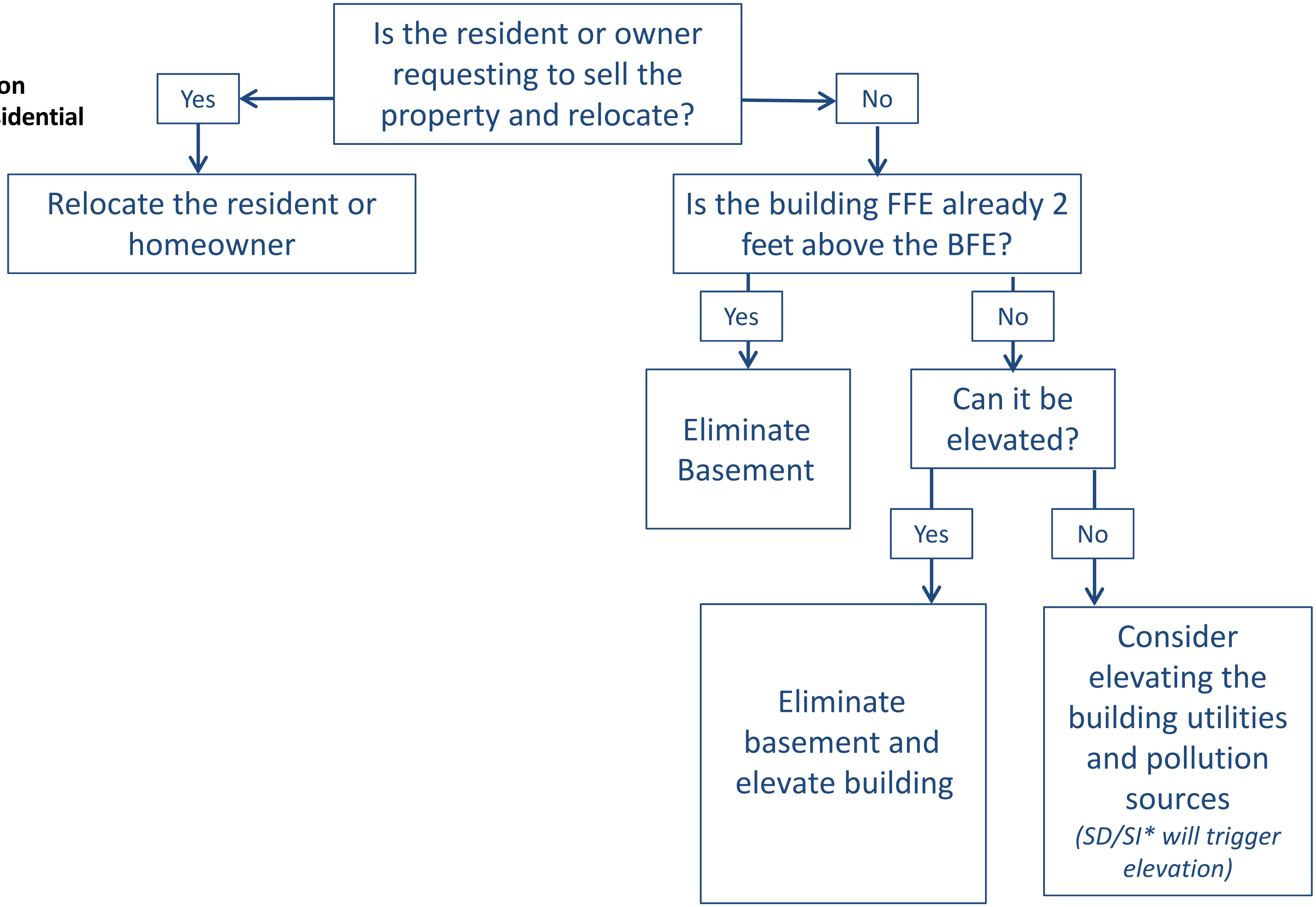
Property-Specific Mitigation Decision Flowchart for Nonresidential Properties



Note: All improvements must be consistent with the Flood Damage Prevention Code. Consult the Village Code Enforcement Officer in all cases.

Figure 4-6

Property-Specific Mitigation Decision Flowchart for Residential Properties



*Substantial Damage/Substantial Improvement

Note: All improvements must be consistent with the Flood Damage Prevention Code. Consult the Village Code Enforcement Officer in all cases.

4.9 Benefit Cost Analysis Overview

A Benefit-Cost Analysis (BCA) is used to validate the cost-effectiveness of a proposed hazard mitigation project. A BCA is a method by which the future benefits of a project are estimated and compared to its cost. The end result is a benefit-cost ratio (BCR), which is derived from a project's total net benefits divided by its total project cost. The BCR is a numerical expression of the cost effectiveness of a project. A project is considered by FEMA to be cost effective when the BCR is 1.0 or greater, indicating the long-term benefits of the project are sufficient to justify the up-front and long-term costs.

A BCA was conducted for the proposed alternatives on East Brook and West Brook. The benefits were summed outside of the BCA program and compared to the costs. The primary limitation to this method is that it neglects the maintenance costs for mitigation projects, which are typically estimated (for example, $500 per year for floodplain bench "maintenance") and assigned a present value by the BCA program. However, the magnitude of the benefits and costs in Walton (discussed below) are so much greater than the present value of maintenance costs that they can be neglected.

Other factors and assumptions for the BCA include the following:

- Benefits for acquired/relocated properties were determined as "acquisitions" in the BCA program. An acquisition benefit is computed by comparing the current condition (flood damage could occur) to a future condition where damage cannot occur because the building has been removed.
- Benefits for all other properties (the majority of those considered) were generated as local flood reduction projects. A local flood reduction benefit is computed by comparing the current condition (flood damage could occur) to a future condition where damage is lower because a mitigation project has been completed.
- Lost revenue was included only for businesses that provided such information.
- Default depth-damage curves were used in the program.
- Existing and future water surface elevations were determined from the HEC-GeoRAS surfaces created for the proposed alternatives.
- First floor elevations were estimated using LiDAR topographic mapping.
- Adjustments to the LiDAR topography were made for buildings based on direct observations of first floors relative to adjacent grades.
- Building replacement values were based on the assessed values and square footages provided by the Delaware County Planning Department's GIS database[7].

For several of the bridges on East and West Brooks, the BCA includes benefits that could have been generated for avoiding future street cleanup, avoided detours, avoided emergency response, avoided utility damage, etc. This report recognizes that the contents of the Kraft

[7] Property appraisals will be needed for any application developed for FEMA mitigation programs.

building and some other buildings may not be well-represented by defaults in the BCA program, but an effort to construct site-specific damage functions was not believed appropriate.

4.10 Benefit Cost Analysis for Individual Property Mitigation

Section 4.9 of this document discusses property-specific flood mitigation through elevations and floodproofing. Many of these projects may be eligible for grants, but cost-effectiveness is required to secure certain grant funds. The FEMA BCA program can be used in a straightforward manner to evaluate BCRs associated with property-specific elevations and floodproofing. The required information includes pertinent land surface and building elevations, the flood elevations published in the FIS and noted on the FIRM, the stream channel elevation published in the FIS, and project costs for elevating or floodproofing buildings.

Like all projects evaluated through BCA, the highest benefits will be generated for projects that reduce flooding from frequent events and infrequent events, as opposed to projects that reduce flooding from only infrequent events. Therefore, higher BCRs will tend to be calculated for the buildings at lower elevations along Delaware Street and side streets.

One potential pathway toward rapid cost effectiveness determination is to utilize the interpretation from FEMA that was effective as of August 15, 2013. Under this relatively new interpretation, acquisitions and elevations are considered cost-effective if the project costs are less than $276,000 and $175,000, respectively. To be eligible for this automatic determination, structures must be located in SFHAs. The figure of $175,000 for a building elevation is likely sufficient for elevating many of the residential buildings in Walton.

Costs for floodproofing of individual non-residential buildings could vary widely in Walton. Consider the following:

- A low door shield costs approximately $1,500[8]. Dewberry[9] reports a range of $500-$1,500 for door gaskets and seals. Fully floodproofed doors can cost more, up to $4,000 per door, but may be excessive given many of the existing door elevations in the downtown area.

- Dewberry reports a range of $500-$1,500 to elevate an electrical service and meter, a range of $500-$1,500 to floodproof electrical service and meter, a range of $500-$1,500 to elevate HVAC equipment, and a range of $500-$1,500 (and up) to floodproof HVAC equipment. FEMA reports a range of $1,500-$2,000 to include outlets and switches in the elevation of electric service and meter in a house. Given the uncertainty related to actions that business owners may choose, a range of $1,500-$2,000 is reasonable for all utility-related costs.

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[8] Typical vendor "PS Doors" (http://www.psdoors.com/)

[9] http://www.sbidc.org/documents/RedHookCaseStudyFindingsReportFINAL.pdf

Total costs to retrofit a single business to make it more flood-resilient in the long term are rarely reported in the literature. In the New York Rising Community Reconstruction Plan[10] for the Red Hook section of Brooklyn, New York, total cost estimates per small business in this close-knit community ranged from $6,000 to $50,000 for implementing a variety of floodproofing measures. Given the number of doors, openings, and utilities associated with some of the businesses in Walton, this range may be reasonable for a group of buildings along Delaware Street.

[10] http://stormrecovery.ny.gov/sites/default/files/crp/community/documents/redhook_nyrcr_plan_20mb_0.pdf

5.0 EAST BROOK FLOOD MITIGATION ALTERNATIVES AND BCA

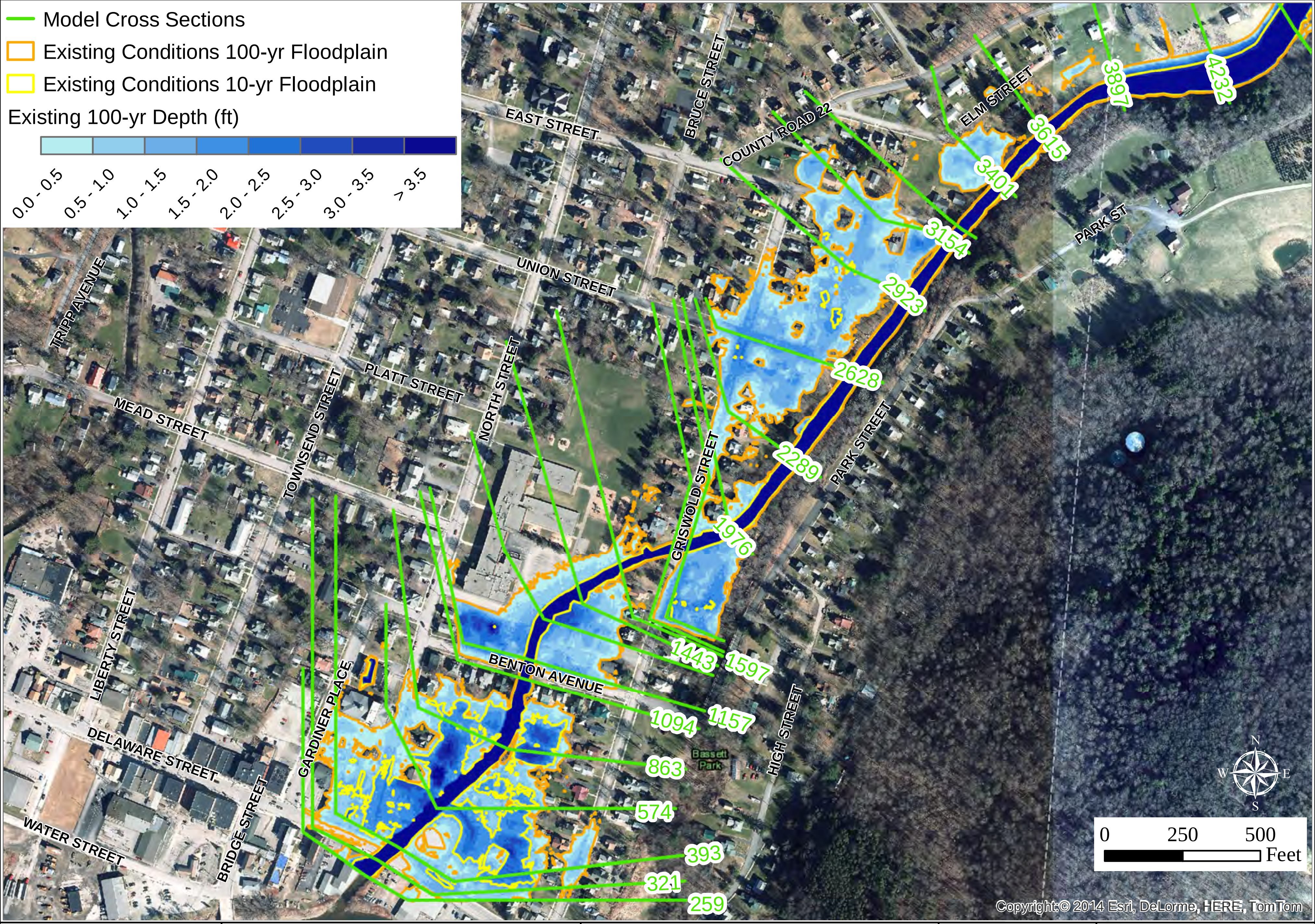
This chapter focuses specifically on the alternatives analysis and benefit cost analysis results for East Brook.

5.1 East Brook Mitigation Alternatives

Hydraulic analysis was completed for East Brook to identify possible mitigation alternatives. Alternatives presented have been selected due to their flood reduction benefit. Additional alternatives or slight variations to the presented alternatives have been tested during evaluation. Existing depth mapping has been provided as a baseline comparison for evaluation of presented alternatives (Figure 5-1).

Some 2006 storm flood paths were not reflected in the existing conditions 100-year flood model results. Specifically, flooding occurred at the school upstream of the Benton Avenue bridge and also where water exited the channel upstream of Griswold Street and flowed along the road. This is partially because the 2006 flood was larger than the 100-year flood. Also, because the modeling assumes clear flow at the bridge, with no obstructions. This is consistent with FEMA guidelines and typical modeling practice. During the 2006 flood the bridge openings could have easily became blocked with debris, reducing flow through the bridges and forcing more water out and onto the roads and adjacent properties. Modeling was completed to simulate this debris blocked situation. The Benton Avenue and Griswold Street bridge openings were blocked with 2.5 feet of sediment and debris, causing the water surface elevation upstream of the bridges to go up. Under this condition the downstream end of the school would be flooded and water could have left the channel at Griswold Street and flowed across the school field and hit the building.

As a first trial, modeling was completed with all of the bridges removed to see the effect of the structures on upstream flooding. Flood reduction benefits extended only a short distance upstream of bridges and never as far upstream as the next bridge, demonstrating a spatial modularity of options but also suggesting the need for a combination of bridge, channel, and floodplain improvements to maximize flood risk reduction.



SOURCE(S):

NYSDOP
MMI HECRAS

N

FIG 5-1: EXISTING CONDITIONS NO BACKWATER DEPTH MAPPING

MXD: Y:\5197-06\Maps\Report Figures\Fig 5-1 EXISTING-Combo1-ndepth_Depth.mxd

LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By:	JCL
MMI#:	5197-06
Original:	9/28/2015
Revision:	9/8/2017
Scale:	1 in = 400 ft

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5.1.1 East Brook Alternatives # 1 & 2 – Delaware Street Bridge (STA 0+00 to STA 1120+00)

The current bridge over the East Brook is 42 feet wide, with a 20% skew to the river. This bridge overtops for all storms greater than the 25-year recurrence interval. MMI modeled a wider bridge, maximizing the capacity of the bridge, while minimizing the impact to surrounding buildings. Alternative #1 is a 110 foot span replacement bridge with one pier that would require removal of the commercial building at Top Dog on the upstream right bank of the bridge and creation of a floodplain in the Breakey Motors parking area downstream on the left bank. Alternative #2 includes the replacement bridge modeled with a restored floodplain corridor (FP4) between the confluence with the West Branch and Benton Avenue. Creation of the floodplain would require removal of two homes on the downstream side of Benton Avenue. The FP4 Floodplain is approximately 1,120 feet long with a width that varies between 90 and 120 feet depending on local constraints. Table 5-1 provides water surface elevations at cross sections upstream and downstream of the bridge. Figures 5-2 and 5-3 depict the Delaware Street alternatives.

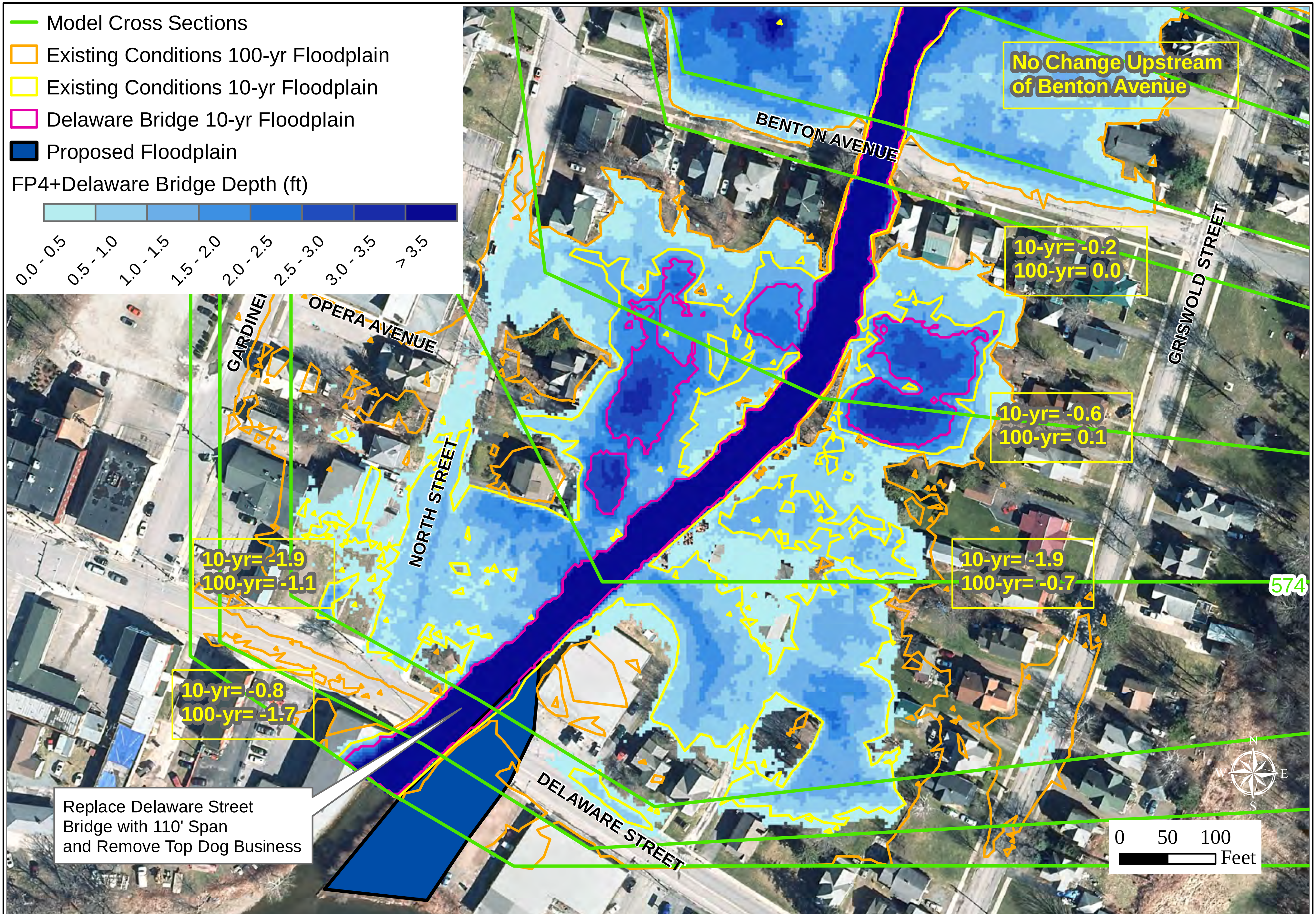
TABLE 5-1
Comparison of Water Surface Elevations near Delaware Street (100-Year)
[feet NAVD88]

River Station	Location	Existing Conditions	Alt. 1	Net Change Alt. 1	Alt. 2	Net Change Alt. 2
1157	St John Baptist Church	1214.5	1214.5	0.0	1214.5	0.0
1127	Benton Avenue Bridge					
1094	Residential	1211.0	1211.0	0.0	1210.5	-0.5
863	Business and Residential	1210.7	1210.8	0.1	1210.0	-0.7
574	McAdams Lawnmower	1210.1	1209.3	-0.7	1209.0	-1.0
393	NAPA, Top Dog	1209.7	1208.7	-1.1	1208.7	-1.1
351	Delaware Street Bridge					
321	Brandow's Feed & Seed	1208.5	1206.9	-1.6	1206.9	-1.6
259	Brandow's Feed & Seed	1208.1	1206.4	-1.7	1206.4	-1.7

Modeling demonstrated the following:

- Replacing the bridge reduces upstream water surface elevations.
- Floodplain creation reduces downstream water surface elevation and further reduces upstream water surface elevations.
- It is clear from Table 5-1 that water surface reductions do not extend upstream to Benton Avenue.
- Backwater conditions from the West Branch reduce the effectiveness of this alternative when the West Branch is flooding.

NAPA auto parts is an example of a property on Delaware Street that benefits most from bridge replacement. The water surface elevation was reduced 1.9 feet for the 10-year flood and 1.1 feet for the 100-year flood when not backwatered by the WBDR.



SOURCE(S):

NYSDOP
MMI HECRAS

N

FIG. 5-2: DELAWARE REPLACEMENT NO BACKWATER DEPTH MAPPING

MXD: Y:\5197-06\Maps\Report Figures\Fig 5-2 Delaware - 110NDepth.mxd

LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By:	JCL
MMI#:	5197-06
Original:	9/28/2015
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Scale:	1 in = 129 ft

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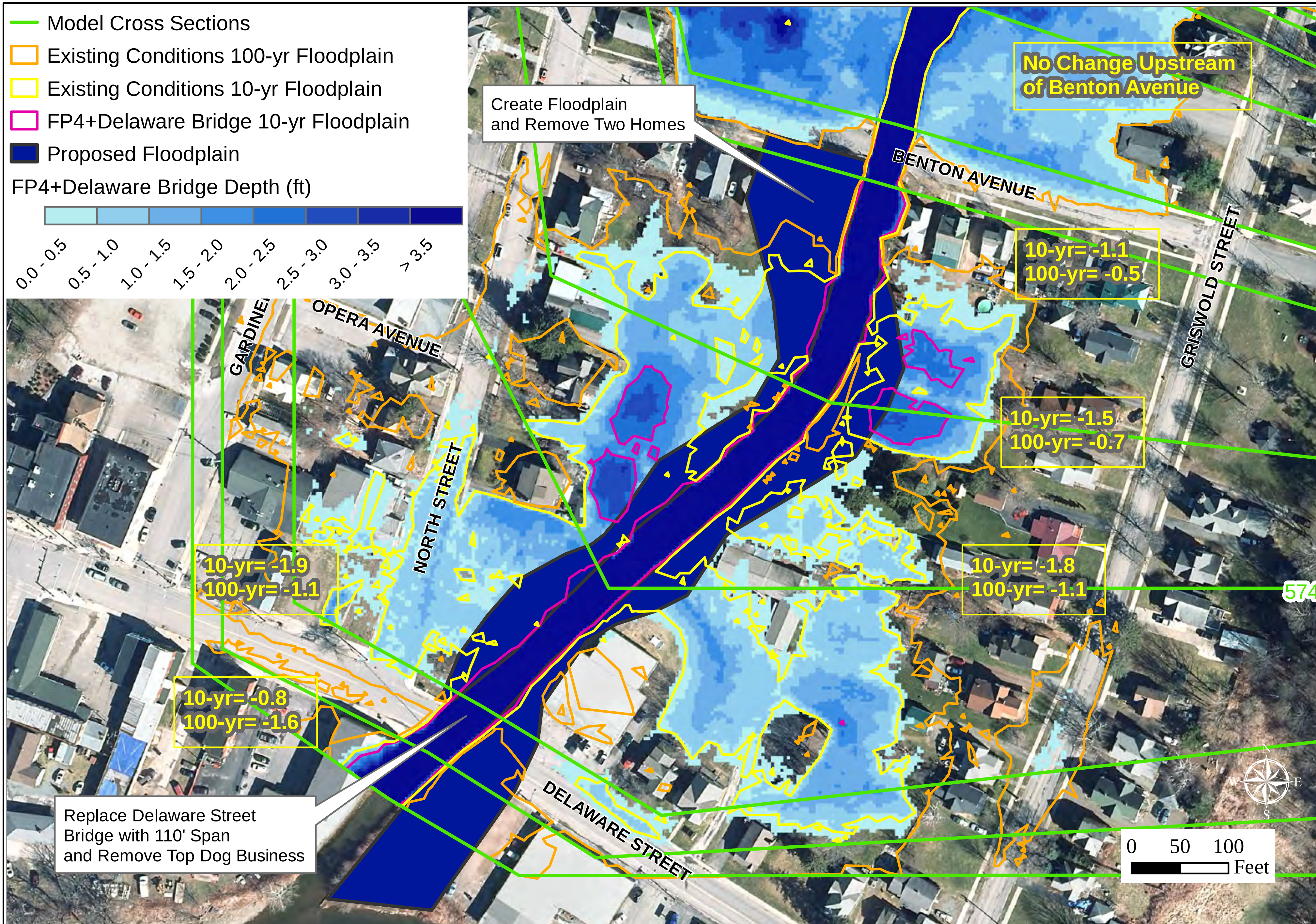

SOURCE(S):

NYSDOP
MMI HECRAS

N

FIG. 5-3: FP4 + DELAWARE REPLACEMENT NO BACKWATER DEPTH MAPPING

MXD: Y:\5197-06\Maps\Report Figures\Fig 5-3 FP4+110Delaware_Depth.mxd

LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By:	JCL
MMI#:	5197-06
Original:	9/28/2015
Revision:	9/13/2017
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5.1.2 East Brook Alternatives # 3, 4, 5, & 6 – Benton Avenue Bridge (STA 863+00 to STA 1765+00)

The current Benton Avenue bridge over East Brook is 35 feet wide and overtops for all storms greater than the 10-year recurrence interval. MMI modeled a wider bridge, maximizing the capacity of the bridge, while minimizing the impact to surrounding buildings. Bridge spans of 90 (requiring removal of 2 homes) and 120 feet (requiring removal of 4 homes) were tested, each with and without floodplain restoration (FP1) at the upstream elementary school property. Creation of the FP1 floodplain would require lowering the elevation of a portion of the school parking and widening the channel to bankfull width. Table 5-2 provides water surface elevations at cross sections upstream and downstream of the bridge. Figures 5-4 to 5-7 depicts the Benton Avenue alternatives.

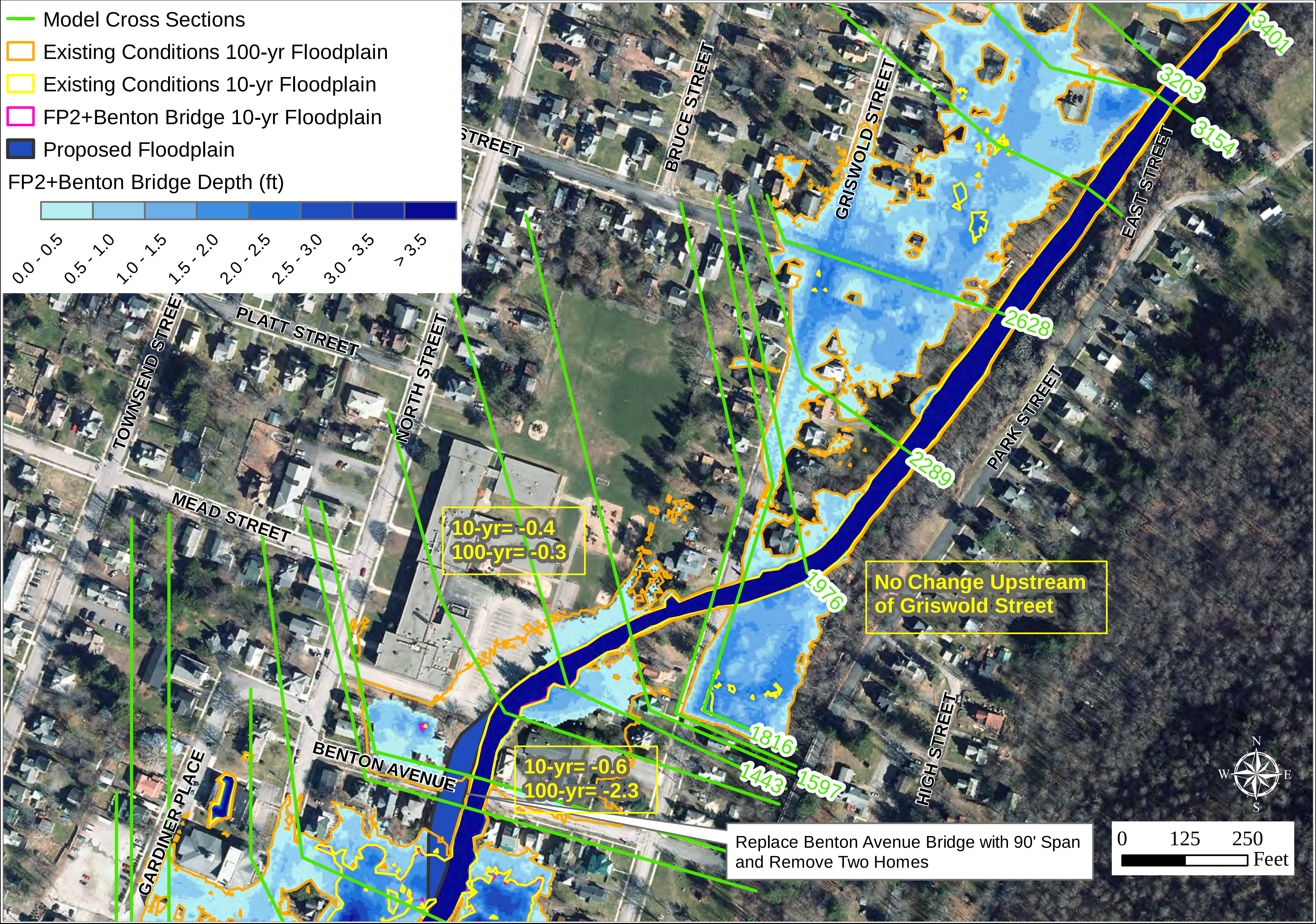
TABLE 5-2
Comparison of Water Surface Elevations near Benton Avenue (100-Year)
[feet NAVD88]

River Station	Location	Existing Conditions	Net Change Alt. 3 (90' Bridge)	Net Change Alt. 4 (90' + FP1)	Net Change Alt. 5 (120' Bridge)	Net Change Alt. 6 (120' + FP1)
1816	Homes on Griswold	1219.6	0.0	0.0	0.0	0.0
1789	Griswold Street Bridge		0.0	0.0	0.0	0.0
1765	Home on Griswold	1216.1	-0.1	-0.1	0.0	-0.1
1597	School Fields, Homes	1215.7	-0.1	-2.1	-0.1	-2.8
1443	Elementary School	1215.3	-0.3	-1.6	-0.2	-2.5
1302	Elementary School	1215.1	-2.3	-1.6	-3.7	-3.5
1157	St John Baptist Church	1214.5	-1.5	-1.5	-3.2	-3.2
1127	Benton Avenue Bridge		0.0	0.0	0.0	0
1094	Residential	1211.0	0.3	0.3	0.3	0.28
863	Business and Residential	1210.7	0.0	0.0	0.0	0

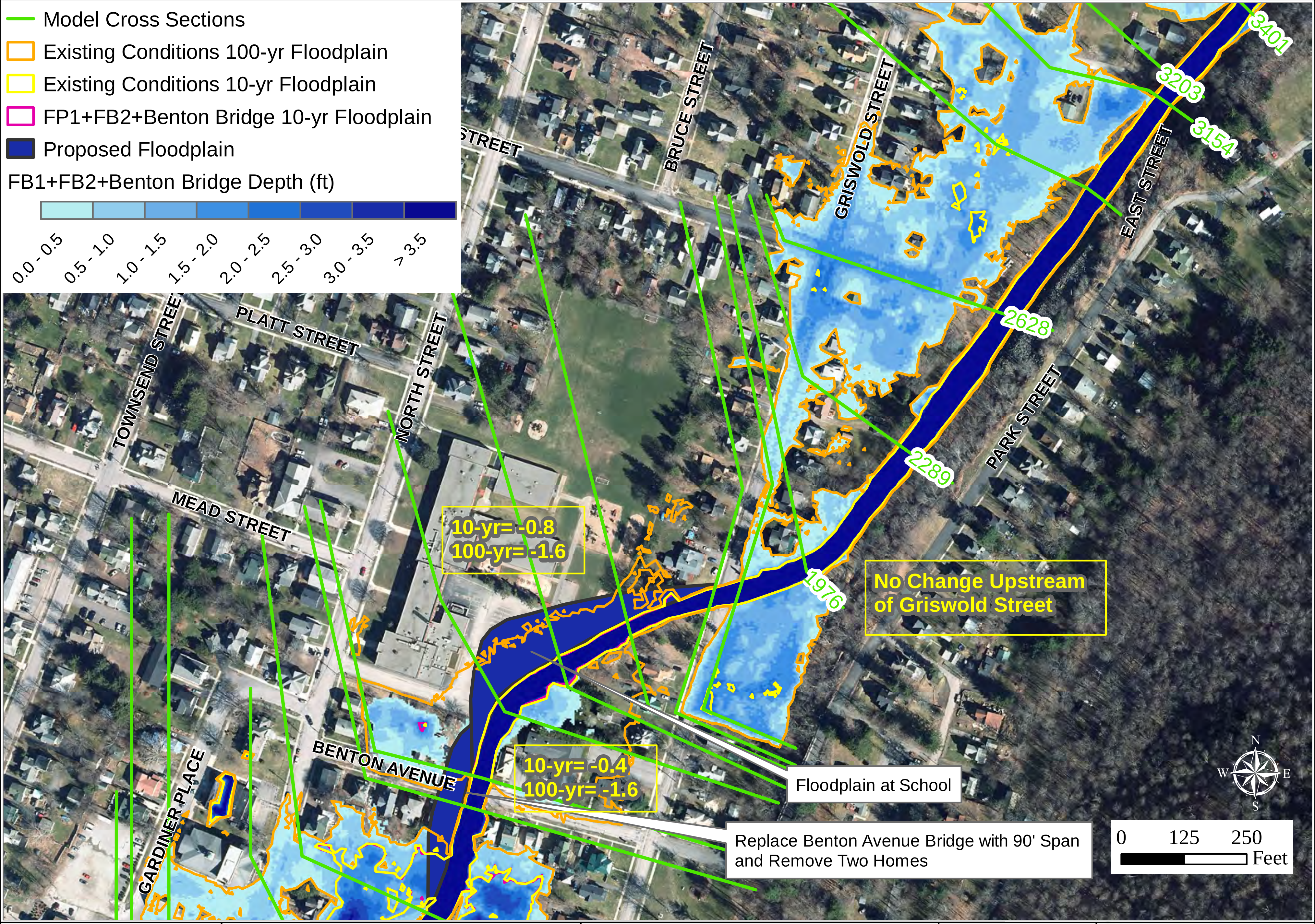
Modeling demonstrated the following:

- Replacing the bridge reduces upstream water surface elevations.
- Floodplain creation further reduces upstream water surface elevations.
- Alternative #6 with the larger bridge and floodplain restoration has the largest and most consistent benefits.
- It is clear from Table 5-2 that water surface reductions do not extend upstream to Griswold Street.

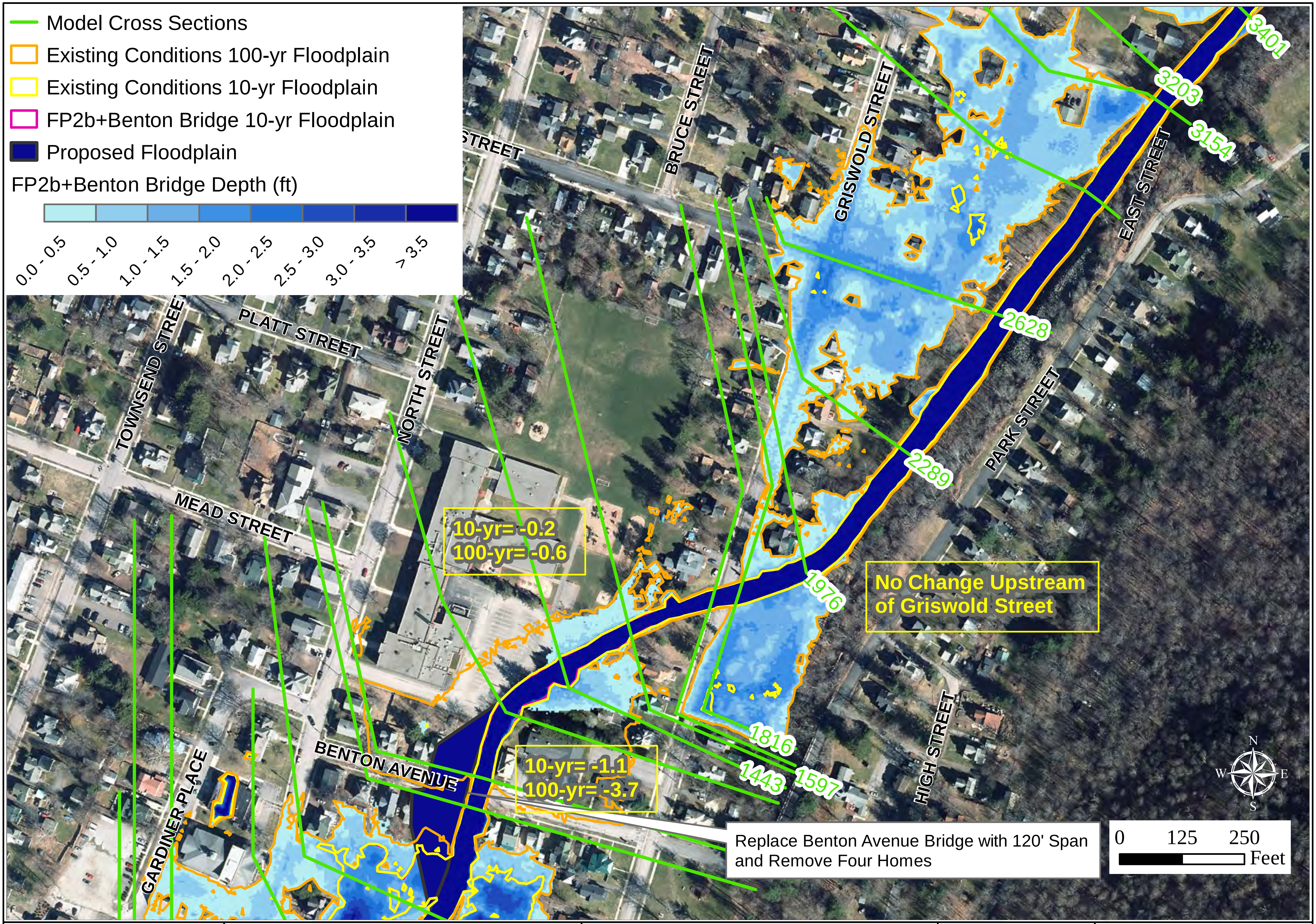
The Elementary School is an example of a property that benefits most from bridge replacement. For alternative #6 water surface elevation was reduced 1.0 feet for the 10-year flood and 3.5 feet for the 100-year flood.



SOURCE(S):	FIG. 5-4: FP2 + BENTON REPLACEMENT DEPTH MAPPING	LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES	Map By: JCL	MILONE & MACBROOM
NYSDOP MMI HECRAS	MXD: Y:\5197-06\Maps\Report Figures\Fig 5-4 FP2+90Benton_Depth.mxd	LOCATION: WALTON, DELAWARE COUNTY, NY	MMI#: 5197-06 Original: 9/13/2017 Revision: 9/13/2017 Scale: 1 in = 248 ft	99 Realty Drive Cheshire, CT 06410 (203) 271-1773 Fax: (203) 272-9733 www.miloneandmacbroom.com



SOURCE(S):	FIG. 5-5: FP1 + FP2 + BENTON REPLACEMENT DEPTH MAPPING	LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES	Map By: JCL	MILONE & MACBROOM
NYSDOP MMI HECRAS	MXD: Y:\5197-06\Maps\Report Figures\Fig 5-5 FP1+FP2+90Benton_Depth.mxd	LOCATION: WALTON, DELAWARE COUNTY, NY	MMI#: 5197-06 Original: 9/13/2017 Revision: 9/13/2017 Scale: 1 in = 248 ft	99 Realty Drive Cheshire, CT 06410 (203) 271-1773 Fax: (203) 272-9733 www.miloneandmacbroom.com



SOURCE(S):

NYSDOP
MMI HECRAS

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FIG. 5-6: FP2b + BENTON REPLACEMENT (120') DEPTH MAPPING

MXD: Y:\5197-06\Maps\Report Figures\Fig 5-6 FP2b+120Benton_Depth.mxd

LOCAL FLOOD ANALYSIS
WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By:	JCL
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Original:	9/24/2015
Revision:	9/19/2017
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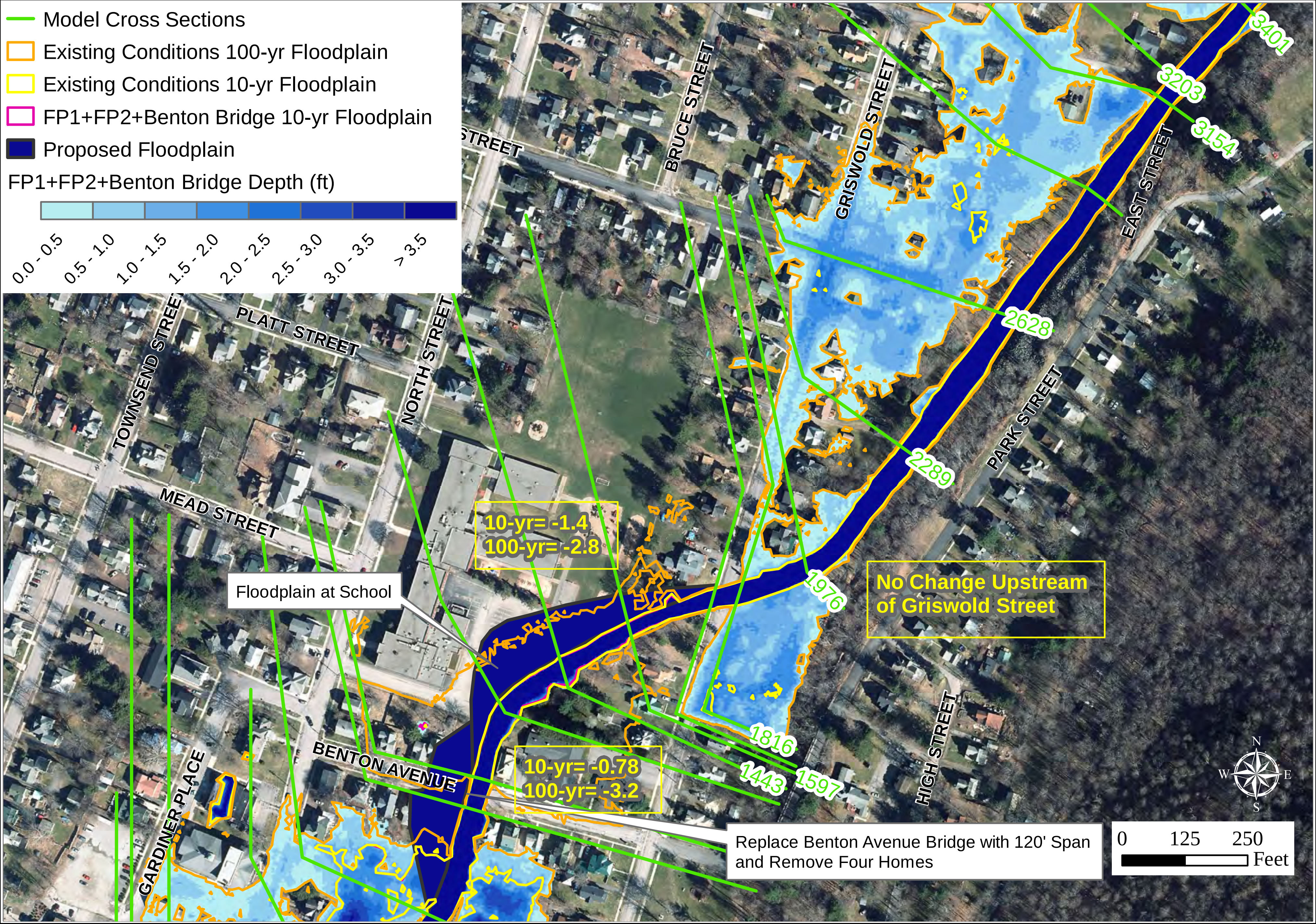

SOURCE(S):

NYSDOP
MMI HECRAS

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FIG. 5-7: FP1 + FP2 + BENTON REPLACEMENT (120') DEPTH MAPPING

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LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

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5.1.3 East Brook Alternatives # 7 & 8 – Benton Avenue Bridge (STA 863+00 to STA 1765+00)

As an alternative to replacement presented in the previous subsection, MMI modeled removal without replacement of the Benton Avenue bridge with and without floodplain restoration (FP1) at the upstream elementary school property. Removal of bridge includes widening channel to bankfull width and no removal of homes. Creation of the floodplain would require lowering the elevation of a portion of the school parking and widening the channel to bankfull width. Table 5-3 provide water surface elevations at cross sections upstream and downstream of the bridge. Figures 5-8 and 5-9 depict the Benton Avenue alternatives.

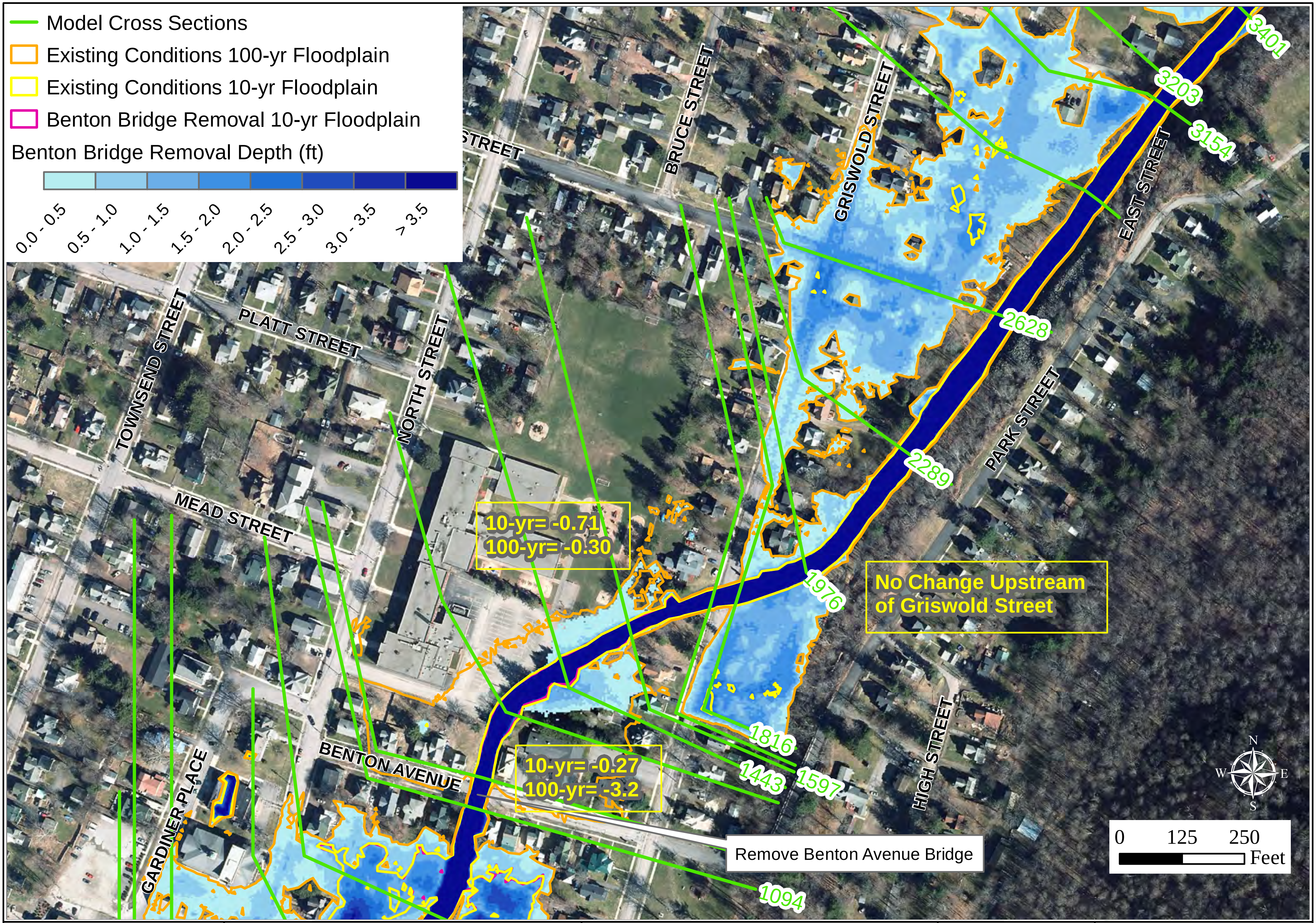
TABLE 5-3
Comparison of Water Surface Elevations near Benton Avenue (100-Year)
[feet NAVD88]

River Station	Location	Existing Conditions	Alt. 7 (No Bridge)	Net Change Alt. 7 (No Bridge)	Alt. 8 (No Bridge + FP1)	Net Change Alt. 8 (No Bridge + FP1)
1816	Homes on Griswold	1219.6	1219.6	0.0	1219.6	0.0
1789	Griswold Street Bridge			0.0		0.0
1765	Home on Griswold	1216.1	1216.0	-0.1	1215.9	-0.1
1597	School Fields, Homes	1215.7	1215.6	-0.1	1213.3	-2.4
1443	Elementary School	1215.3	1215.0	-0.3	1213.3	-1.9
1302	Elementary School	1215.1	1211.6	-3.4	1213.0	-2.1
1157	St John Baptist Church	1214.5	1211.4	-3.2	1211.4	-3.2
1127	Benton Avenue Bridge			0.0		0.0
1094	Residential	1211.0	1211.0	0.0	1211.0	0.0
863	Business and Residential	1210.7	1210.7	0.0	1210.7	0.0

Modeling demonstrated the following:

- Removing the bridge reduces upstream water surface elevations without causing increases in water surface elevation downstream.
- Floodplain creation further reduces the extent of upstream water surface elevation reductions.
- Alternative #8 including the floodplain restoration has increased flood reduction benefits relative to only removing the bridge.
- However, Alternative #8 has lesser flood benefits as compared to Alternative #6 that includes removal of four homes and replacement of the bridge.

The church is an example of a property that benefits most from bridge removal. For alternative #8 water surface elevation was reduced 1.2 feet for the 10-year flood and 3.2 feet for the 100-year flood.



SOURCE(S):

NYSDOP
MMI HECRAS

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FIG. 5-8: BENTON REMOVAL AND NO REPLACEMENT DEPTH MAPPING

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LOCAL FLOOD ANALYSIS
WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By: JCL
MMI#: 5197-06
Original: 9/24/2015
Revision: 9/19/2017
Scale: 1 in = 248 ft

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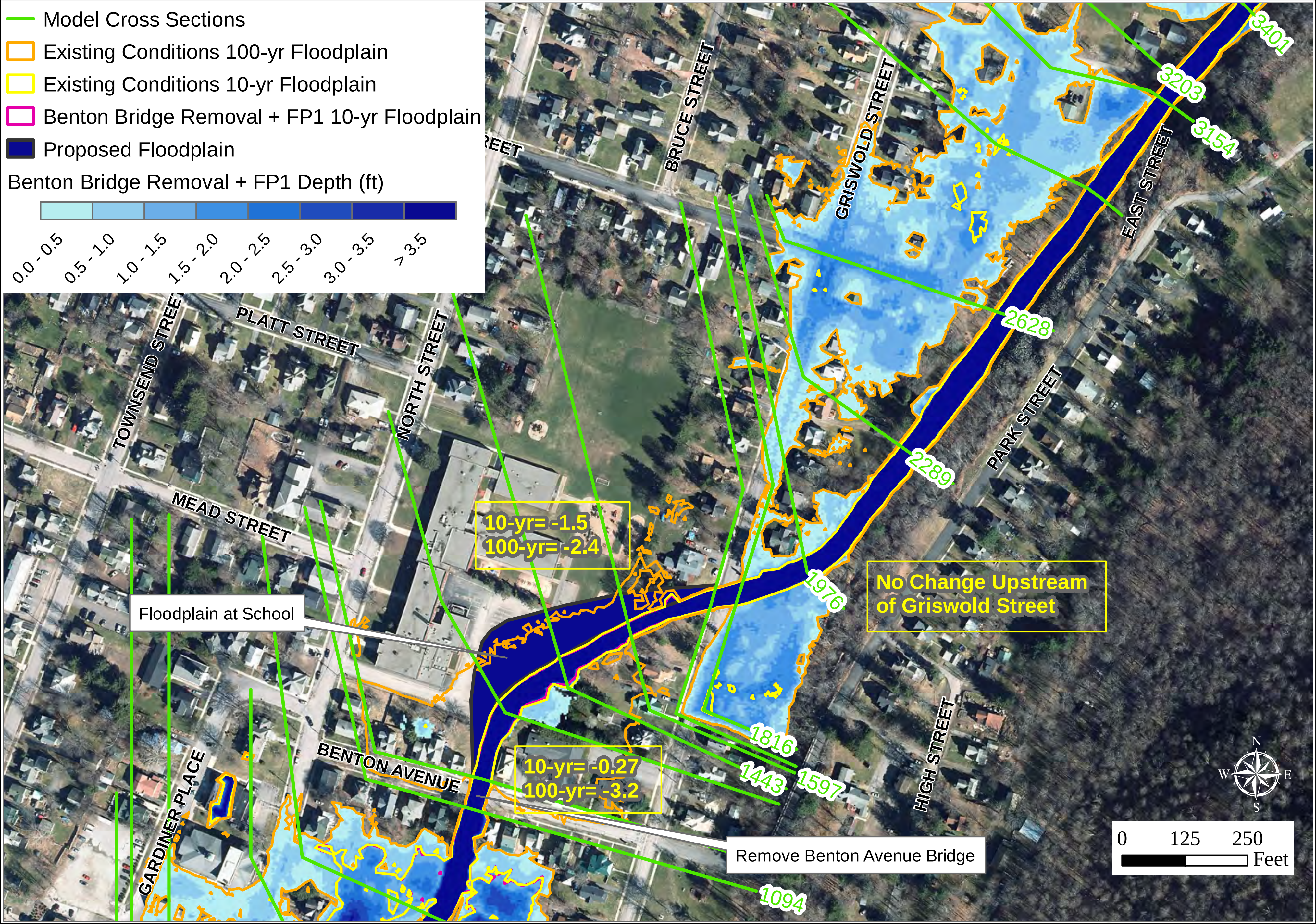


SOURCE(S):	FIG. 5-9: BENTON REMOVAL AND NO REPLACEMENT + FP1 DEPTH MAPPING	LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES	Map By: JCL	MILONE & MACBROOM
NYSDOP MMI HECRAS	MXD: Y:\5197-06\Maps\Report Figures\Fig 5-9 FP1+Benton Removal Depth.mxd	LOCATION: WALTON, DELAWARE COUNTY, NY	MMI#: 5197-06 Original: 9/24/2015 Revision: 9/19/2017 Scale: 1 in = 248 ft	99 Realty Drive Cheshire, CT 06410 (203) 271-1773 Fax: (203) 272-9733 www.miloneandmacbroom.com

5.1.4 East Brook Alternatives # 9 & 10 – Griswold Street Bridge (STA 1765+00 to STA 3900+00)

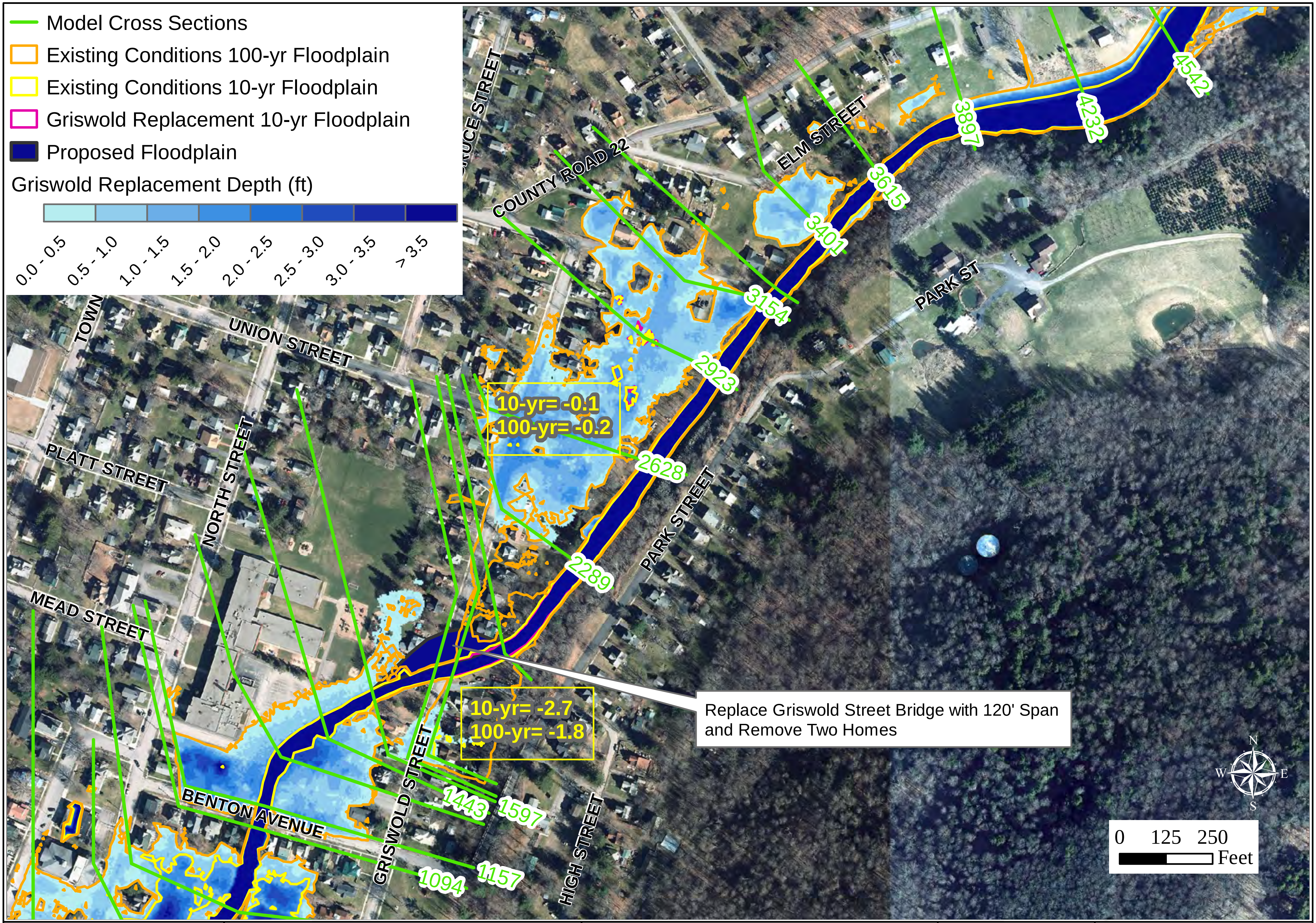
The current Griswold Street bridge over East Brook is 40 feet wide, with a 30% skew to the river. This bridge overtops for all storms greater than the 10-year recurrence interval. MMI modeled a wider bridge, maximizing the capacity of the bridge, while minimizing the impact to surrounding buildings. Alternative #9 is a 120 foot span replacement bridge that would require removal of two homes. Alternative #10 includes the replacement bridge modeled with a restored floodplain corridor (FP3) between Griswold Street and the existing floodplain restoration project near Elm Street. Creation of the FP3 floodplain would require removal of four accessory buildings. The FP3 floodplain is approximately 2,100 feet long with a width of 120 feet. Table 5-4 provides water surface elevations at cross sections upstream and downstream of the bridge. Figures 5-10 and 5-11 depict the Griswold Street alternatives.

TABLE 5-4
Comparison of Water Surface Elevations near Griswold Street (100-Year)
[feet NAVD88]

River Station	Location	Existing Conditions	Alt. 9	Net Change Alt. 9	Alt. 10	Net Change Alt. 10
3897	East Brook Road	1234.7	1234.7	0.0	1233.9	-0.9
3615	Elm Street	1231.7	1231.7	0.0	1231.1	-0.6
3401	Brook Street	1231.3	1231.3	0.0	1229.4	-1.9
3203	Upstream East Street	1229.1	1229.1	0.0	1228.2	-0.9
3154	Downstream East Street	1229.5	1229.5	0.0	1227.2	-2.3
2923		1226.6	1226.6	0.0	1226.0	-0.6
2628	Union Street	1224.5	1224.3	-0.2	1222.6	-1.9
2289		1221.3	1221.7	0.4	1219.1	-2.2
1976		1219.8	1217.0	-2.8	1217.9	-1.8
1816	Homes on Griswold	1219.6	1217.8	-1.8	1217.8	-1.8
1789	Griswold Street Bridge			0.0		0.0
1765	Homes on Griswold	1216.1	1217.2	1.2	1217.2	1.2

Modeling demonstrated the following:

- Replacing the bridge reduces upstream water surface elevations, but increases downstream water surface elevations unless paired with downstream floodplain restoration.
- Floodplain creation further reduces upstream water surface elevations.
- When the bridge replacement is combined with upstream floodplain creation, flood waters are contained within the channel and new floodplain in almost all locations except some shallow flooding in backyards not impacting any structures.



SOURCE(S):

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FIG. 5-10: GRISWOLD BRIDGE REPLACEMENT DEPTH MAPPING

MXD: Y:\5197-06\Maps\Report Figures\Fig 5-10 Griswold120_Depth.mxd

LOCAL FLOOD ANALYSIS
WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By: JCL
MMI#: 5197-06
Original: 9/2/2015
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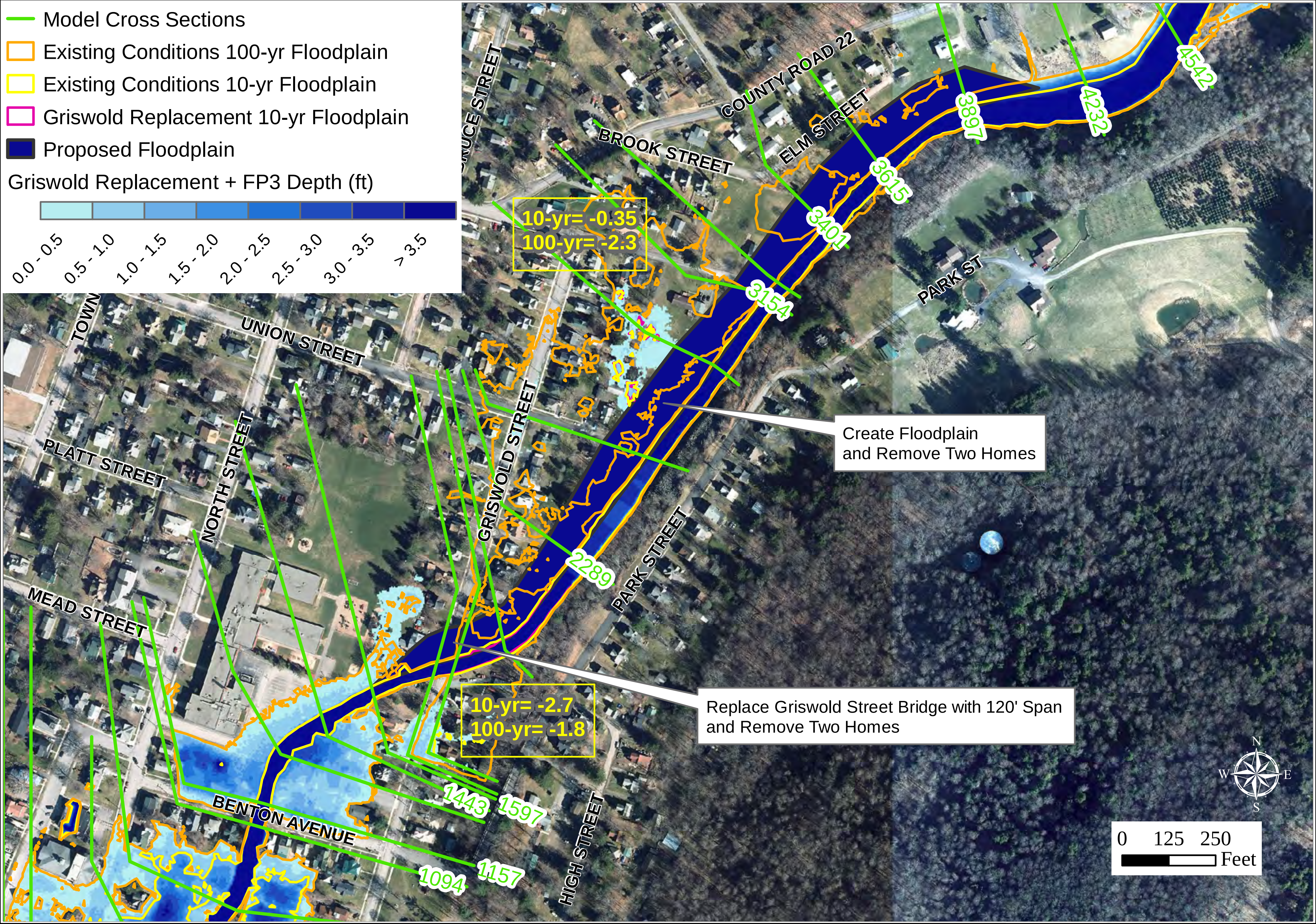

SOURCE(S): NYSDOP MMI HECRAS	FIG. 5-11: GRISWOLD BRIDGE REPLACEMENT + FP3 DEPTH MAPPING MXD: Y:\5197-06\Maps\Report Figures\Fig 5-11 FP3 + Griswold120_Depth.mxd	LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES LOCATION: WALTON, DELAWARE COUNTY, NY	Map By: JCL MMI#: 5197-06 Original: 9/2/2015 Revision: 9/20/2017 Scale: 1 in = 333 ft

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5.1.5 East Brook Combination of Alternatives

A combination of the previously presented alternatives has been provided to show the benefits of these alternatives when combined.

Combination 1 includes:

- Alternative 1: Replace Delaware Street Bridge with 110 foot span
- Alternative 2: Floodplain (FP4) between Delaware and Benton Streets
- Alternative 5: Replace Benton Avenue Bridge with 120 foot span
- Alternative 6: Floodplain (FP1) at school
- Alternative 9: Replace Griswold Street Bridge with 120 foot span
- Alternative 10: Floodplain (FP3) between Griswold Street Bridge and 2013 DCSWCD Floodplain

Combination 2 includes:

- Alternative 1: Replace Delaware Street Bridge with 110 foot span
- Alternative 2: Floodplain (FP4) between Delaware and Benton Streets
- Alternative 7: Remove Benton Avenue Bridge
- Alternative 8: Floodplain (FP1) at school
- Alternative 9: Replace Griswold Street Bridge with 120 foot span
- Alternative 10: Floodplain (FP3) between Griswold Street Bridge and 2013 DCSWCD Floodplain

In some locations there are additive benefits from backwater eliminated by implementing downstream alternatives. Tables 5-5 and 5-6 provide water surface elevations along East Brook for both the 10-year and 100-year flood events. Figure 5-12 shows existing conditions depths for easy comparison to the flood depths associated with the combined alternatives shown in Figures 5-13 and 5-14.

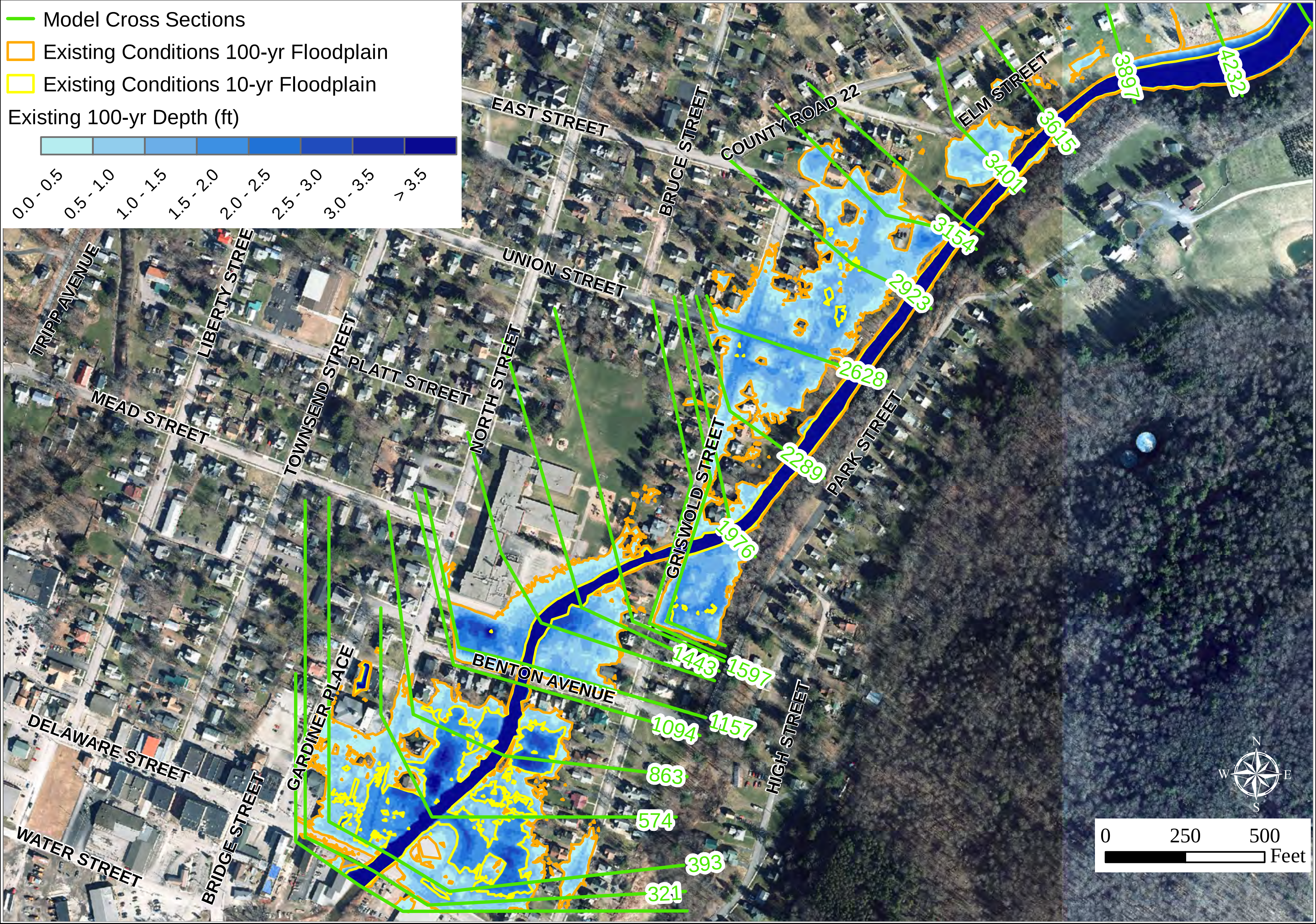
Modeled results assume a normal depth downstream boundary conditions, as though the West Branch of the Delaware River is not flooding. The backwater from the West Branch will reduce the effectiveness of the alternatives, especially at the downstream end of the model area at the confluence. The effect of backwatering from West Branch is limited to the area downstream of Benton Street, with no effects of backwatering from the mainstem seen upstream of Benton Street Bridge for the 100-year flood. During the 10-year storm the backwatering from the mainstem extends upstream of the Benton Street bridge because the bridge opening is full and changes the bridge hydraulics. It is important to note that FEMA also used a normal depth downstream boundary condition in their modeling of East Brook, and therefore the LFA methodology is consistent.

TABLE 5-5
Comparison of Water Surface Elevations along East Brook (10-year)
[feet NAVD88]

River Station	Location	Existing Condition	Combo 1	Net Change (Combo 1)	Combo 2	Net Change (Combo 2)
4542		1238.8	1238.8	0.0	1238.8	0.0
4232		1235.7	1235.7	0.0	1235.7	0.0
3897	East Brook Road	1232.5	1232.4	-0.1	1232.4	-0.1
3615	Elm Street	1230.4	1229.9	-0.4	1229.9	-0.4
3401	Brook Street	1228.4	1227.7	-0.8	1227.7	-0.8
3203	Upstream East Street	1227.5	1226.7	-0.8	1226.7	-0.8
3154	Downstream East Street	1226.5	1226.2	-0.3	1226.2	-0.3
2923		1225.3	1224.6	-0.7	1224.6	-0.7
2628	Union Street	1222.2	1221.4	-0.8	1221.4	-0.8
2289		1218.9	1218.0	-1.0	1218.0	-1.0
1976		1217.9	1214.8	-3.1	1214.9	-3.1
1816	Homes on Griswold	1217.4	1214.2	-3.2	1214.2	-3.2
1789	Griswold Street Bridge			0.0		0.0
1765	Homes on Griswold	1213.8	1213.4	-0.3	1213.4	-0.3
1597	School Fields, Homes	1213.1	1211.5	-1.6	1211.5	-1.6
1443	Elementary School	1212.4	1210.8	-1.5	1210.6	-1.8
1302	Elementary School	1211.7	1210.0	-1.7	1209.3	-2.4
1157	St John Baptist Church	1210.5	1209.8	-0.7	1209.0	-1.5
1127	Benton Avenue Bridge			0.0		0.0
1094	Residential	1210.1	1209.0	-1.1	1209.0	-1.2
863	Business and Residential	1209.5	1208.0	-1.5	1208.0	-1.5
574	McAdams Lawnmower	1208.8	1207.0	-1.8	1207.0	-1.8
393	NAPA, Top Dog	1208.4	1206.5	-1.9	1206.5	-1.9
351	Delaware Street Bridge			0.0		0.0
321	Brandow's Feed & Seed	1206.4	1205.6	-0.8	1205.6	-0.8
259	Brandow's Feed & Seed	1205.8	1204.9	-0.8	1204.9	-0.8

TABLE 5-6
Comparison of Water Surface Elevations along East Brook (100-year)
[feet NAVD88]

River Station	Location	Existing Condition	Combo 1	Net Change (Combo 1)	Combo 2	Net Change (Combo 2)
4542		1240.2	1240.2	0.0	1240.2	0.0
4232		1237.0	1236.9	0.0	1236.9	0.0
3897	East Brook Road	1234.7	1233.9	-0.9	1233.9	-0.9
3615	Elm Street	1231.7	1231.1	-0.6	1231.1	-0.6
3401	Brook Street	1231.3	1229.4	-1.9	1229.4	-1.9
3203	Upstream East Street	1229.1	1228.2	-0.9	1228.2	-0.9
3154	Downstream East Street	1229.5	1227.2	-2.3	1227.2	-2.3
2923		1226.6	1226.0	-0.6	1226.0	-0.6
2628	Union Street	1224.5	1222.6	-1.9	1222.6	-1.9
2289		1221.3	1219.1	-2.2	1219.1	-2.2
1976		1219.8	1217.1	-2.7	1217.1	-2.7
1816	Homes on Griswold	1219.6	1216.8	-2.8	1216.8	-2.8
1789	Griswold Street Bridge			0.0		0.0
1765	Homes on Griswold	1216.1	1215.4	-0.7	1215.4	-0.7
1597	School Fields, Homes	1215.7	1212.9	-2.8	1212.9	-2.8
1443	Elementary School	1215.3	1212.7	-2.5	1212.8	-2.5
1302	Elementary School	1215.1	1211.5	-3.6	1211.1	-3.9
1157	St John Baptist Church	1214.5	1211.3	-3.3	1210.5	-4.1
1127	Benton Avenue Bridge			0.0		0.0
1094	Residential	1211.0	1210.5	-0.5	1210.5	-0.6
863	Business and Residential	1210.7	1210.0	-0.7	1210.0	-0.7
574	McAdams Lawnmower	1210.1	1209.0	-1.0	1209.0	-1.0
393	NAPA, Top Dog	1209.7	1208.7	-1.1	1208.7	-1.1
351	Delaware Street Bridge			0.0		0.0
321	Brandow's Feed & Seed	1208.5	1206.9	-1.6	1206.9	-1.6
259	Brandow's Feed & Seed	1208.1	1206.4	-1.7	1206.4	-1.7



SOURCE(S):

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FIG. 5-12: EXISTING CONDITIONS NO BACKWATER DEPTH MAPPING

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LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By:	JCL
MMI#:	5197-06
Original:	9/28/2015
Revision:	9/21/2017
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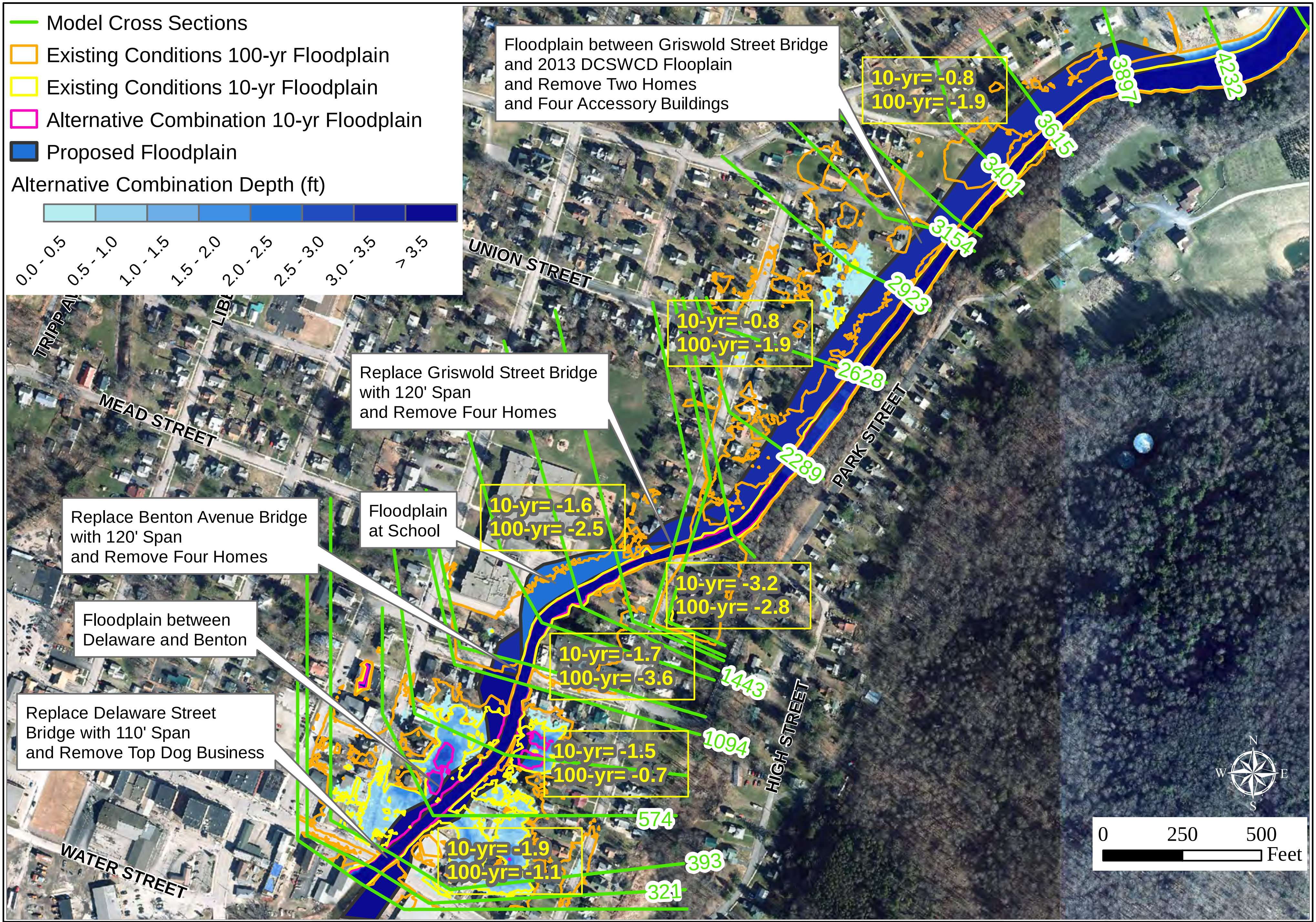

SOURCE(S):

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FIG. 5-13: EAST BROOK COMBINATION 1 NO BACKWATER DEPTH MAPPING

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LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

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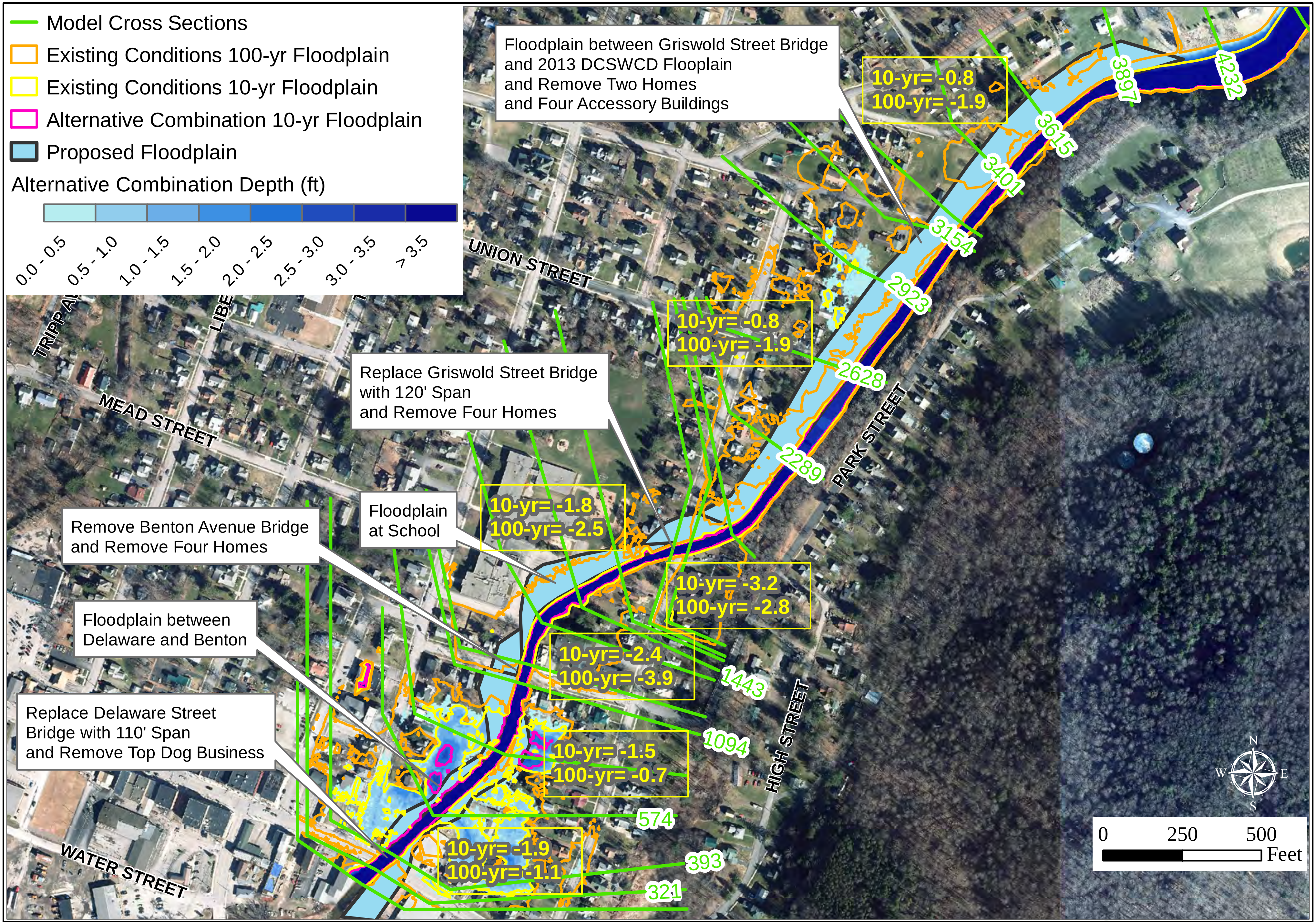

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FIG. 5-14: EAST BROOK COMBINATION 2 DEPTH GRID MAPPING

MXD: Y:\5197-06\Maps\Report Figures\Fig 5-14 Combo2-ndepth_Depth.mxd

LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

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5.2 East Brook Benefit Cost Analysis

5.2.1 Property Acquisitions

The first step of the benefits generation was to determine the benefits associated with the act of removing buildings that are located where bridge removals or floodplain enhancements require earthwork. These buildings possess flood risk and therefore their removal equates to benefits associated with elimination of flood risk. The buildings listed in Table 5-7 are those that would need to be removed in conjunction with the floodplain enhancement projects.

TABLE 5-7
Benefits Provided by Acquisitions/Relocations

Alternative	Description	Potential Property Acquisitions / Relocations	Individual Property Acquisition Benefits	Total Building Acquisition Benefits
1	Delaware Street bridge replacement and remove one business	2 North Street	$172,245	$172,245
2	Delaware Street bridge replacement and floodplain bench (FP4)	10-12 Benton Avenue	$146,077	$461,978
		14 Benton Avenue	$143,656	
		2 North Street	$172,245	
3	Benton Ave bridge replacement (90') and remove 2 homes	13 Benton Avenue	$151,030	$294,686
		14 Benton Avenue	$143,656	
4	Benton Ave bridge replacement (90') and remove 2 homes + floodplain at school (FP1)	13 Benton Avenue	$151,030	$294,686
		14 Benton Avenue	$143,656	
5	Benton Ave bridge replacement (120') and remove 4 homes	10-12 Benton Avenue	$146,077	$590,908
		11 Benton Avenue	$150,145	
		13 Benton Avenue	$151,030	
		14 Benton Avenue	$143,656	
6	Benton Ave	10-12 Benton Avenue	$146,077	$590,908

Alternative	Description	Potential Property Acquisitions / Relocations	Individual Property Acquisition Benefits	Total Building Acquisition Benefits
	bridge replacement (120') and remove 4 homes + floodplain at school (FP1)	11 Benton Avenue	$150,145	
		13 Benton Avenue	$151,030	
		14 Benton Avenue	$143,656	
7	Benton Ave bridge removal and no replacement	None	None	None
8	Benton Ave bridge removal and no replacement + floodplain at school (FP1)	None	None	None
9	Griswold Street bridge replacement (includes 2 homes removed)	53 Griswold Street	$229,371	$377,918
		60 Griswold Street	$148,547	
10	Griswold Street bridge replacement and upstream floodplain (FP3) (includes four homes removed)	53 Griswold Street	$229,371	$1,064,441
		60 Griswold Street	$148,547	
		8 Elm Street	$544,811	
		14 East Street	$141,712	

The benefits are greater for the buildings with the lowest elevations and greatest flood damage potential and lower for the smaller buildings located at higher elevations. The benefit figures in Table 5-7 were advanced for use in computing total benefits for the East Brook projects.

5.2.2 Benefits Associated with Floodplain Enhancement and Creation Projects

Benefits for properties that remain after floodplain creation were generated as local flood reduction projects using the Flood Module of the BCA program. A local flood reduction benefit is computed by comparing the current condition (flood damage that could occur) to a future condition where damage is lower because a mitigation project has been completed.

Revenue losses were included for businesses that provided such information. Daily revenue figures were determined by dividing the revenue lost after the 2006 flood by the number of days that each business was shut down. Closure of seven days was assumed for most of the businesses, with the exception of businesses that provided longer durations of shut-downs. Table 5-8 lists the businesses that were addressed using this method in the BCA.

TABLE 5-8
Businesses that Provided Flood of 2006 Revenue Losses

Business	Number of Days of Closure	Business	Number of Days of Closure
Napa Auto	7	Magic Car Wash (Top Dog)	30
McAdams Lawnmower	120	Karate (Yarnover)	60
Jewelry and Frame Shop	60	Walton Liquor	21

The Damage Frequency Module in the BCA program was used to generate benefits from bridge and road damage figures. The Damage Frequency Module takes into consideration the economic loss due to road detours, historic damage costs such as repairs and inspections, and damage to utilities such as potable water, sewer, and gas. The Damage Frequency Module was also used to calculate benefits for Townsend School. The infrastructure benefits for bridges and roads are included in Table 5-9. Total benefits for the ten alternatives are presented in Table 5-9.

TABLE 5-9
Summary of Benefits

Alternative	Description	Building Acquisition Benefits	Benefits from Water Surface Reductions at Buildings that Remain	Infrastructur e Benefits	Total Benefits
1	Delaware Street bridge replacement and remove one business	$172,245	$737,687	$100,773	$1,011,000
2	Delaware Street bridge replacement and floodplain bench (FP4)	$461,978	$724,309	$100,773	$1,287,000
3	Benton Ave bridge replacement (90') and remove 2 homes	$294,686	$371,539	$23,033	$689,000
4	Benton Ave bridge replacement (90') and	$294,686	$399,888	$23,033	$718,000

Alternative	Description	Building Acquisition Benefits	Benefits from Water Surface Reductions at Buildings that Remain	Infrastructure Benefits	Total Benefits
	remove 2 homes + floodplain at school (FP1)				
5	Benton Ave bridge replacement (120') and remove 4 homes	$590,908	$445,405	$23,033	$1,059,000
6	Benton Ave bridge replacement (120') and remove 4 homes + floodplain at school (FP1)	$590,908	$451,332	$23,033	$1,065,000
7	Benton Ave bridge removal and no replacement	None	$465,031	$23,875	$489,000
8	Benton Ave bridge removal and no replacement + floodplain at school (FP1)	None	$435,770	$23,875	$460,000
9	Griswold Street bridge replacement (includes 2 homes removed)	$377,918	$1,237,799	$72,040	$1,688,000
10	Griswold Street bridge replacement and upstream floodplain (FP3) (includes four homes removed)	$1,064,441	$1,336,239	$72,040	$2,473,000

The Benton Avenue Bridge replacement alternatives (Projects 5 and 6) are heavily influenced by the acquisition of four homes on Benton Avenue. Benefits due to water surface elevation reductions at buildings that remain contribute the majority of benefits for the remaining alternatives.

5.2.3 Costs Associated with Floodplain Enhancement and Creation Projects

Conceptual cost estimates were prepared for the components of the alternatives. The building removal costs are a combination of the Assessor's building value and an estimated demolition cost. Cost estimate documentation is provided in Appendix B. Table 5-10 lists the individual costs.

TABLE 5-10
Summary of Costs for Individual Components

Alternative		Partial Cost Estimate
1	Delaware Street bridge replacement	$2,550,000
	Excavation	$94,000
	Remove Top Dog business	$204,000
2	Delaware Street bridge replacement	$2,550,000
	Floodplain bench (FP4)	$311,000
	Remove 3 homes	$456,000
3	Benton Ave bridge replacement (90')	$1,850,000
	Remove 2 homes	$239,000
	Excavation	$76,000
4	Benton Ave bridge replacement (90')	$1,850,000
	Remove 2 homes	$239,000
	Floodplain bench at school (FP1)	$258,000
5	Benton Ave bridge replacement (120')	$1,850,000
	Remove 4 homes	$479,000
	Excavation	$147,000
6	Benton Ave bridge replacement (120')	$1,850,000
	Remove 4 homes	$479,000
	Floodplain at school (FP1)	$329,000
7	Benton Ave bridge removal and no replacement	$500,000
8	Benton Ave bridge removal and no replacement	$500,000
	Floodplain at school (FP1)	$182,000
9	Griswold Street bridge replacement	$2,750,000
	Remove 2 homes	$385,000
	Excavation	$140,000
10	Griswold Street bridge replacement	$2,750,000
	Remove 4 homes	$656,000
	Upstream floodplain (FP3)	$1,015,000

In all cases, the cost estimates should not be construed as likely construction costs. These are strictly for planning purposes and evaluating cost effectiveness.

5.2.4 Comparison of Benefits and Costs

The individual cost estimates in Table 5-10 were summed and are listed in the fourth column of 5-11 below. The total project benefits are listed in the third column of Table 5-11. When benefits exceed costs, the alternative is considered to have a BCR greater than 1.0. Only the Benton Avenue Bridge removal (Project 7) has a BCR close to 1. This is because the expense associated with constructing a new bridge is not part of the cost.

TABLE 5-11
Comparison of Costs and Benefits

Alternative	Description	Total Benefits	Total Cost	BCR
1	Delaware Street bridge replacement	$1,011,000	$2,848,000	0.35
2	Delaware Street bridge replacement and floodplain bench (FP4)	$1,287,000	$3,317,000	0.39
3	Benton Ave bridge replacement (90') and remove 2 homes	$689,000	$2,165,000	0.32
4	Benton Ave bridge replacement (90') and remove 2 homes + floodplain at school (FP1)	$718,000	$2,347,000	0.31
5	Benton Ave bridge replacement (120') and remove 4 homes	$1,059,000	$2,476,000	0.43
6	Benton Ave bridge replacement (120') and remove 4 homes + floodplain at school (FP1)	$1,065,000	$2,658,000	0.40
7	Benton Ave bridge removal and no replacement	$489,000	$500,000	0.98
8	Benton Ave bridge removal and no replacement + floodplain at school (FP1)	$460,000	$682,000	0.67
9	Griswold Street bridge replacement (includes 2 homes removed)	$1,688,000	$3,275,000	0.52
10	Griswold Street bridge replacement and upstream floodplain (FP3) (includes four homes removed)	$2,473,000	$4,421,000	0.56

The BCA does not include consideration of water quality benefits that could be provided by flood mitigation projects. Although Alternative 7 has a BCR of 0.98 which is below 1.0, the alternative may warrant continued attention since the project could provide water quality benefits to Walton (as they all would).

6.0 WEST BROOK FLOOD MITIGATION ALTERNATIVES AND BCA

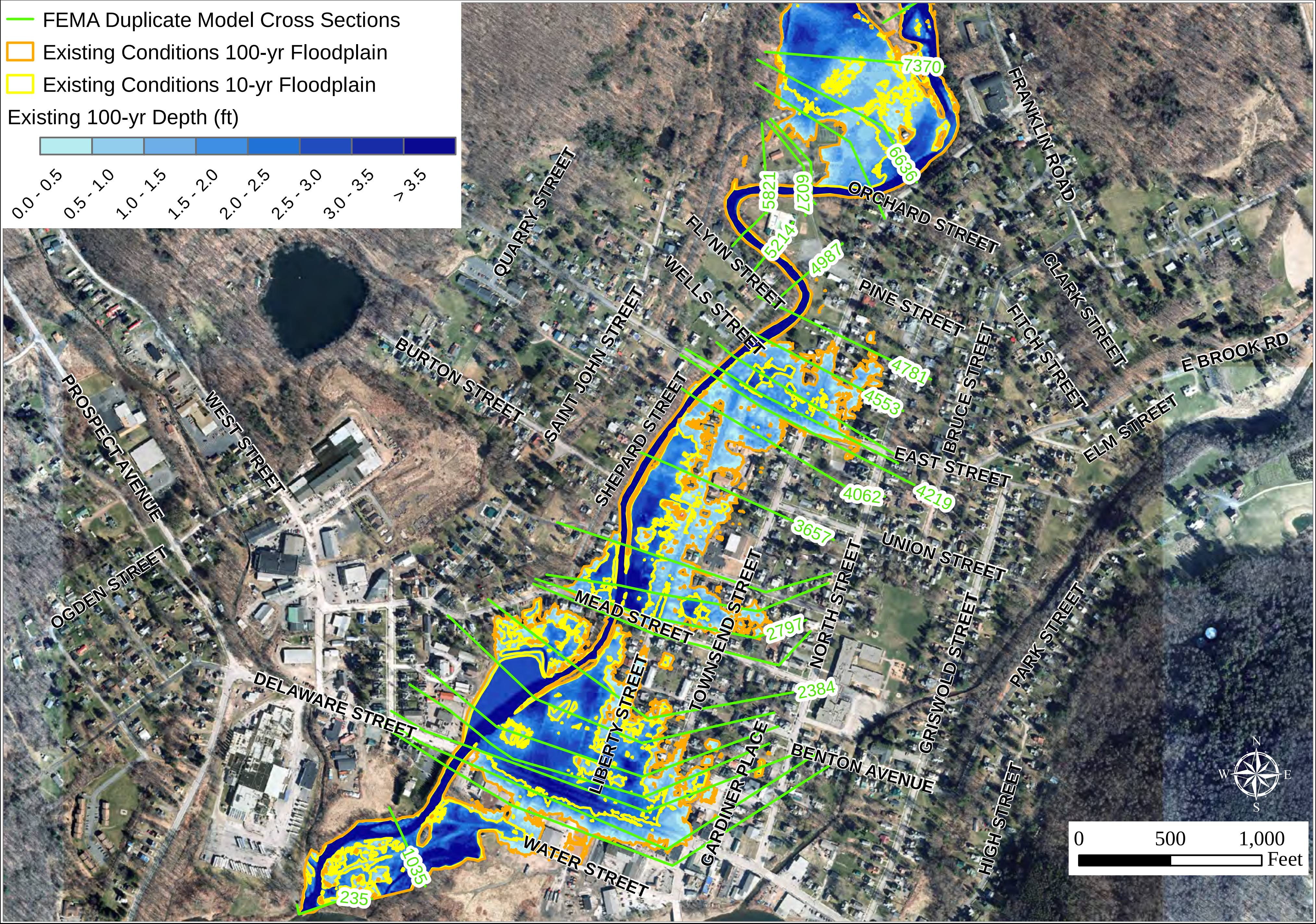
This chapter focuses specifically on the alternatives analysis and benefit cost analysis results for West Brook.

6.1 West Brook Mitigation Alternatives

Hydraulic analysis was completed for West Brook to identify possible mitigation alternatives. Alternatives presented have been selected due to their flood reduction benefit. Additional alternatives or slight variations to the presented alternatives have been tested during evaluation. Existing depth mapping has been provided as a baseline comparison for evaluation of presented alternatives (Figure 6-1).

A 2006 storm flood path was not reflected in the existing conditions 100-year flood model results. This is because the 2006 flood was larger than the 500-year flood. Specifically, in 2006 flood water left the channel at the sharp bend downstream of the Austin Lincoln Park and flowed through residential properties and along Townsend Street. Model results for the 2006 storm event do show flood waters leaving the channel at this location.

As a first trial, modeling was completed with all of the bridges removed to see the effect of the structures on upstream flooding. Flood reduction benefits only extended only a short distance upstream of bridges and never as far upstream as the next bridge, demonstrating a spatial modularity of options but also suggesting the need for a combination of bridge, channel, and floodplain improvements to maximize flood risk reduction.



SOURCE(S):	FIG. 6-1: EXISTING CONDITIONS DEPTH MAPPING WEST BROOK	LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES	Map By: JCL	MILONE & MACBROOM
NYSDOP MMI HECRAS	MXD: Y:\5197-06\Maps\Report Figures\Fig 6-1 West_EXdepth100zoom.mxd	LOCATION: WALTON, DELAWARE COUNTY, NY	MMI#: 5197-06 Original: 12/11/2017 Revision: 9/21/2017 Scale: 1 in = 681 ft	99 Realty Drive Cheshire, CT 06410 (203) 271-1773 Fax: (203) 272-9733 www.miloneandmacbroom.com

6.1.1 West Brook Alternatives # 1 & 2 – Delaware Street Bridge (STA 1035+00 to STA 1835+00)

The current Delaware Street bridge over West Brook is 47 feet wide, with a skew which reduces hydraulic capacity. The roadway overtops for all storms with a 10-year recurrence interval and greater. MMI modeled a wider bridge, maximizing the capacity of the bridge, while minimizing the impact to surrounding properties. Improving hydraulic capacity of the existing bridge was tested with bankfull elevation floodbenches downstream of the bridge (FP1). A bridge span of 120 feet was tested, with floodbench creation downstream (FP1) and upstream (FP2). Creation of the floodbenches would require reducing the size of the parking areas at the CVS and school bus garage. Table 6-1 provides water surface elevations at cross sections upstream and downstream of the bridge. Figures 6-2 and 6-3 depicts the Delaware Street alternatives. As with East Brook in the previous section of this report, this analysis and the flood reduction benefits assume that backwater conditions from the West Branch are not occurring.

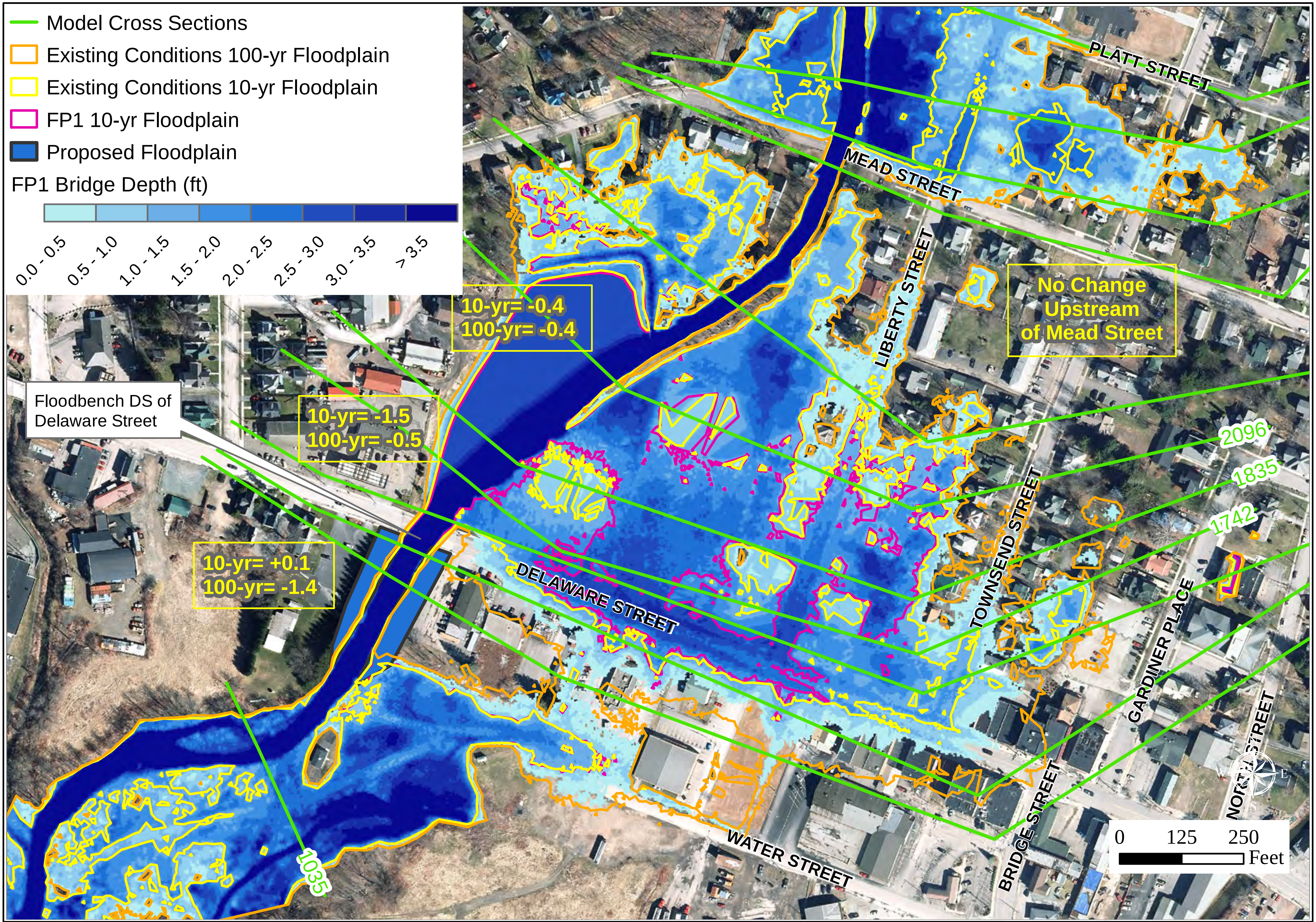
TABLE 6-1
Comparison of Water Surface Elevations near Delaware Street (100-Year)
[feet NAVD88]

River Station	Location	Existing Conditions	Net Change Alt. 1 (FP1 only)	Net Change Alt. 2 (120' + FP1 + FP2)
2763	Mead St. Bridge		0.0	0.0
2734	Homes on Mead St.	1210.96	0.0	0.0
2384	Residential	1209.36	-0.2	-0.2
2096	Big M	1209.25	-0.4	-0.9
1835	School Bus Garage	1209.16	-0.4	-1.2
1742	Sunoco Gas Station	1209.12	-0.5	-1.4
1645	US of Delaware St.	1209.1	-0.5	-1.4
1603	Delaware St. Bridge		0.0	0.0
1559	DS of Delaware St.	1208.4	-1.4	-1.3
1491	CVS Pharmacy	1206.26	-0.4	-0.4
1035	US of Third Brook	1203.96	0.0	0.0

Modeling demonstrated the following:

- Retaining the existing bridge and creating floodbenches downstream reduces upstream water surface elevations and the depth and frequency of flooding over Delaware Street.
- Bridge replacement further reduces upstream water surface elevations.

The Sunoco Gas Station is an example of a property that benefits most from floodplain and bridge improvements. For alternative #2 water surface elevation was reduced 1.3 feet for the 10-year flood and 1.4 feet for the 100-year flood.



SOURCE(S):

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FIG. 6-2: FP1
DEPTH MAPPING
WEST BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 6-2 West_FP1_Depth.mxd

LOCAL FLOOD ANALYSIS
WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By:	JCL
MMI#:	5197-06
Original:	11/2/2015
Revision:	9/22/2017
Scale:	1 in = 250 ft

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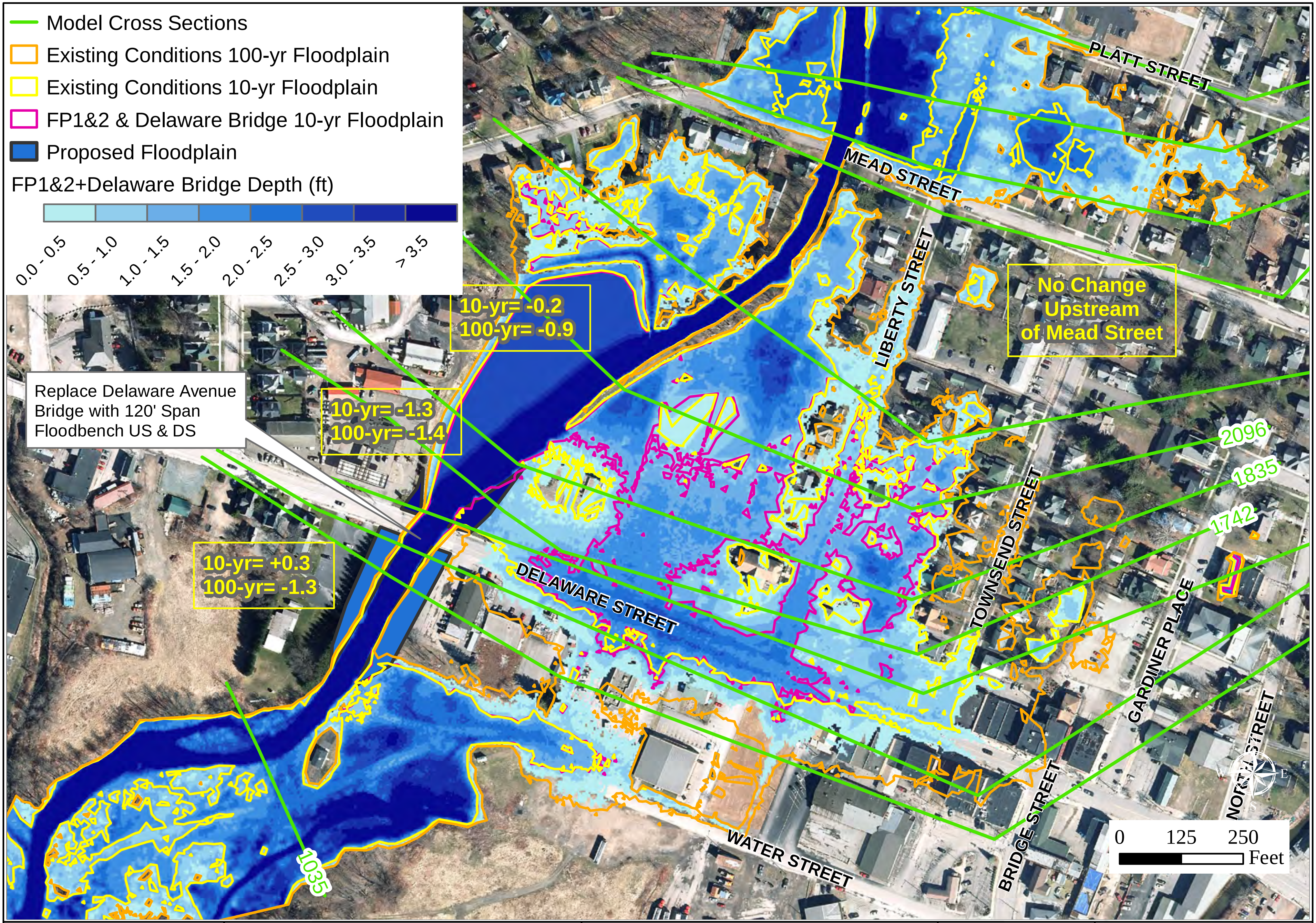

SOURCE(S):

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FIG 6-3: FP1+2 + DELAWARE BRIDGE (120') DEPTH MAPPING WEST BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 6-3 West_FP1-2+120D_Depth.mxd

LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By:	JCL
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6.1.2 West Brook Alternatives # 3 & 4 – Mead Street Bridge (STA 2096+00 to STA 4219+00)

The current Mead Street bridge over West Brook is only 35 feet wide. The roadway overtops for all storms with a 10-year recurrence interval and greater. MMI modeled a wider 150 foot span bridge with one pier, raising the road surface one foot. Replacement of the bridge should proceed with floodplain creation. Floodplain creation downstream west of the channel (FP3) would require acquisition of 2 homes and 3 garages, connecting to the floodplain created in 2011. Floodplain creation upstream west of the channel (FP4) would require acquisition of 2 homes and 1 garage. These alternatives were also tested with floodplain creation east of the channel extending to East Street (FP5) which would require acquisition of 1 home, 1 manufacturing building, and 3 garages. Table 6-2 provides water surface elevations at cross sections upstream and downstream of the bridge. Figures 6-4 and 6-5 depicts the Mead Street alternatives.

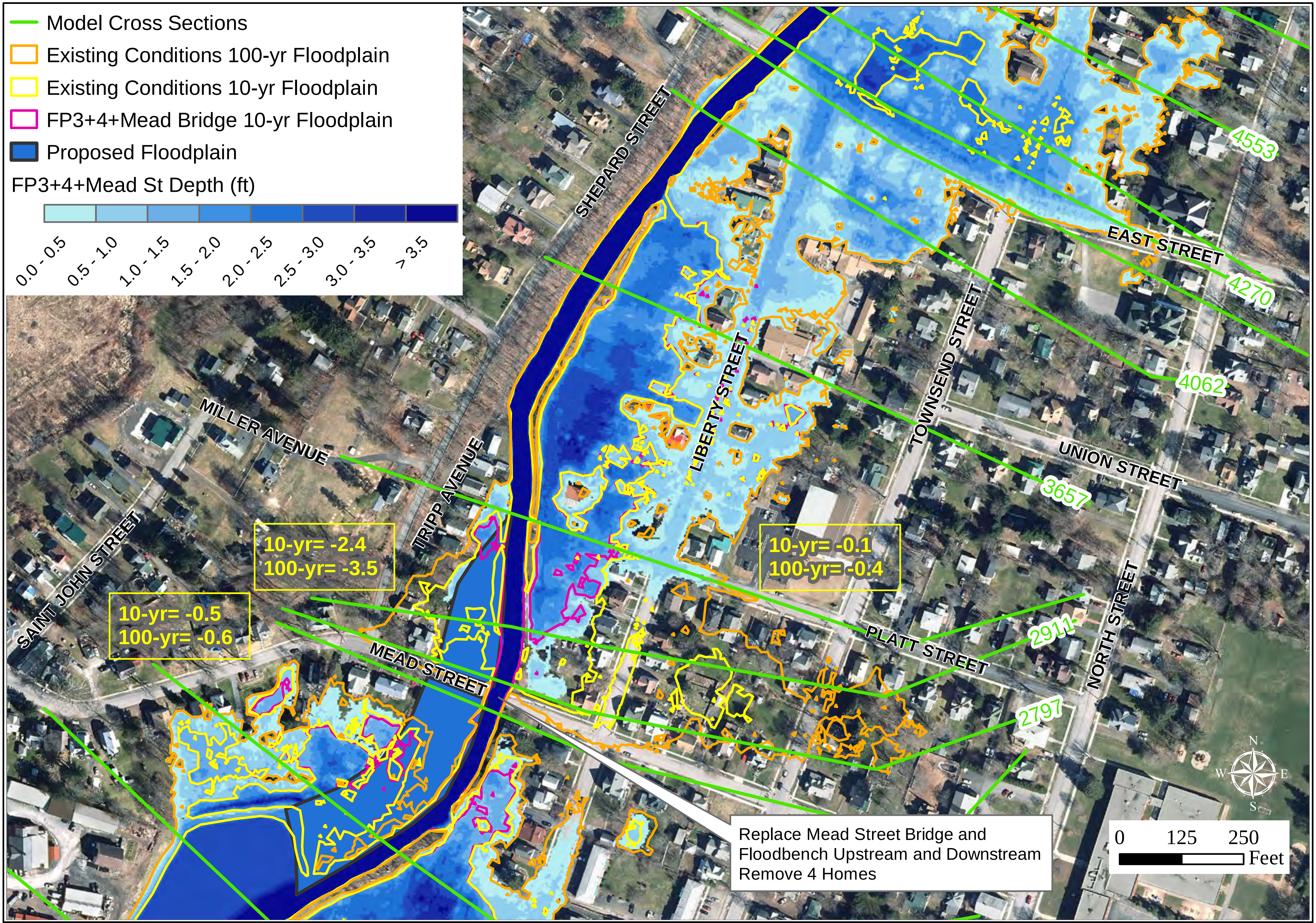
TABLE 6-2
Comparison of Water Surface Elevations near Mead Street (100-Year)
[feet NAVD88]

River Station	Location	Existing Conditions	Net Change Alt. 3 (150' + FP3 + FP4)	Net Change Alt. 4 (150' + FP3 + FP4 + FP5)
4270	Homes on East St.	1223.6	0.0	-0.1
4244	East St. Bridge		0.0	0.0
4219	Homes on East St.	1221.7	0.0	-2.2
4062	Residential	1219.6	0.0	-1.3
3657	Residential	1217.0	0.2	-1.0
3137	Platt Street	1215.4	-0.4	-2.5
2911	Residential	1215.3	-3.4	-3.4
2797	Homes on Mead St.	1215.1	-3.5	-3.5
2763	Mead St. Bridge		0.0	0.0
2734	Homes on Mead St.	1211.0	-0.6	-0.6
2384	Residential	1209.4	0.1	0.1

Modeling demonstrated the following:

- The new bridge would pass the 100-yr flood with 1.3 feet of freeboard, but the 500-yr flood would overtop the road. Many homes upstream of Mead Street are removed from the floodplain.
- Creating FP5 significantly increases the number of homes removed from the floodplain.

Residential properties along Mead and Liberty Streets benefit most from floodplain and bridge improvements. For Alternatives #3 & #4 water surface elevation was reduced 2.4 feet for the 10-year flood and 3.5 feet for the 100-year flood.



SOURCE(S):

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FIG 6-4: FP3 + 4 + MEAD BRIDGE DEPTH MAPPING WEST BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 6-4 FP3+4+MeadStBridge.mxd

LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By: JCL
MMI#: 5197-06
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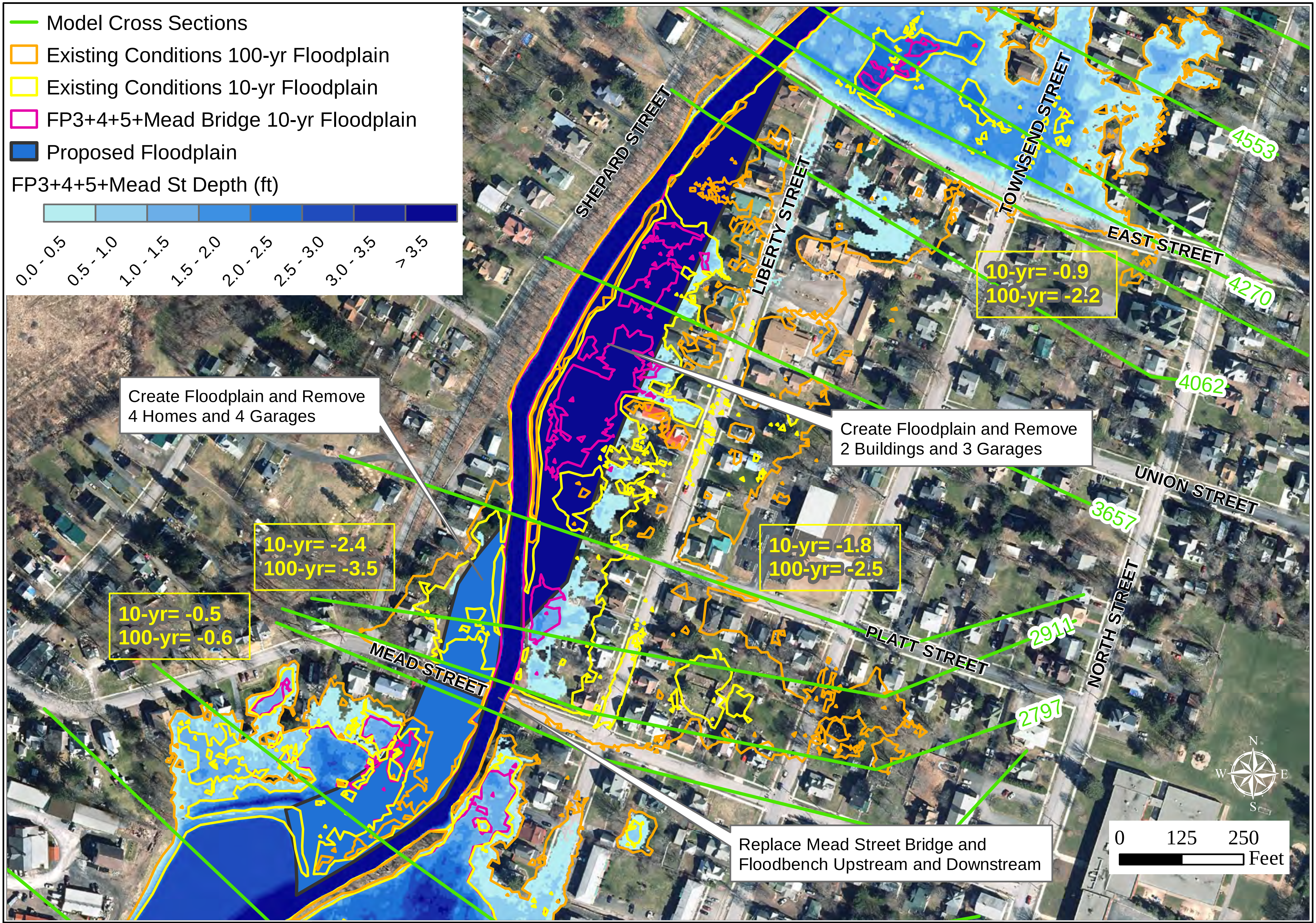

SOURCE(S):

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FIG 6-5: FP3 + 4 + 5 + MEAD BRIDGE DEPTH MAPPING WEST BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 6-5 FP3+4+5+MeadStBridge.mxd

LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

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6.1.3 West Brook Alternatives # 5, 6, & 7 – East Street Bridge (STA 4270+00 to STA 5214+00)

The current East Street bridge over West Brook is only 30 feet wide. The roadway overtops for all storms with a 25-year recurrence interval and greater. MMI modeled a 60 foot span bridge, which is the widest possible without disruption to (or acquisition of) homes. Replacement of the bridge should proceed with floodplain creation at the approaches. Floodplain creation between East Street and the park was tested. A floodplain west of the channel was not considered a viable alternative due to the large cut required and the need for a home acquisition (FP6). A floodplain east of the channel at bankfull elevation in the backyards of homes (FP7) was considered alone and with replacement of the bridge. Acquisitions of buildings were not required for these alternatives. Table 6-3 provides water surface elevations at cross sections upstream and downstream of the bridge. Figures 6-6 to 6-8 depicts the East Street alternatives.

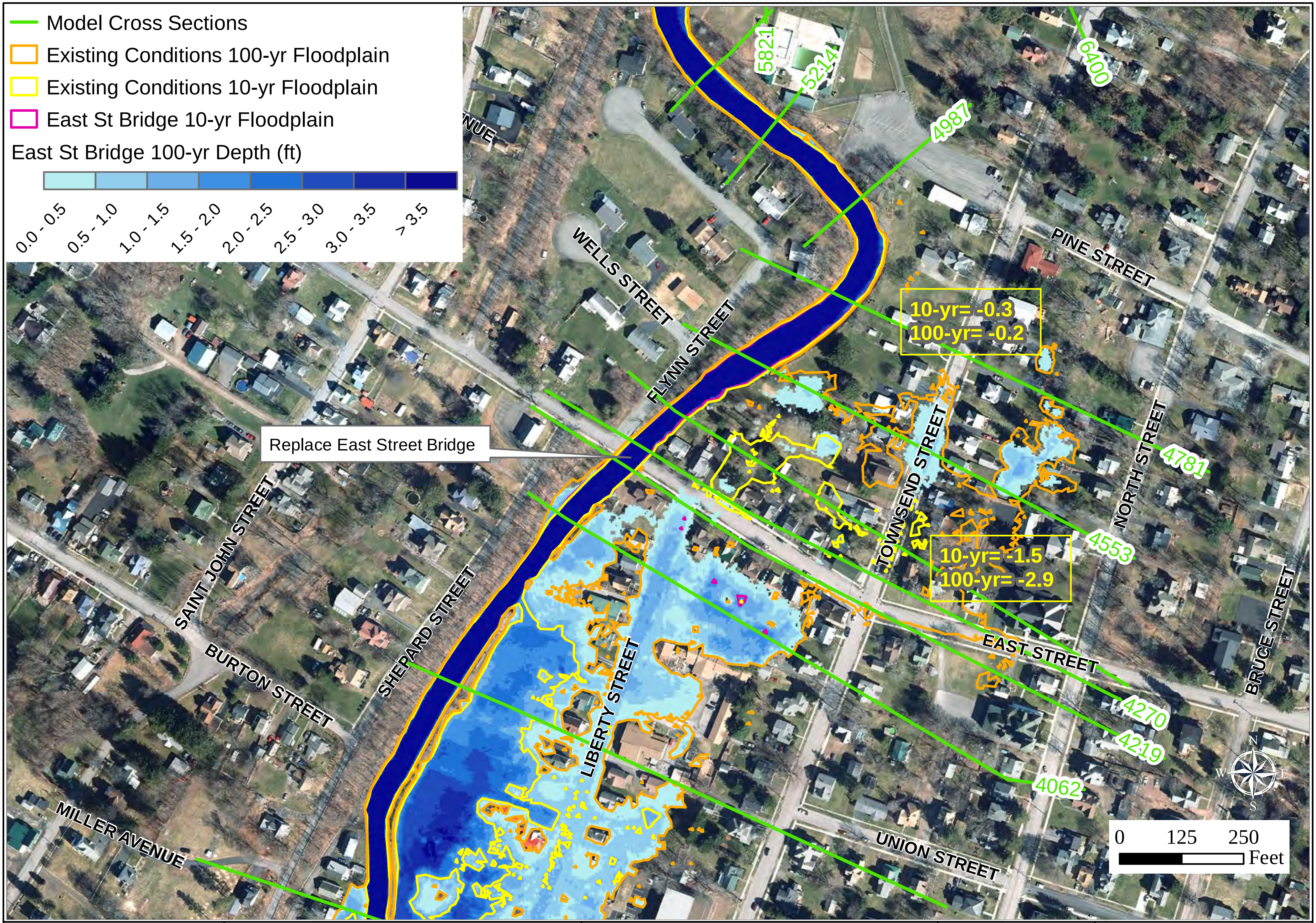
TABLE 6-3
Comparison of Water Surface Elevations near East Street (100-Year)
[feet NAVD88]

River Station	Location	Existing Conditions	Net Change Alt. 5 (60' Bridge)	Net Change Alt. 6 (FP7 only)	Net Change Alt. 7 (60' + FP7)
6027	Park		0.0	0.0	0.0
5821	Park	1231.4	0.0	-0.1	-0.1
5386	Park	1227.4	0.0	0.2	0.2
5214	Park	1226.6	0.0	-1.2	-1.2
4987	Park / Residential	1225.7	0.1	-1.4	-1.5
4781	Residential	1223.5	-0.2	0.4	-1.4
4553	Residential	1223.8	-0.4	0.2	-1.5
4371	Residential	1223.5	-3.3	0.1	-2.5
4270	Homes on East St.	1223.6	-2.9	0.1	-2.9
4244	East St. Bridge		0.0	0.0	0.0
4219	Homes on East St.	1221.7	-1.5	0.0	-1.5

Modeling demonstrated the following:

- The new bridge passes the 100-yr flood, but the 500-yr flood would overtop the road. Many homes upstream of East Street are removed from the floodplain.
- Creating FP7 further increases the number of homes removed from the floodplain.

Residential properties along East and Townsend Streets benefit most from floodplain and bridge improvements. For alternative #7 the water surface elevation was reduced 1.5 feet for the 10-year flood and 2.9 feet for the 100-year flood.



SOURCE(S):

NYSDOP
MMI HECRAS

FIG 6-6: 60' EAST STREET BRIDGE DEPTH MAPPING WEST BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 6-6 EB60_Depth.mxd

LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By:	JCL
MMI#:	5197-06
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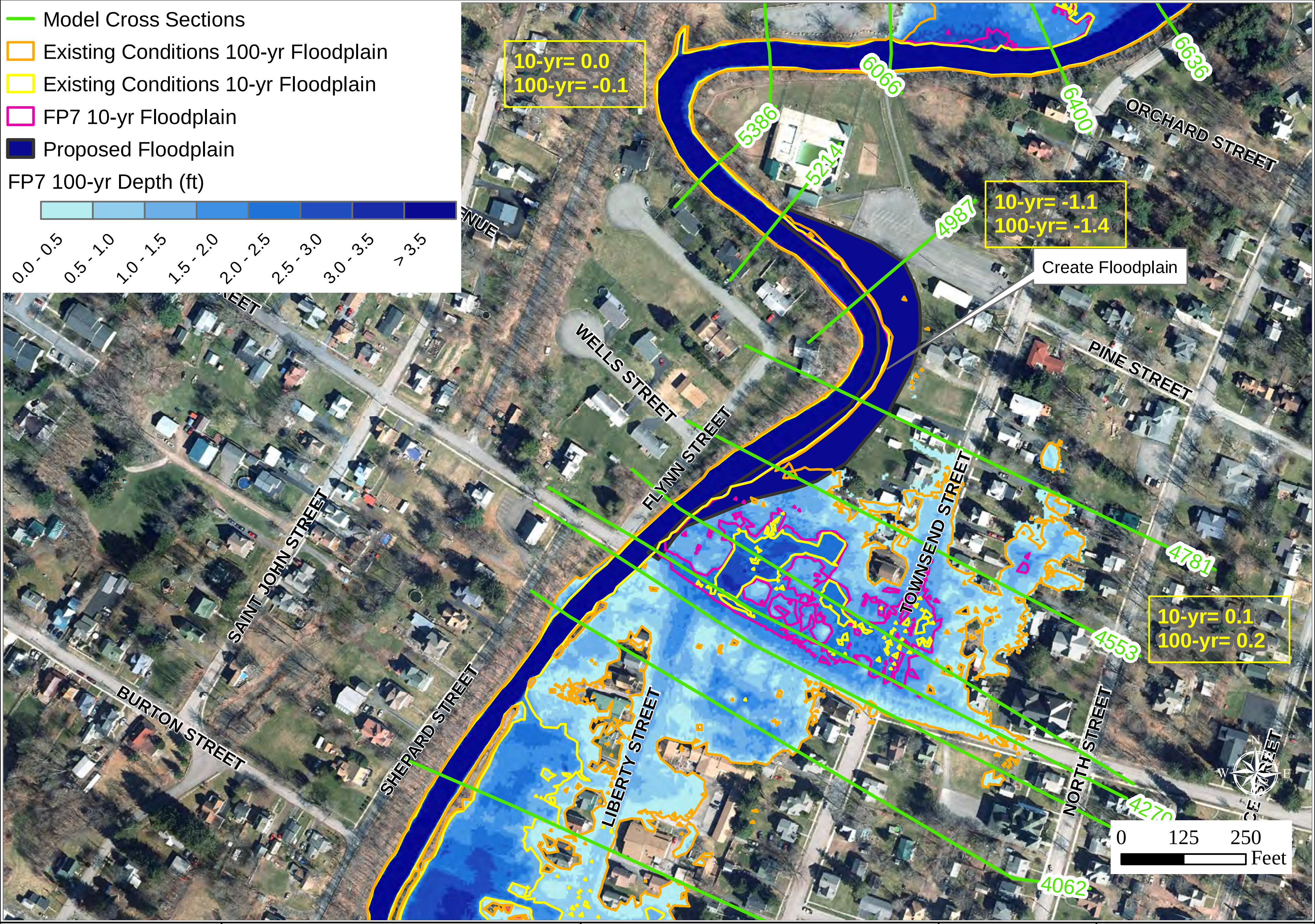

SOURCE(S):	N
NYSDOP MMI HECRAS	

FIG 6-7: FP7 DEPTH MAPPING
WEST BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 6-7 FP7 Depth.mxd

LOCAL FLOOD ANALYSIS
WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By:	JCS
MMI#:	5197-06
Original:	11/2/2015
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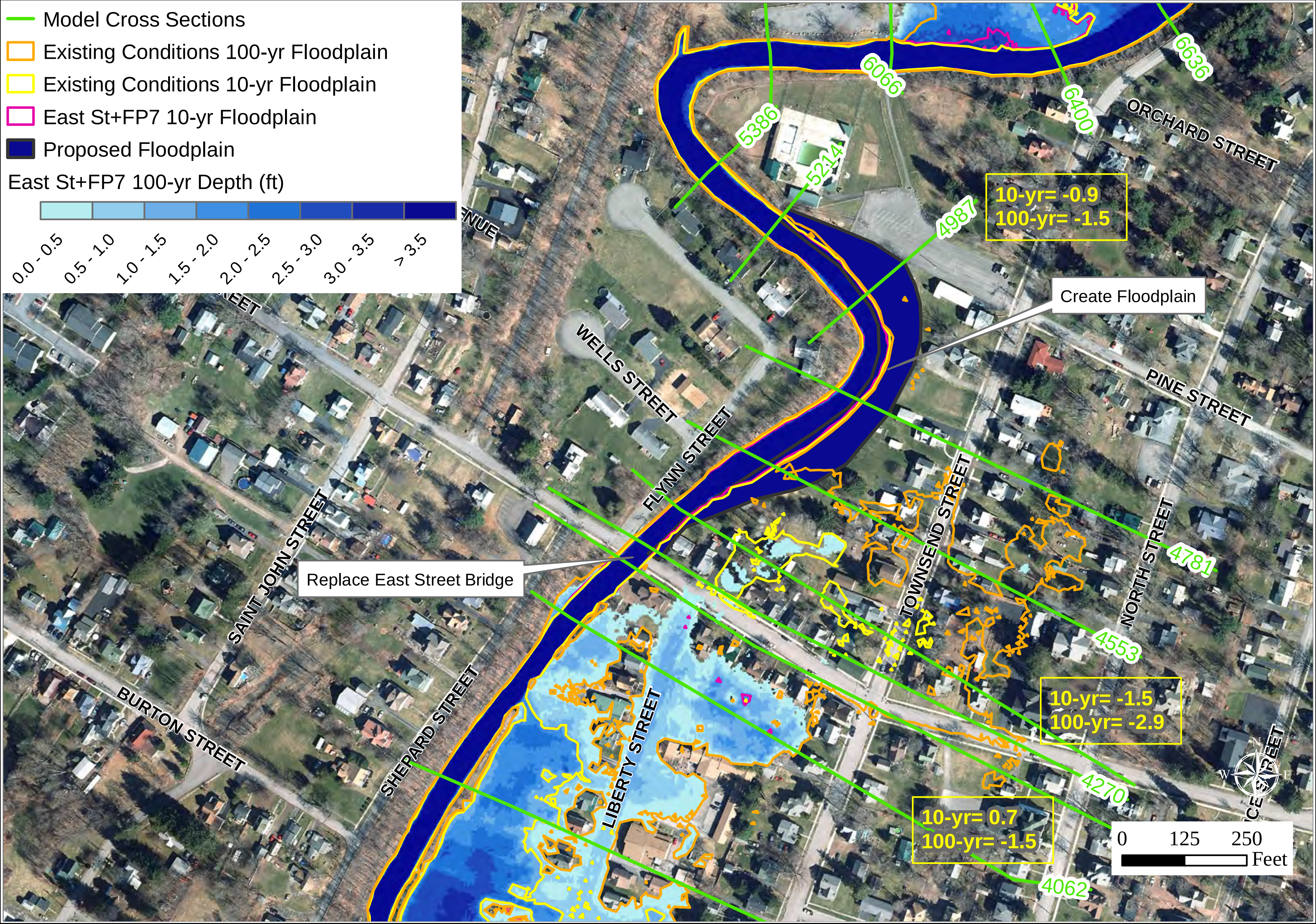

SOURCE(S):

NYSDOP
MMI HECRAS

FIG 6-8: EAST STREET + FP7
DEPTH MAPPING
WEST BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 6-8 East St+FP7_NEW.mxd

LOCAL FLOOD ANALYSIS
WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

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Original:	11/2/2015
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6.1.4 West Brook Combination of Alternatives

A combination of the previously presented alternatives has been provided to show the benefits of these alternatives when combined.

Combination includes:

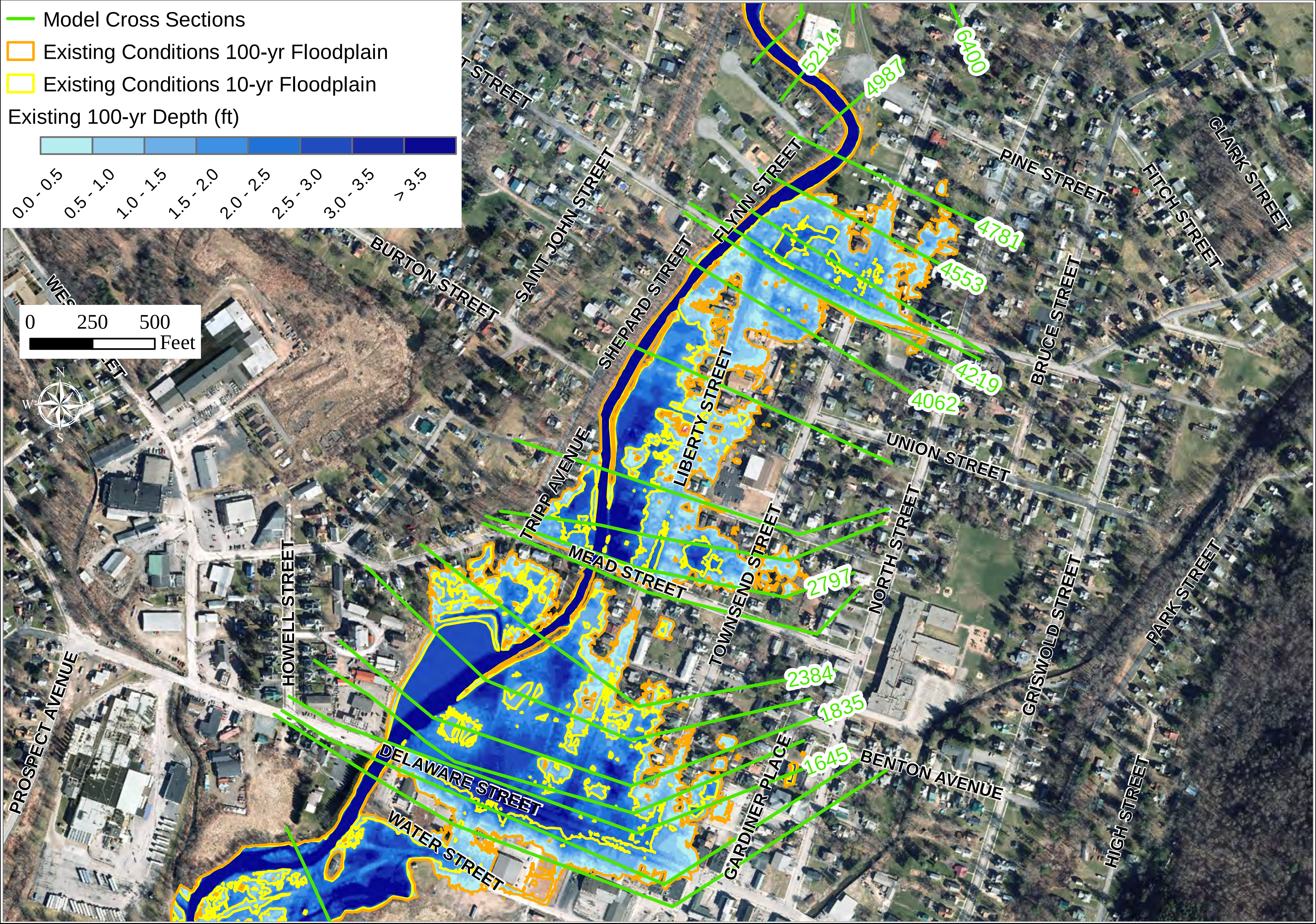
- Alternative 1: Floodplain (FP1) downstream of Delaware Street
- Alternative 2: Replace Delaware Street Bridge with 120 foot span
    - Floodplain (FP2) upstream of Delaware Street
- Alternative 3: Replace Mead Street Bridge with 150 foot span
    - Floodplain (FP3) downstream of Mead Street
    - Floodplain (FP4) upstream of Mead Street
- Alternative 4: Floodplain (FP5) between Mead and East Streets
- Alternative 5: Replace East Street Bridge with 60 foot span
- Alternative 6: Floodplain (FP7) upstream of East Street Bridge

In some locations there are additive benefits from backwater eliminated by implementing downstream alternatives. Table 6-4 provides water surface elevations along West Brook for both the 10-year and 100-year flood events. Figure 6-9 shows existing conditions depths for easy comparison to the flood depths associated with the combined alternative shown in Figure 6-10.

Modeled results assume a normal depth downstream boundary condition, as though the West Branch of the Delaware River is not flooding. The backwater from the West Branch will reduce the effectiveness of the alternatives, especially at the downstream end of the model area at the confluence. The effect of backwatering from West Branch is mostly concentrated downstream of Delaware Street, with existing conditions modeling of the 100-year flood rising only 0.1 feet upstream of Delaware Street when backwatering is considered. No effects of backwatering from the mainstem are seen upstream of Mead Street. It is important to note that FEMA also used a normal depth downstream boundary condition in their modeling of West Brook, and therefore the LFA methodology is consistent.

TABLE 6-4
Comparison of Water Surface Elevations along West Brook
[feet NAVD88]

		10-year			100-year		
River Station	Location	Existing Conditions	Alternative	Net Change	Existing Conditions	Alternative	Net Change
	Park Bridge			0.0			0.0
6027	Park	1231.2	1231.2	0.0	1232.8	1233.0	0.1
5821	Park	1230.0	1230.0	0.0	1231.4	1231.2	-0.1
5386	Park	1225.9	1225.9	0.0	1227.4	1227.6	0.2
5214	Park	1225.0	1224.5	-0.5	1226.6	1225.4	-1.2
4987	Park / Residential	1224.0	1223.1	-0.9	1225.7	1224.2	-1.5
4781	Residential	1222.0	1221.2	-0.9	1223.5	1222.1	-1.4
4553	Residential	1222.2	1220.2	-1.9	1223.8	1222.2	-1.6
4371	Residential	1221.5	1219.0	-2.5	1223.5	1220.6	-2.9
4270	Homes on East St.	1221.3	1218.8	-2.5	1223.6	1220.3	-3.3
4244	East St. Bridge			0.0			0.0
4219	Homes on East St.	1218.9	1218.1	-0.8	1221.7	1219.0	-2.7
4062	Residential	1217.6	1217.4	-0.2	1219.6	1218.3	-1.3
3657	Residential	1216.3	1215.1	-1.1	1217.0	1216.1	-1.0
3137	Platt Street	1213.8	1212.1	-1.8	1215.4	1213.0	-2.5
2911	Residential	1213.4	1210.9	-2.5	1215.3	1212.0	-3.4
2797	Homes on Mead St.	1213.0	1210.6	-2.4	1215.1	1211.6	-3.5
2763	Mead St. Bridge			0.0			0.0
2734	Homes on Mead St.	1210.2	1209.7	-0.5	1211.0	1210.5	-0.5
2384	Residential	1208.5	1208.4	0.0	1209.4	1209.1	-0.3
2096	Big M	1207.9	1207.7	-0.2	1209.3	1208.4	-0.9
1835	School Bus Garage	1207.7	1206.9	-0.8	1209.2	1207.9	-1.2
1742	Sunoco Gas Station	1207.6	1206.3	-1.3	1209.1	1207.7	-1.4
1645	US of Delaware St.	1207.6	1206.2	-1.3	1209.1	1207.7	-1.4
1603	Delaware St. Bridge			0.0			0.0
1559	DS of Delaware St.	1205.5	1205.8	0.3	1208.4	1207.1	-1.3
1491	CVS Pharmacy	1205.0	1205.0	0.0	1206.3	1205.8	-0.4
1035	US of Third Brook	1202.7	1202.7	0.0	1204.0	1204.0	0.0



SOURCE(S):

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FIG. 6-9 EXISTING CONDITIONS DEPTH MAPPING WEST BROOK

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LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By:	JCL
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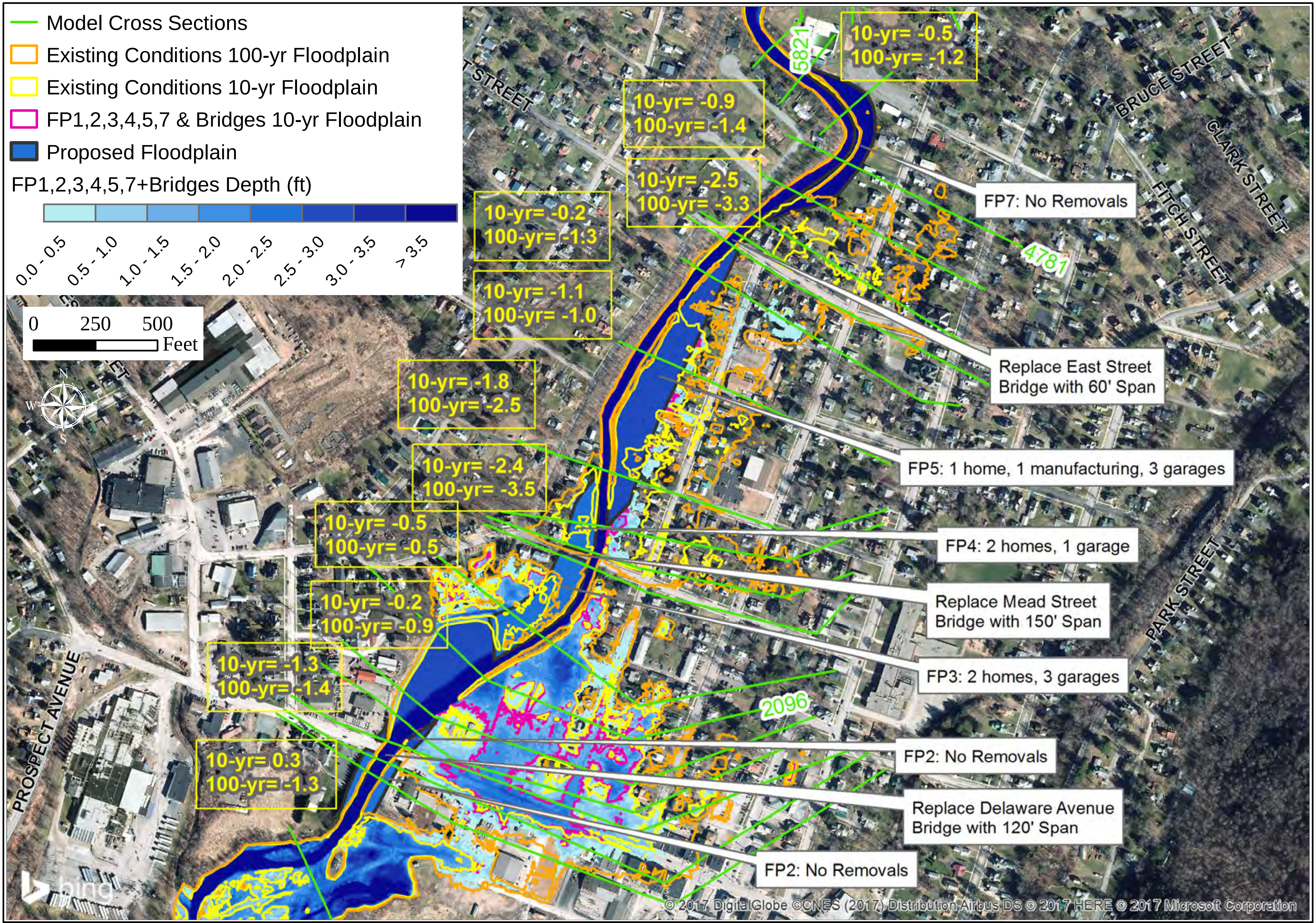

SOURCE(S):

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FIG. 6-10: FP 1,2,3,4,5,7 & BRIDGES DELAWARE, MEAD, EAST DEPTH MAPPING, WEST BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 6-10 West_FP1-2-3-4-5-7+D120+150M+E60_Depth.mxd

LOCAL FLOOD ANALYSIS
WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By:	JCL
MMI#:	5197-06
Original:	6/27/2016
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6.2 West Brook BCA

6.2.1 Property Acquisitions and Benefits

The first step of the benefits generation was to determine the benefits associated with the act of removing buildings that are located where bridge removals or floodplain enhancements require earthwork. These buildings possess flood risk and therefore their removal equates to benefits associated with elimination of flood risk. The buildings listed in Table 6-5 are those that would need to be removed in conjunction with the floodplain enhancement projects.

TABLE 6-5
Benefits Provided by Acquisitions/Relocations

Alternative	Description	Potential Property Acquisitions / Relocations	Individual Property Acquisition Benefits	Total Building Acquisition Benefits
1	Floodplain Downstream of Delaware Street (FP1)	None	None	None
2	Floodplains Downstream and Upstream of Delaware Street, (FP 1+2) and Replace Delaware Street Bridge	None	None	None
3	Floodplains Upstream and Downstream of Mead Street (FP 3+4) and Replace Mead Street Bridge	48 Mead Street	$276,804	$1,095,234
		46 Mead Street	$219,105	
		49 Mead Street	$388,912	
		45 Mead Street	$210,413	
4	Mead Street Floodplains and Floodplain Between East Street and Mead Street (FP 3+4+5) and Replace Mead Street Bridge	48 Mead Street	$276,804	$1,586,670
		46 Mead Street	$219,105	
		49 Mead Street	$388,912	
		45 Mead Street	$210,413	
		53 Liberty Street	$491,436	
5	Replace East Street Bridge	None	None	None
7	Floodplain between East Street and park, and Replace East Street Bridge	None	None	None

6.2.2 Benefits Associated with Floodplain Enhancement and Creation Projects

Benefits for properties that remain after floodplain creation were generated as local flood reduction projects using the Flood Module of the BCA program. A local flood reduction benefit is computed by comparing the current condition (flood damage that could occur) to a future condition where damage is lower because a mitigation project has been completed.

Revenue losses were included for businesses that provided such information. Daily revenue figures were determined by dividing the revenue lost after the 2006 flood by the number of days that each business was shut down. Along West Brook, only Big M Supermarket provided revenue figures. Big M Supermarket reported an annual budget of $14,407,895 and 19 days of closure after the 2006 Flood.

The Damage Frequency Module in the BCA program was used to generate benefits from bridge and road damage figures. The Damage Frequency Module takes into consideration the economic loss due to road detours, historic damage costs such as repairs and inspections, and damage to utilities such as potable water, sewer, and gas. The infrastructure benefits for bridges and roads are included in Table 6-6. Total benefits for the six proposed projects were calculated. Table 6-6 presents these figures.

TABLE 6-6
Summary of Benefits

Alternative	Description	Building Acquisition Benefits	Benefits from Water Surface Reductions at Buildings that Remain	Infrastructure Benefits	Total Benefits
1	Floodplain Downstream of Delaware Street (FP1)	None	$3,142,179	None	$3,142,000
2	Floodplains Downstream and Upstream of Delaware Street, (FP 1+2) and Replace Delaware Street Bridge	None	$3,404,750	$706,515	$4,111,000
3	Floodplains Upstream and Downstream of	$1,095,234	$181,075	$195,971	$1,472,000

Alternative	Description	Building Acquisition Benefits	Benefits from Water Surface Reductions at Buildings that Remain	Infrastructure Benefits	Total Benefits
	Mead Street (FP 3+4) and Replace Mead Street Bridge				
4	Mead Street Floodplains and Floodplain Between East Street and Mead Street (FP 3+4+5) and Replace Mead Street Bridge	$1,586,670	$317,338	$195,971	$2,100,000
5	Replace East Street Bridge	None	$262,782	$385,565	$648,000
7	Floodplain between East Street and park, and Replace East Street Bridge	None	$272,329	$385,565	$658,000

The benefits for alternatives 3 and 4 around Mead Street are heavily influenced by building acquisitions. The high benefits for alternatives 1 and 2 are primarily due to reduction of water surface elevations at the Big M Supermarket, which provides $1,309,000 in benefits.

6.2.3 Costs Associated with Floodplain Enhancement and Creation Projects

Conceptual cost estimates were prepared for the components of the proposed projects. The building removal costs are a combination of the Assessor's building value and an estimated demolition cost. Cost estimate documentation is provided in Appendix B. Table 6-7 lists the individual costs.

TABLE 6-7
Summary of Costs for Individual Components

Alternative		Partial Cost Estimate
1	Floodplain Downstream of Delaware Street (FP1)	$102,000
2	Replace Delaware Street Bridge	$2,750,000
	Floodplains downstream of Delaware Street (FP 1+2)	$132,000

Alternative		Partial Cost Estimate
3	Replace Mead Street Bridge	$2,300,000
	Floodplains Upstream and Downstream of Mead Street (FP 3+4)	$334,000
	Remove 4 homes	$522,000
4	Replace Mead Street Bridge	$2,300,000
	Mead Street Floodplains and Floodplain between East Street and Mead Street (FP 3+4+5)	$761,000
	Remove 5 homes and 3 garages	$948,000
5	Replace East Street Bridge	$1,100,000
7	Replace East Street Bridge	$1,100,000
	Floodplain between East Street and park (FP 7)	$107,000

In all cases, the cost estimates should not be construed as likely construction costs. These are strictly for planning purposes and evaluating cost effectiveness.

6.2.4 Comparison of Benefits and Costs

The individual cost estimates in Table 6-7 were summed and are listed in the fourth column of Table 6-8 below. The total alternative benefits are listed in the third column of Table 6-8. When benefits exceed costs, the alternative is considered to have a BCR greater than 1.0.

TABLE 6-8
Comparison of Costs and Benefits

Alternative	Description	Total Benefits	Total Cost	BCR
1	Floodplain Downstream of Delaware Street (FP1)	$3,142,000	$102,000	30.80
2	Floodplains Downstream and Upstream of Delaware Street, (FP 1+2) and Replace Delaware Street Bridge	$4,111,000	$2,882,000	1.43
3	Floodplains Upstream and Downstream of Mead Street (FP 3+4) and Replace Mead Street Bridge	$1,472,000	$3,156,000	0.47
4	Mead Street Floodplains and Floodplain Between East Street and Mead Street (FP 3+4+5) and Replace Mead Street Bridge	$2,100,000	$4,009,000	0.52
5	Replace East Street Bridge	$648,000	$1,100,000	0.59

Alternative	Description	Total Benefits	Total Cost	BCR
7	Floodplain between East Street and park, and Replace East Street Bridge	$658,000	$1,207,000	0.55

Creation of a floodplain downstream of Delaware Street (Alternative 1) and the combination of floodplains upstream and downstream of Delaware Street with the Delaware Street Bridge Replacement (Alternative 2) both have BCRs greater than 1. It is important to note that the high benefits associated with reduced flooding at Big M supermarket have dominated these ratios. If one of these alternatives is pursued, a more detailed BCA should be conducted to support the benefit figures.

7.0 THIRD BROOK FLOOD MITIGATION ALTERNATIVES AND BCA

This chapter focuses specifically on the alternatives analysis and benefit cost analysis results for Third Brook.

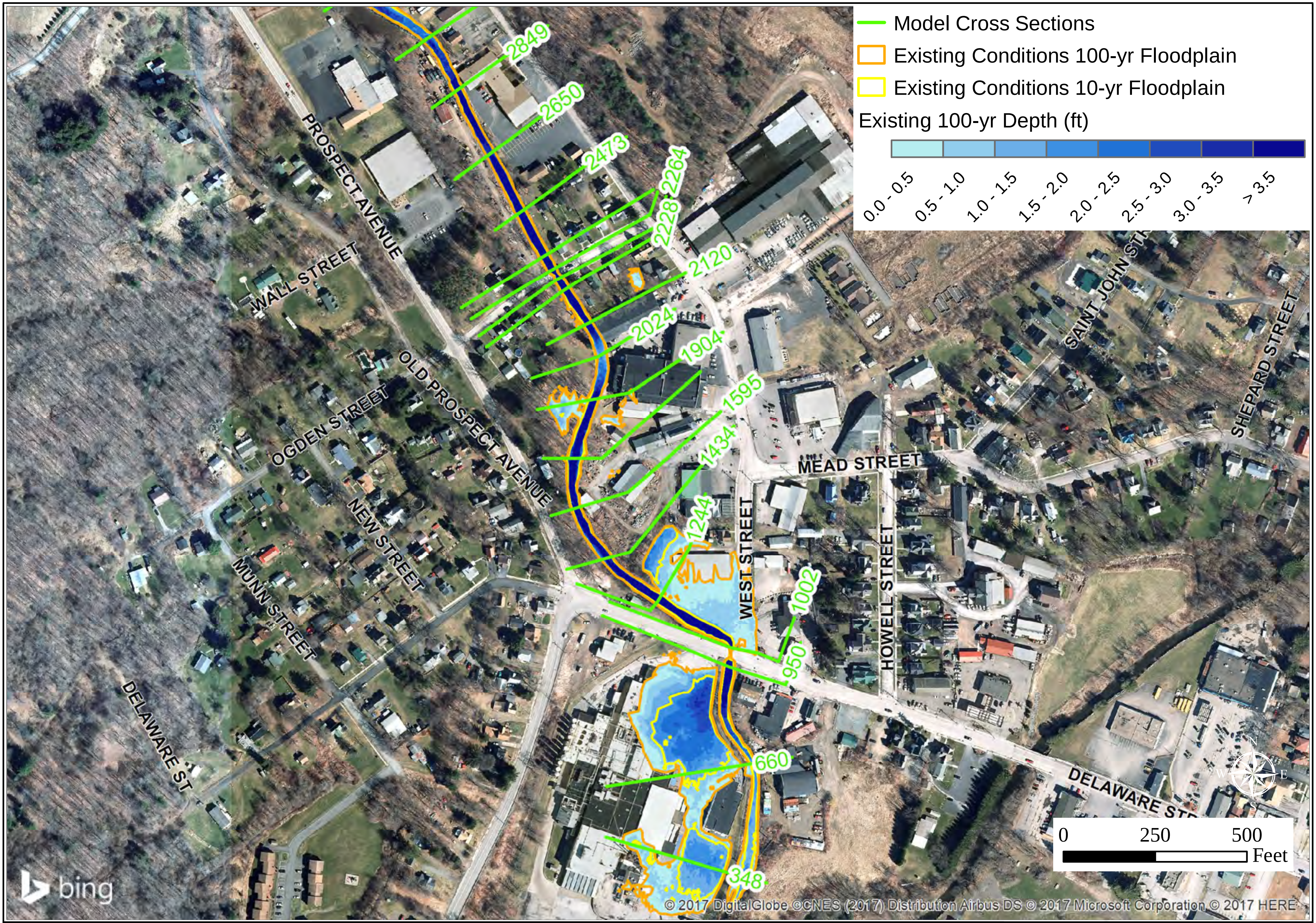
7.1 <u>Third Brook Mitigation Alternatives</u>

Hydraulic analysis was completed for Third Brook to identify possible mitigation alternatives. Alternatives presented have been chosen due to their flood reduction benefit. Additional alternatives or slight variations to the presented alternatives have been tested during evaluation. Initial alternatives were identified in the Third Brook Watershed Management Plan which was developed partly in response to the 2006 flood that devastated the Third Brook corridor. During this storm, water from Third Brook overflowed from the channel and traveled down West Street and flooded many buildings as depicted in the photograph below.

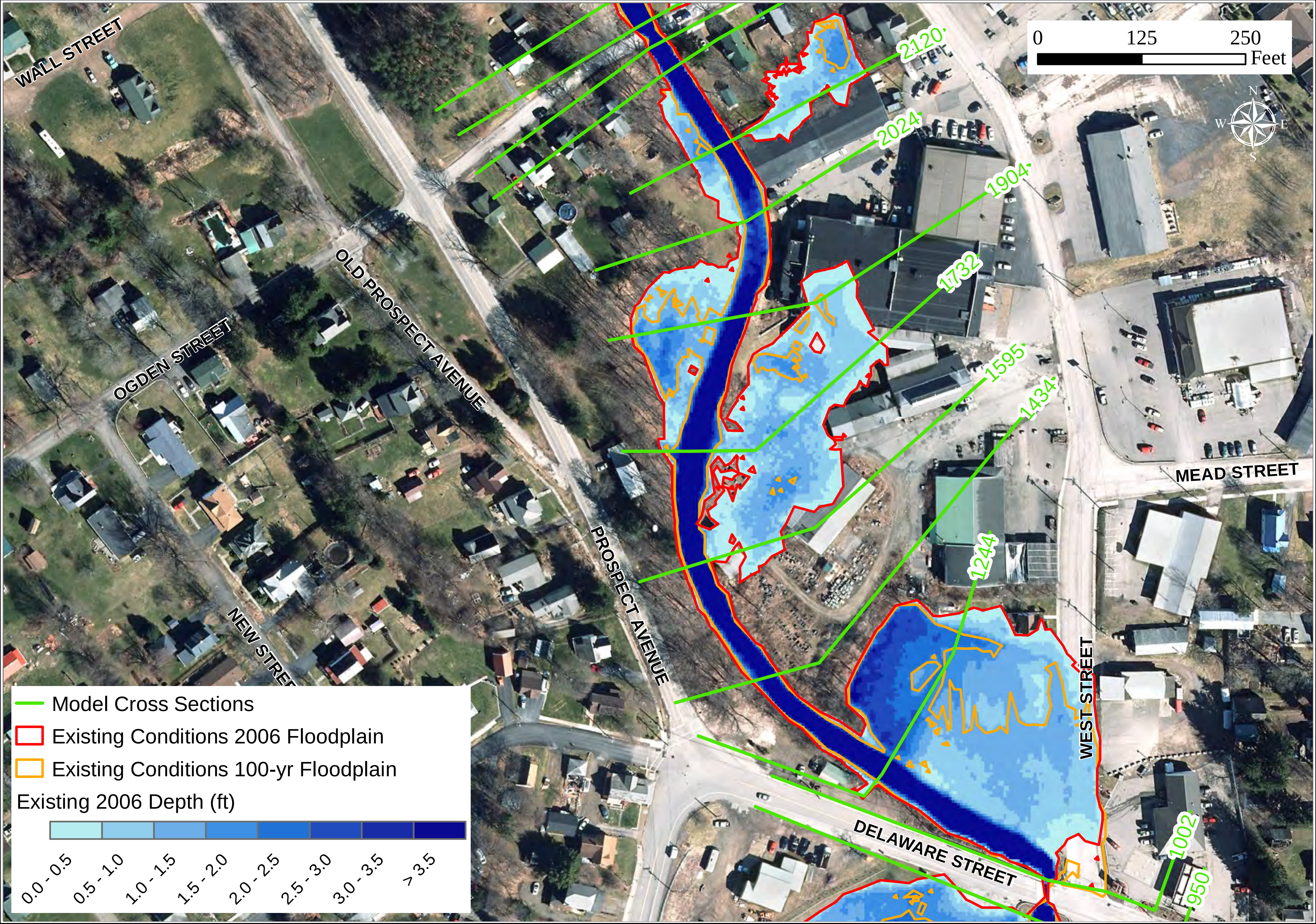
As simulated in FEMA's corrected model, the 100-year flood is contained within the channel downstream of the old reservoir and extending to the auction house, where flooding occurred during 2006 (Figure 7-1). The model of 2006 flood discharge shows more flooding outside the channel between Ogden Street and Delaware Street, but not to the extent observed during the storm (Figure 7-2). This is because the modeling assumes clear flow at the bridge, with no obstructions. This is consistent with FEMA guidelines and typical modeling practice. During the 2006 flood the bridge opening became blocked with debris, reducing flow through the bridges and forcing more water out and onto the roads and adjacent properties. Modeling was completed to simulate this debris blocked situation. Bridge openings were blocked with 4 feet of sediment and debris, causing the water surface elevation upstream of Ogden Street to rise an additional 3.3 feet for the 100-year storm and 1.5 feet for the 2006 storm and upstream of Delaware Street 1.0 feet for the 100-year storm and 2.3 feet for the 2006 storm. Once the water leaves the channel, it follows the path of least resistance, which is down West Street.

Modeled results assume a normal depth downstream boundary conditions, as though the West Branch of the Delaware River is not flooding. The backwater from the West Branch will reduce the effectiveness of the alternatives, especially at the downstream end of the model area at the confluence of Third Brook and West Brook. No effects of backwatering from the mainstem West Branch are simulated upstream of Delaware Street. These backwater effects influence only the Kraft property. FEMA also used a normal depth downstream boundary condition in their modeling of Third Brook.

Existing depth mapping has been provided as a baseline comparison for evaluation of presented alternatives (Figures 7-1 and 7-2).



SOURCE(S):	FIG. 7-1: EXISTING CONDITIONS DEPTH MAPPING LOWER THIRD BROOK	LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES	Map By: JCL	MILONE & MACBROOM
NYSDOP MMI HECRAS	MXD: Y:\5197-06\Maps\Report Figures\Fig 7-1 Third_EXdepth100_lower.mxd	LOCATION: WALTON, DELAWARE COUNTY, NY	MMI#: 5197-06 Original: 9/29/2017 Revision: 9/28/2017 Scale: 1 in = 338 ft	99 Realty Drive Cheshire, CT 06410 (203) 271-1773 Fax: (203) 272-9733 www.miloneandmacbroom.com



SOURCE(S):

NYSDOP
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N

FIG. 7-2: EXISTING CONDITIONS 2006 DEPTH MAPPING LOWER THIRD BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 7-2 Third_EX_Lower_Depth_2006.mxd

LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

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7.1.1 Third Brook Alternatives # 1 & 2 – Delaware & Ogden Street Areas (STA 950+00 to STA 3245+00)

The lower reaches of Third Brook have experienced out of bank flooding caused by a combination of a constricted channel and undersized bridges that catch debris during flooding and force water into the floodplains. A series of potential floodplain enhancement areas were identified during preparation of the Third Brook Watershed Management Plan extending from just upstream of Delaware Street up through Ogden Street to upstream of the Fire Department. These floodplains have been modeled as a group (Alternative 1).

Creation of floodplains would impact back yards of residences and businesses on both sides of the river. The most impacted properties include the materials storage area behind Harold Neale Excavating, use of most of the Del-Ton Sanitation property, use of the cut stone storage yard and removal of the old garage behind the Agway store.

The current Delaware Street bridge over Third Brook is 20 feet wide, with a severe skew which reduces hydraulic capacity to effectively only 14 feet wide. The roadway overtops for all storms with a 50-year recurrence interval and greater during clear flow and greater than the 10-year recurrence interval when blocked with debris.

The current Ogden Street bridge over Third Brook is 23 feet wide. Modeling shows that the roadway overtops during the 500-year and simulation of the 2006 storm during clear flow and during the 10-year storm when blocked with debris.

MMI modeled wider bridges, maximizing the capacity of the bridges, while minimizing the impact to surrounding properties. A bridge span of 50 feet was modeled at both locations, along with the floodplain creation (Alternative 2). Table 7-1 provides water surface elevations at cross sections upstream and downstream of the bridge. Figures 7-3 to 7-6 depicts the Delaware and Ogden Street alternatives.

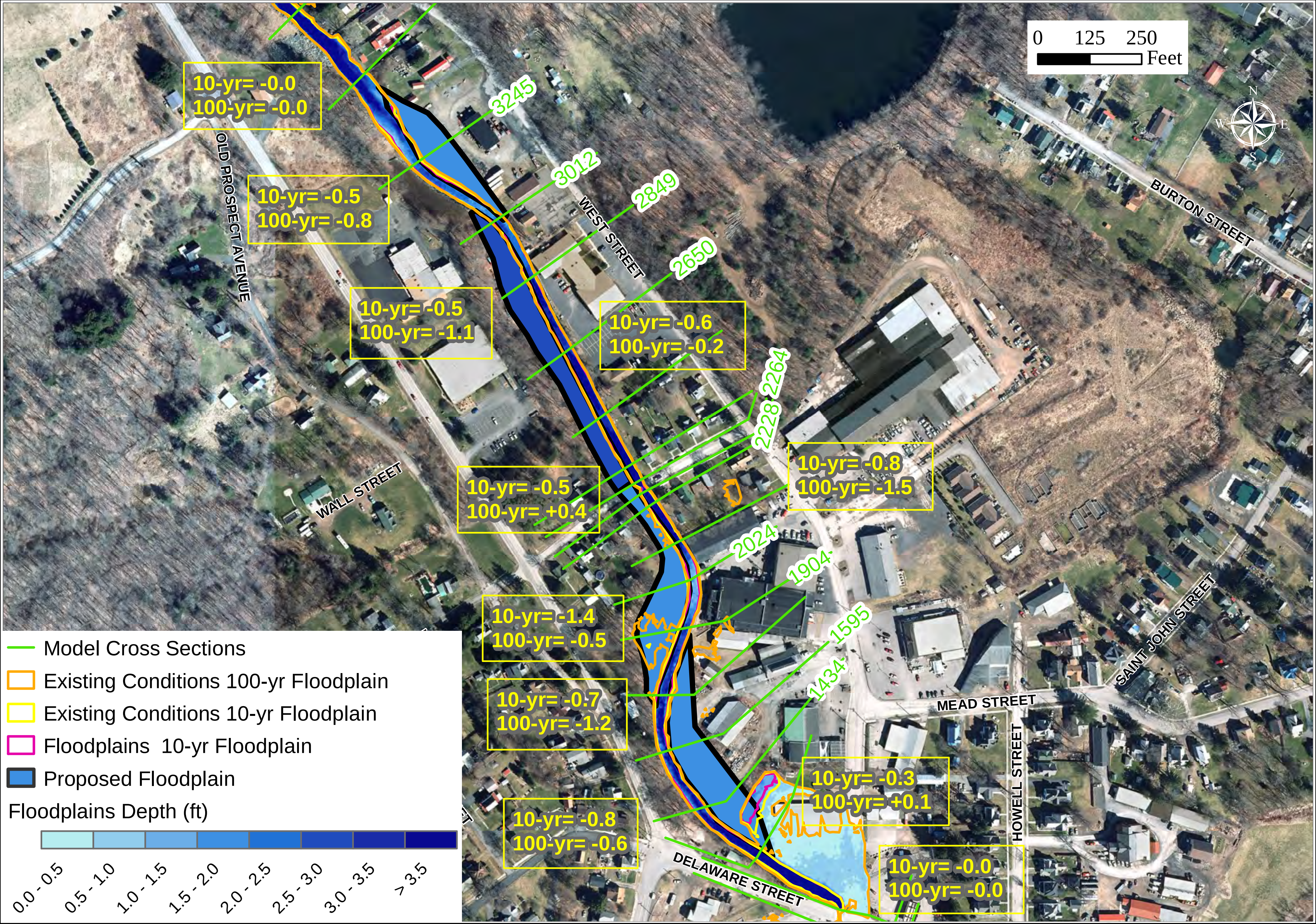
Modeling demonstrated the following:

- Although many buildings are not mapped within 100-year floodplain, there continues to be a flood risk due to the small size of the bridges and their risk of clogging.
- Bridge replacements show significantly lower flood water surfaces upstream of the bridges.
- Properties located near the bridges do not see flood benefits of just the floodplain creation without also replacing the bridges.
- Floodplain creation significantly reduces water surface elevations along the channel.

Klinger Power Sports is an example of a property that benefits most from floodplain and bridge improvements. For Alternative #1 water surface elevation was reduced 1.7 feet for the 100-year flood. The Walton Fire Department sees a water surface reduction of 1.1 feet for the 100-year flood.

TABLE 7-1
Comparison of Water Surface Elevations near Delaware & Ogden Streets
[feet NAVD88]

		100-year			2006 Flood		
River Station	Location	Existing Conditions	Net Change Alt. 1 (FP only)	Net Change Alt. 2 (FP + Bridges)	Existing Conditions	Net Change Alt. 1 (FP only)	Net Change Alt. 2 (FP + Bridges)
3491		1273.5	0.0	0.0	1274.3	0.0	0.0
3245		1265.2	-0.8	-0.8	1266.2	-1.4	-1.4
3012		1258.1	-0.4	-0.4	1259.5	-0.7	-0.7
2849	Fire Department	1256.2	-1.1	-1.1	1257.7	-2.3	-2.3
2650	Fire Dept. Parking	1250.8	-0.2	-0.2	1251.8	-0.2	-0.2
2473		1247.4	-0.7	-0.7	1249.0	-0.6	-1.4
2336		1245.2	0.5	-1.2	1247.7	0.7	-2.2
2293	Homes on Ogden	1244.8	0.4	-1.3	1247.4	0.6	-2.3
2279	Ogden St. Bridge		0.0	0.0		0.0	0.0
2264	Homes on Ogden	1243.7	-1.8	-0.7	1244.8	-0.8	-0.2
2228		1243.5	-1.5	-1.5	1243.5	-1.0	-0.4
2120		1240.6	-0.8	-0.8	1242.6	-1.7	-1.7
2024		1236.1	-0.5	-0.5	1237.3	-1.3	-1.3
1904	Klinger Power Sports	1235.9	-1.7	-1.7	1236.8	-1.8	-1.8
1732	Self-Storage	1232.3	-1.2	-1.2	1234.1	-2.2	-2.2
1595		1229.1	-1.5	-1.5	1231.2	-2.9	-2.9
1434	Agway	1225.0	-0.6	-0.3	1225.7	-0.3	-0.1
1244	9 West Street	1223.0	0.0	-1.3	1225.1	-0.1	-2.4
1002	Hess Gas Station	1221.8	0.0	-4.4	1221.2	0.0	-2.4
980	Delaware St. Bridge		0.0	0.0		0.0	0.0
950	Kraft / TA's Place	1218.0	0.0	-2.0	1220.1	0.0	-3.0
660	Kraft Foods	1210.0	0.0	0.0	1211.1	0.0	0.0



SOURCE(S):

NYSDOP
MMI HECRAS

FIG. 7-3: FLOODPLAINS DEPTH MAPPING THIRD BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 7-3 Third_FP-WSPlan_Lower_Depth.mxd

LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By:	JCL
MMI#:	5197-06
Original:	12/23/2015
Revision:	9/28/2017
Scale:	1 in = 300 ft

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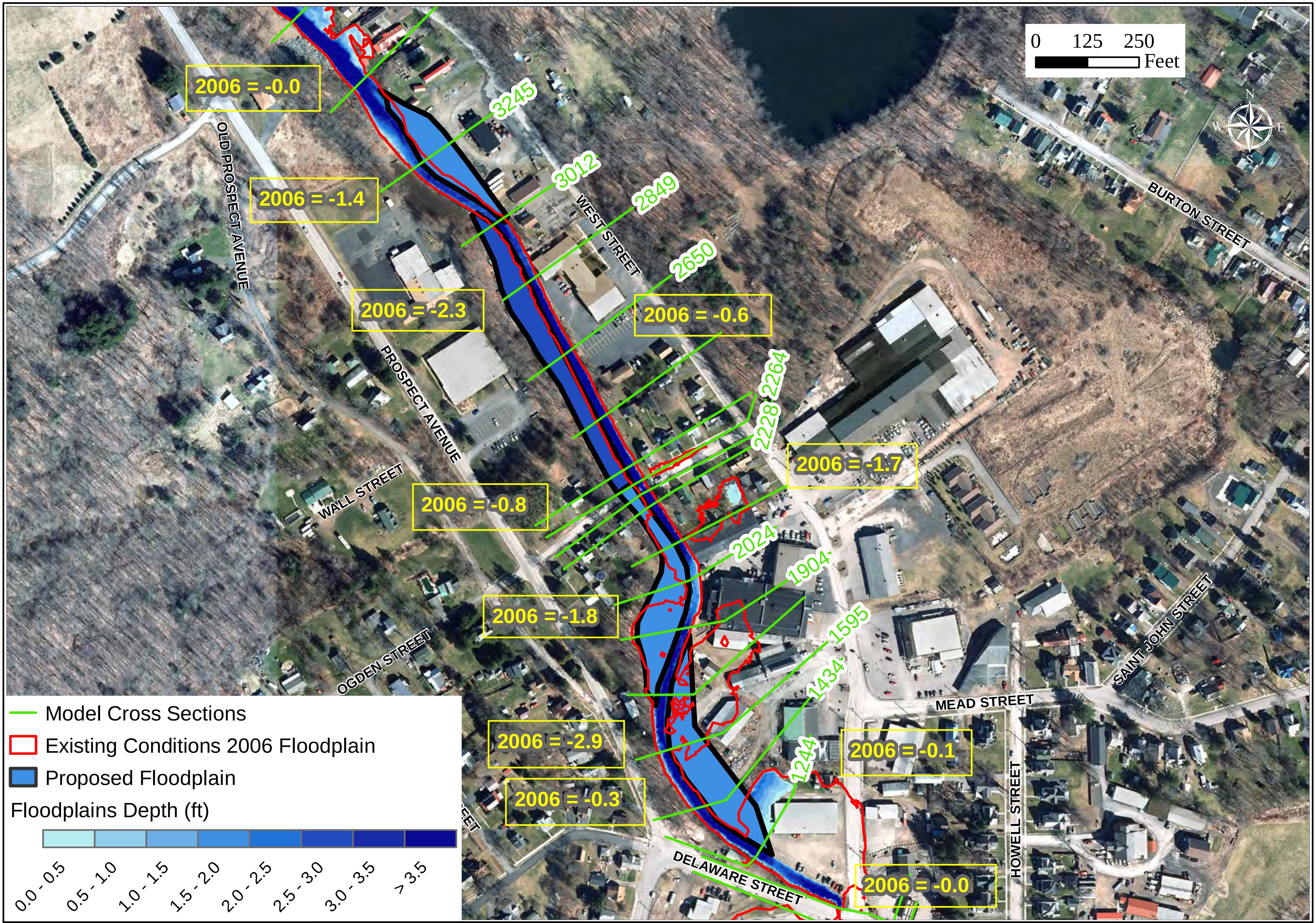

SOURCE(S):

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FIG. 7-4: FLOODPLAINS
2006 DEPTH MAPPING
THIRD BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 7-4 Third_FP-WSPlan_Lower_2006.mxd

LOCAL FLOOD ANALYSIS
WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By:	JCL
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Original:	12/23/2015
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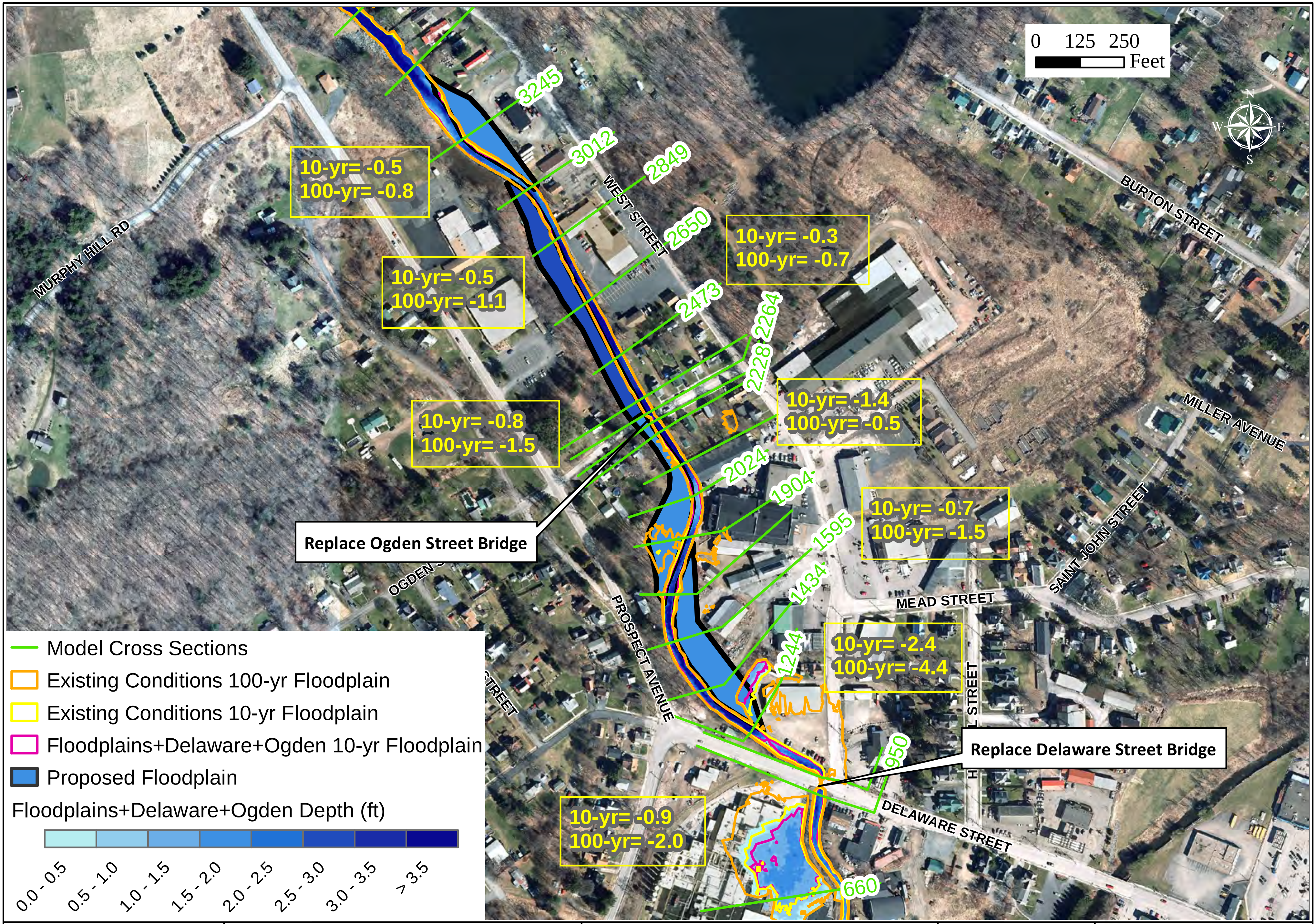
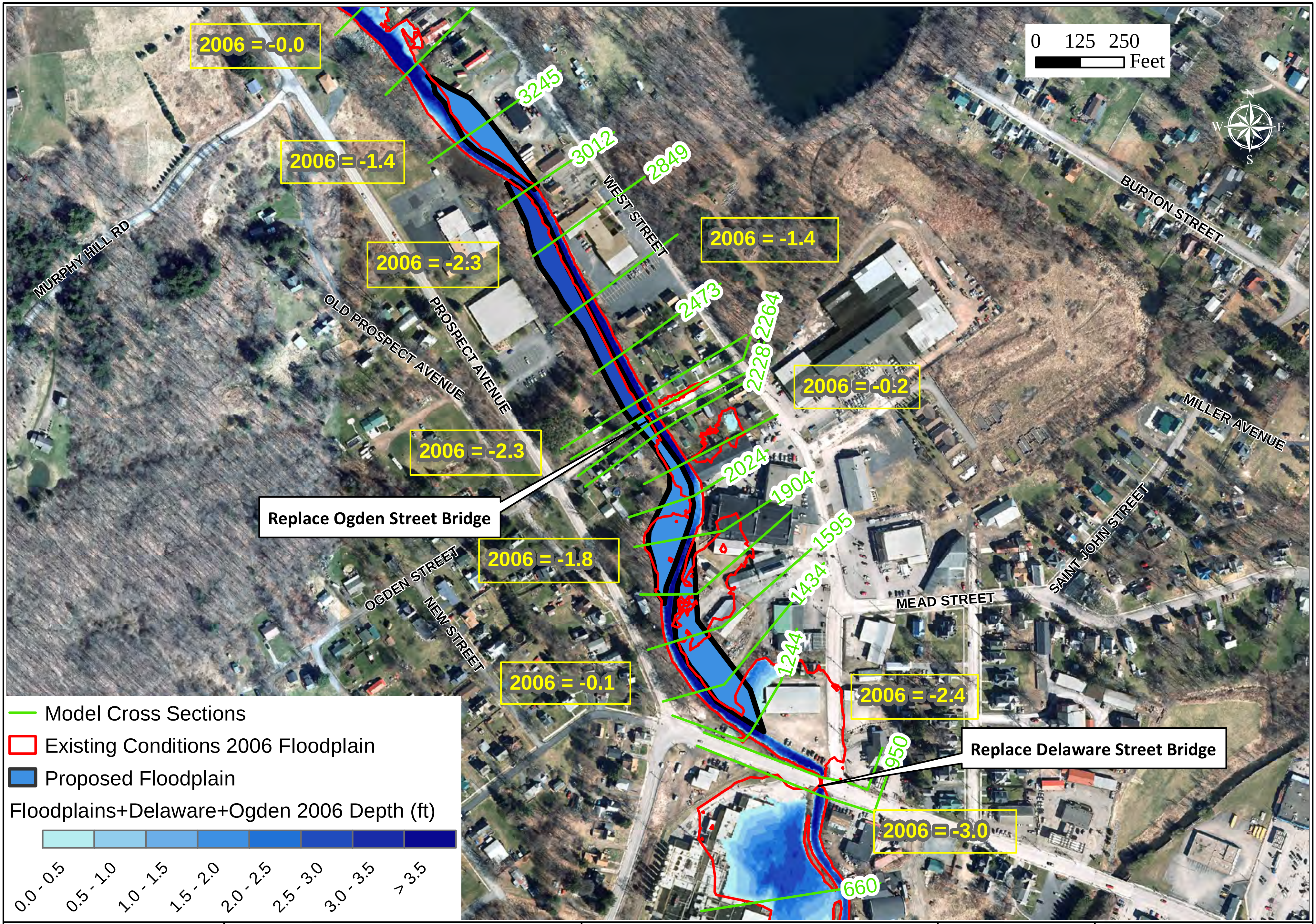


SOURCE(S): NYSDOP, MMI HECRAS	FIG. 7-5: FLOODPLAINS+ DELAWARE+OGDEN DEPTH MAPPING THIRD BROOK	LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES	Map By: JCL	MILONE & MACBROOM
N	MXD: Y:\5197-06\Maps\Report Figures\Fig 7-5 Third_FP-and Bridge.mxd	LOCATION: WALTON, DELAWARE COUNTY, NY	MMI#: 5197-06; Original: 12/23/2015; Revision: 9/28/2017; Scale: 1 in = 350 ft	99 Realty Drive Cheshire, CT 06410; (203) 271-1773 Fax: (203) 272-9733; www.miloneandmacbroom.com



SOURCE(S):

NYSDOP
MMI HECRAS

FIG. 7-6: FLOODPLAINS+ DELAWARE+OGDEN 2006 DEPTH MAPPING THIRD BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 7-6 Third_FP-and Bridge_2006.mxd

LOCAL FLOOD ANALYSIS
WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By: JCL
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Original: 12/23/2015
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7.1.2 Third Brook Alternative # 3 – Kraft Foods Area (STA 20+00 to STA 1002+00)

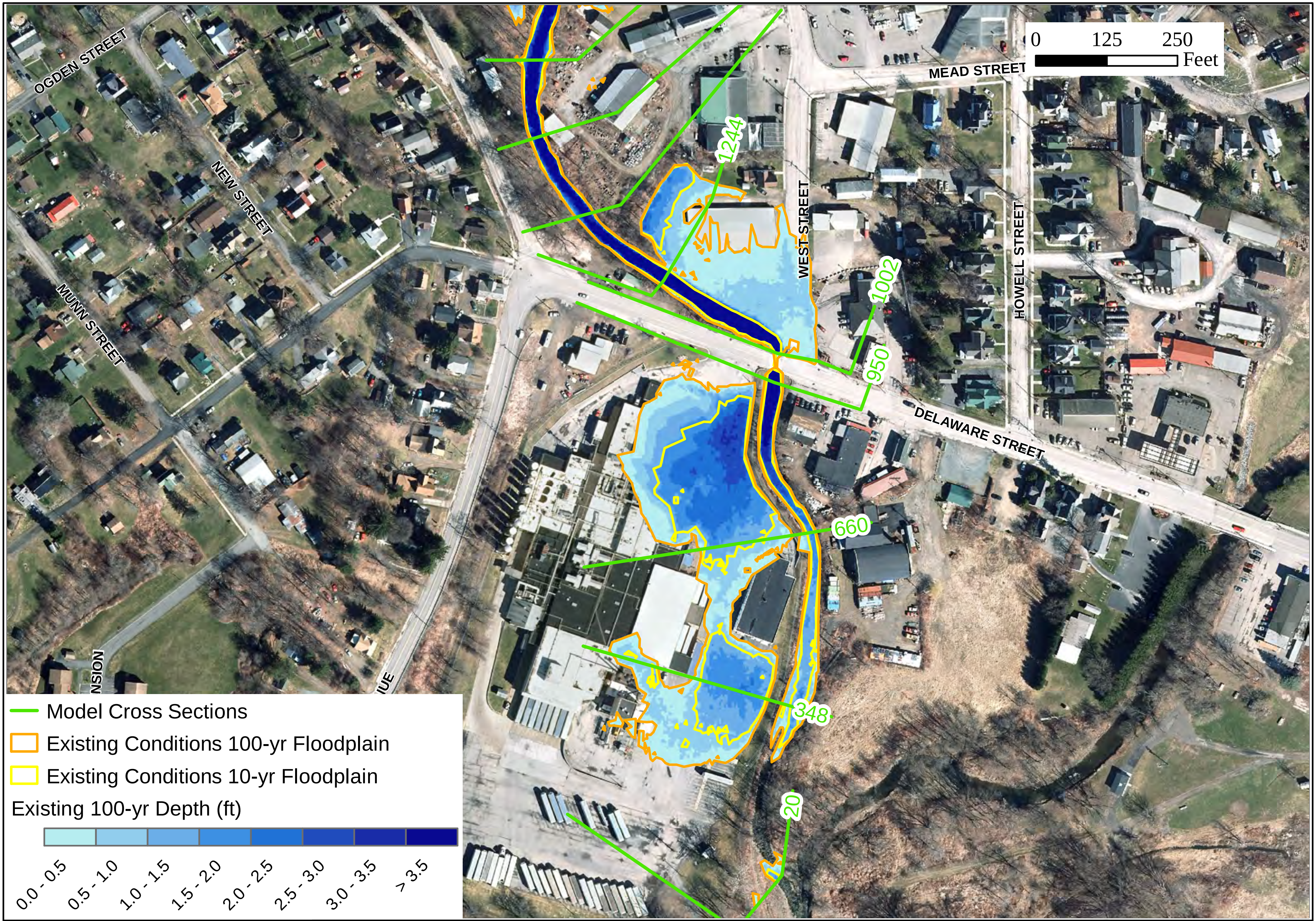
The Walton Flood Commission reported that a small stream may have been located historically on the West side of the Kraft property and therefore this area could potentially be used to bypass flood flows in the future. A bypass culvert and channel were tested that would allow water to flow under Delaware Street to the west of the existing Delaware Street bridge and flow behind (on the west side of) the Kraft building, parallel to Prospect Avenue (Alternative 3). The bypass culvert would be 25 feet wide by 4 feet tall and 110 feet long. The culverts upstream invert would be set at the 2-year flood elevation, so that all non-flood flows would continue down the existing Third Brook channel and only a portion of the flood flows larger than the 2-year storm would enter the bypass. There is not much space behind the Kraft building and the bypass channel will likely require installation of retaining walls along the road in order to fit. Table 7-2 provides water surface elevations near Kraft Foods. Existing conditions hydraulic conditions have been depicted for comparison in Figures 7-7 and 7-8. Figures 7-9 and 7-10 depicts the Kraft Foods area alternatives.

Modeling demonstrated the following:

- The bypass channel allows approximately 100 cfs to leave the channel (10% of the flood discharge) for the 100-year flood and approximately 190 cfs to leave the channel (11 % of the flood discharge) for the 2006 flood. Higher volumes cannot be removed from the main channel of Third Brook without significant alterations to hydraulics.
- Although flood water surface elevations would be reduced very slightly, Kraft Foods would still experience flooding with this alternative in place.

TABLE 7-2
Comparison of Water Surface Elevations near Kraft Foods
[feet NAVD88]

		100-year		2006 Flood	
River Station	Location	Existing Conditions	Net Change Alt. 3	Existing Conditions	Net Change Alt. 3
1595		1229.1	0.0	1231.2	0.0
1434	Agway	1225.0	-0.4	1225.7	-0.8
1244	9 West Street	1223.0	-0.3	1225.1	-0.5
1002	Hess Gas Station	1221.8	-0.2	1221.2	0.5
980	Delaware St. Bridge				
950	Kraft / TA's Place	1218.0	-0.3	1220.1	-0.5
660	Kraft Foods	1210.0	-0.2	1211.1	-0.3
348	Kraft Foods	1206.0	-0.2	1207.2	-0.3
20	US of West Brook	1200.3	-0.2	1202.1	-0.8



SOURCE(S):

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FIG. 7-7: EXISTING CONDITIONS DEPTH MAPPING THIRD BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 7-7 Third_EX-Kraft_D100.mxd

LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

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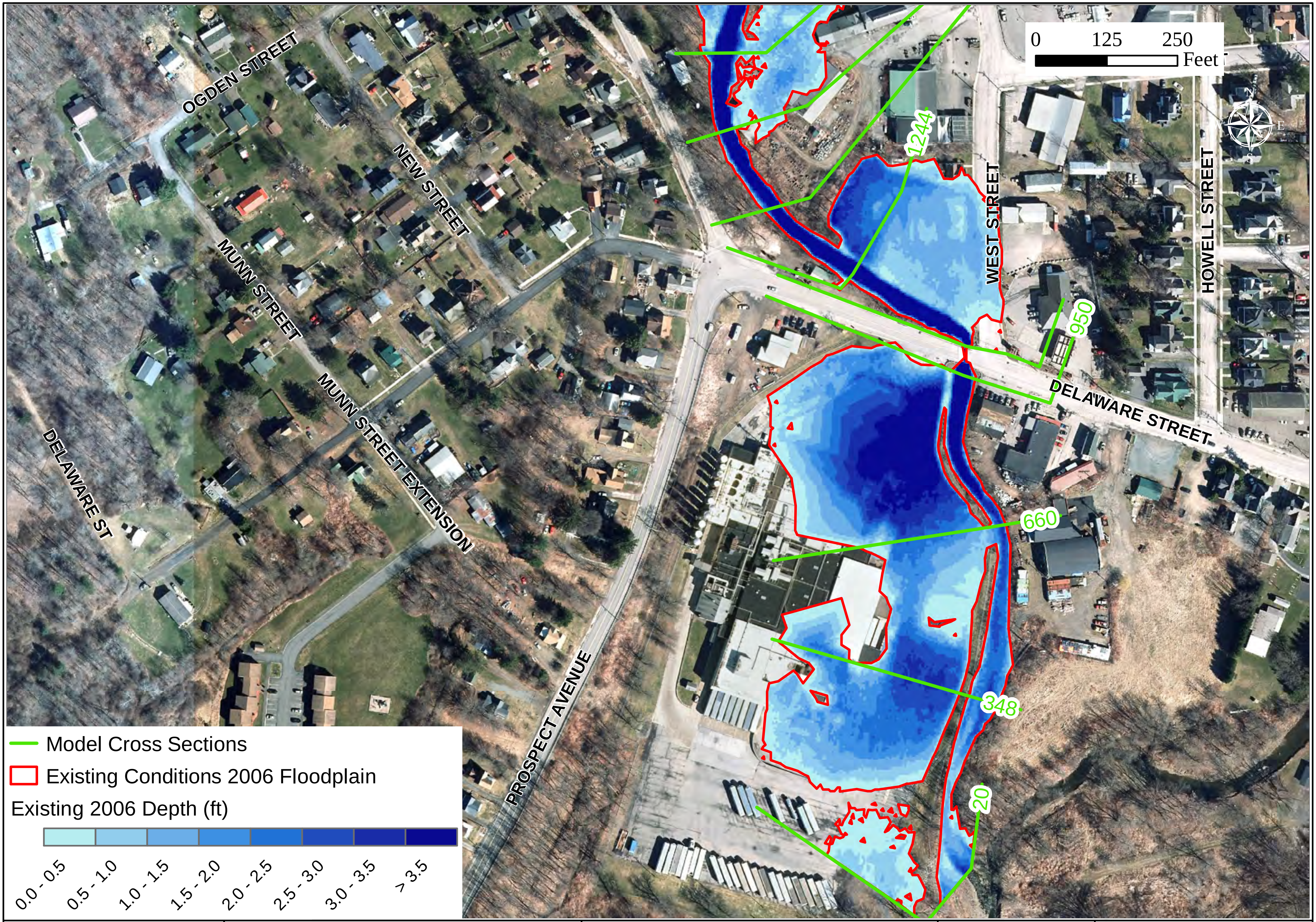

SOURCE(S):

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FIG. 7-8: EXISTING CONDITIONS 2006 DEPTH MAPPING THIRD BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 7-8 Third_EX-Kraft_D2006.mxd

LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By: JCL
MMI#: 5197-06
Original: 2/1/2016
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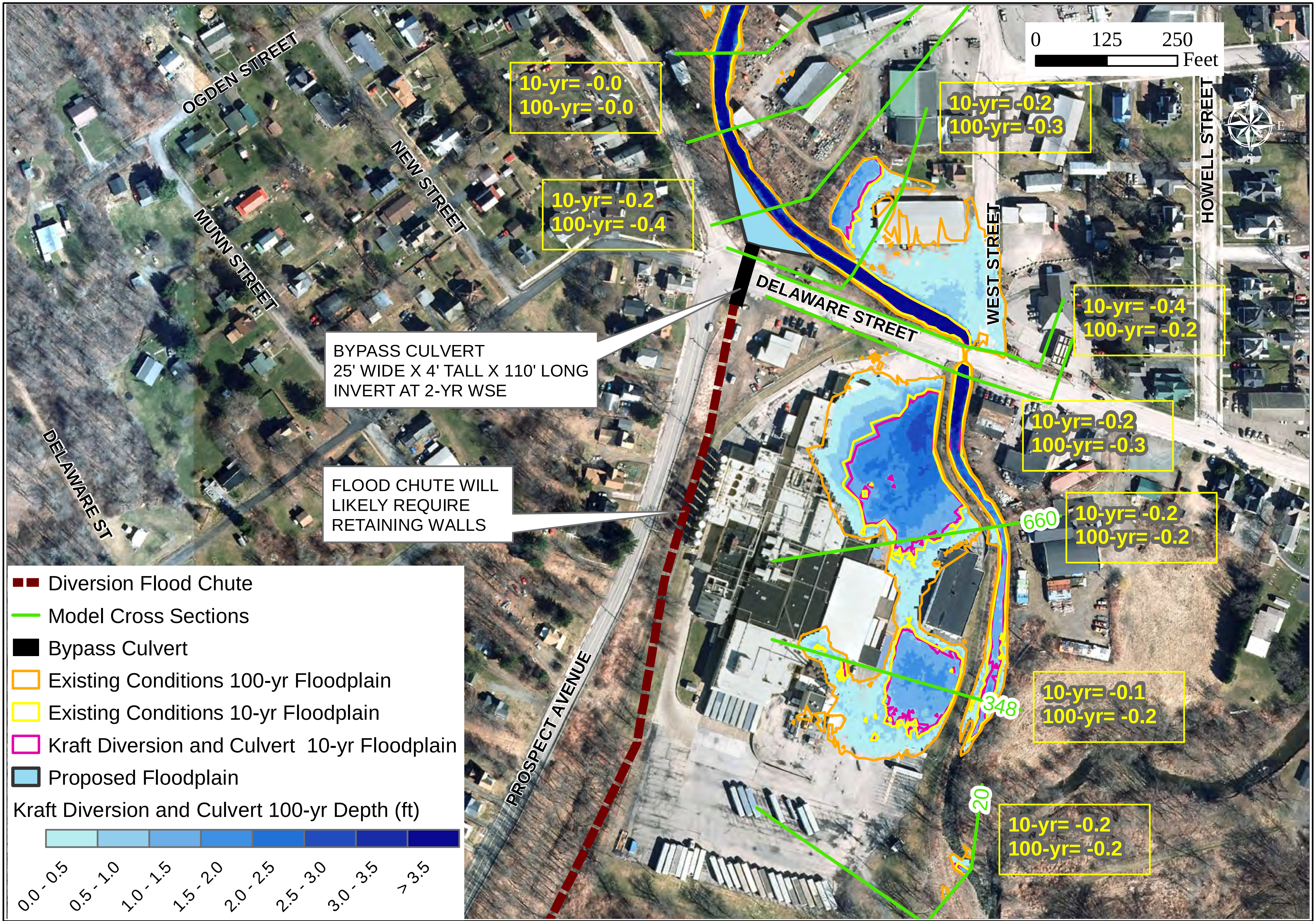

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FIG. 7.9: DIVERSION FLOOD CHUTE +BYPASS CULVERT DEPTH MAPPING THIRD BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 7-9 Third_KraftBypass_Lower_Depths.mxd

LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

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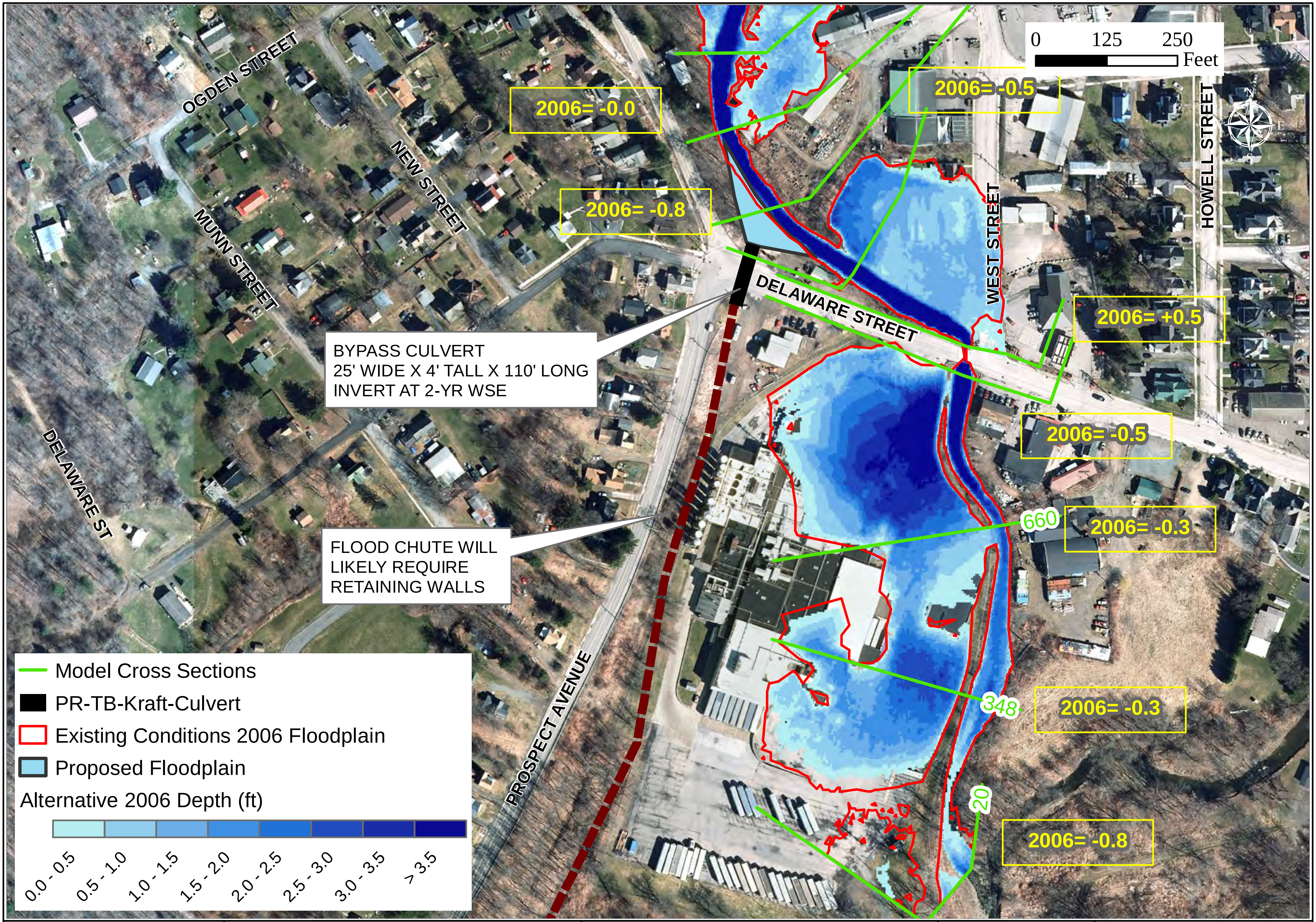


SOURCE(S): NYSDOP MMI HECRAS	FIG. 7-10: DIVERSION CHUTE + BYPASS CULVERT 2006 DEPTH MAPPING - THIRD BROOK	LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES	Map By: JCL	MILONE & MACBROOM
	MXD: Y:\5197-06\Maps\Report Figures\Fig 7-10 Third_KraftBypass_Lower_D2006.mxd	LOCATION: WALTON, DELAWARE COUNTY, NY	MMI#: 5197-06 Original: 2/1/2016 Revision: Scale: 1 in = 218 ft	99 Realty Drive Cheshire, CT 06410 (203) 271-1773 Fax: (203) 272-9733 www.miloneandmacbroom.com

7.1.3 Third Brook Alternative # 4 – Upstream Area (STA 7010+00 to STA 7211+00)

A floodplain was tested in the upstream portion of the model along Lower Third Brook Road where a handful of homes are present on the west side of the road. This is located between two previous erosion locations identified as EWP sites 8 and 9. The floodplain was set at the bankfull water surface elevation and sloped up to existing grade at a 3:1 slope and extending 260 feet along the bank with an average width of 40 feet. No infrastructure or buildings would need to be removed to create the floodplain.

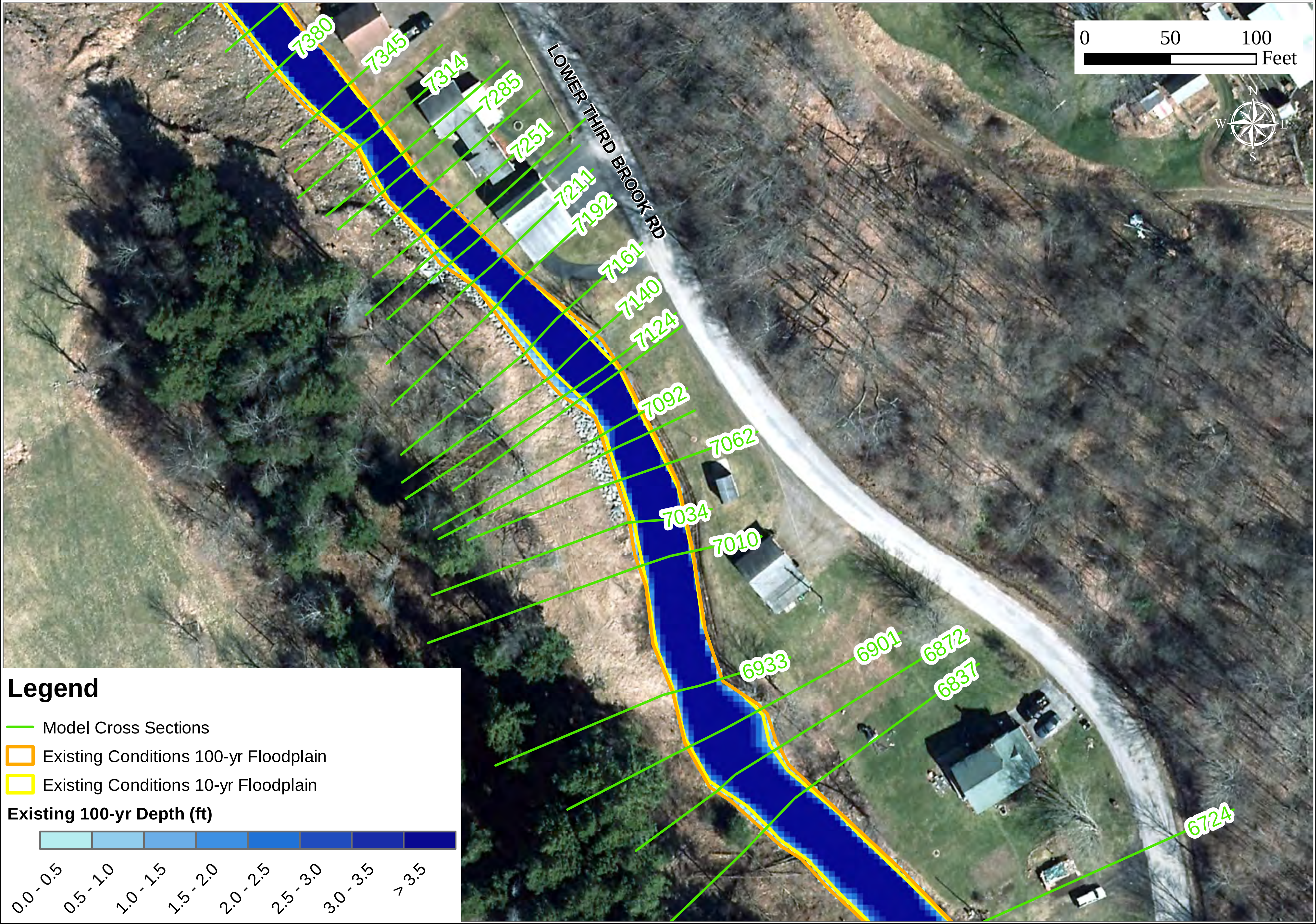
Table 7-3 provides water surface elevations at the Upstream Area. Existing conditions hydraulic conditions have been depicted for comparison in Figures 7-11 and 7-12. Figures 7-13 and 7-14 depicts the upstream area alternatives.

Modeling demonstrated the following:

- The flood extents of the existing 100-year and 2006 flood do not show inundation of the adjacent homes.
- Flood water surface elevations would be reduced in this residential area by up to 3.0 feet for the 100-year storm and up to 4.4 feet for the 2006 flood.

TABLE 7-3
Comparison of Water Surface Elevations at Upstream Area
[feet NAVD88]

	100-year		2006 Flood	
River Station	Existing Conditions	Net Change Alt. 4	Existing Conditions	Net Change Alt. 4
7228	1366.7	0.0	1368.5	0.0
7211	1366.5	-0.5	1368.2	-0.5
7192	1365.8	-0.4	1367.8	-0.9
7161	1365.8	-1.8	1367.9	-2.5
7140	1365.5	-2.0	1367.8	-3.3
7124	1365.7	-3.0	1368.0	-4.4
7117	1363.9	-1.5	1366.1	-2.8
7092	1363.0	-1.4	1365.1	-1.6
7081	1362.6	-1.3	1364.5	-1.1
7062	1362.4	-1.3	1364.4	-1.1
7034	1362.0	-1.0	1364.0	-0.7
7010	1360.7	0.1	1362.4	0.7
6933	1358.4	0.0	1360.2	0.0



SOURCE(S):

NYSDOP
MMI HECRAS

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FIG. 7-11: EXISTING CONDITIONS DEPTH MAPPING THIRD BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 7-11 Third_EXsub_US_D-100.mxd

LOCAL FLOOD ANALYSIS
WEST BRANCH TRIBUTARIES

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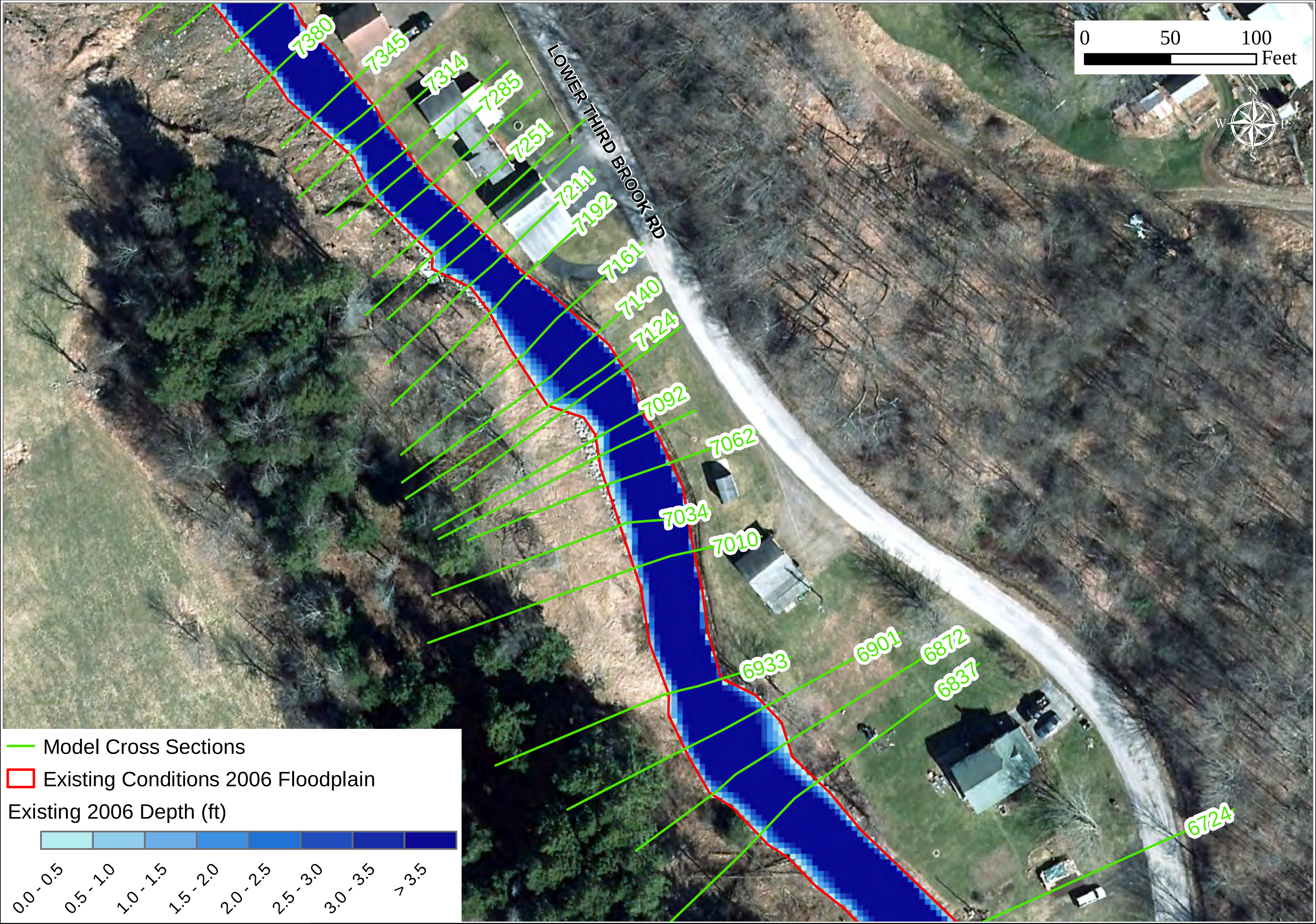

SOURCE(S):

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MMI HECRAS

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FIG. 7-12: EXISTING CONDITIONS
2006 DEPTH MAPPING
THIRD BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 7-12 Third_EXsub_US_D-2006.mxd

LOCAL FLOOD ANALYSIS
WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By: JCL
MMI#: 5197-06
Original: 2/2/2016
Revision: 10/3/2017
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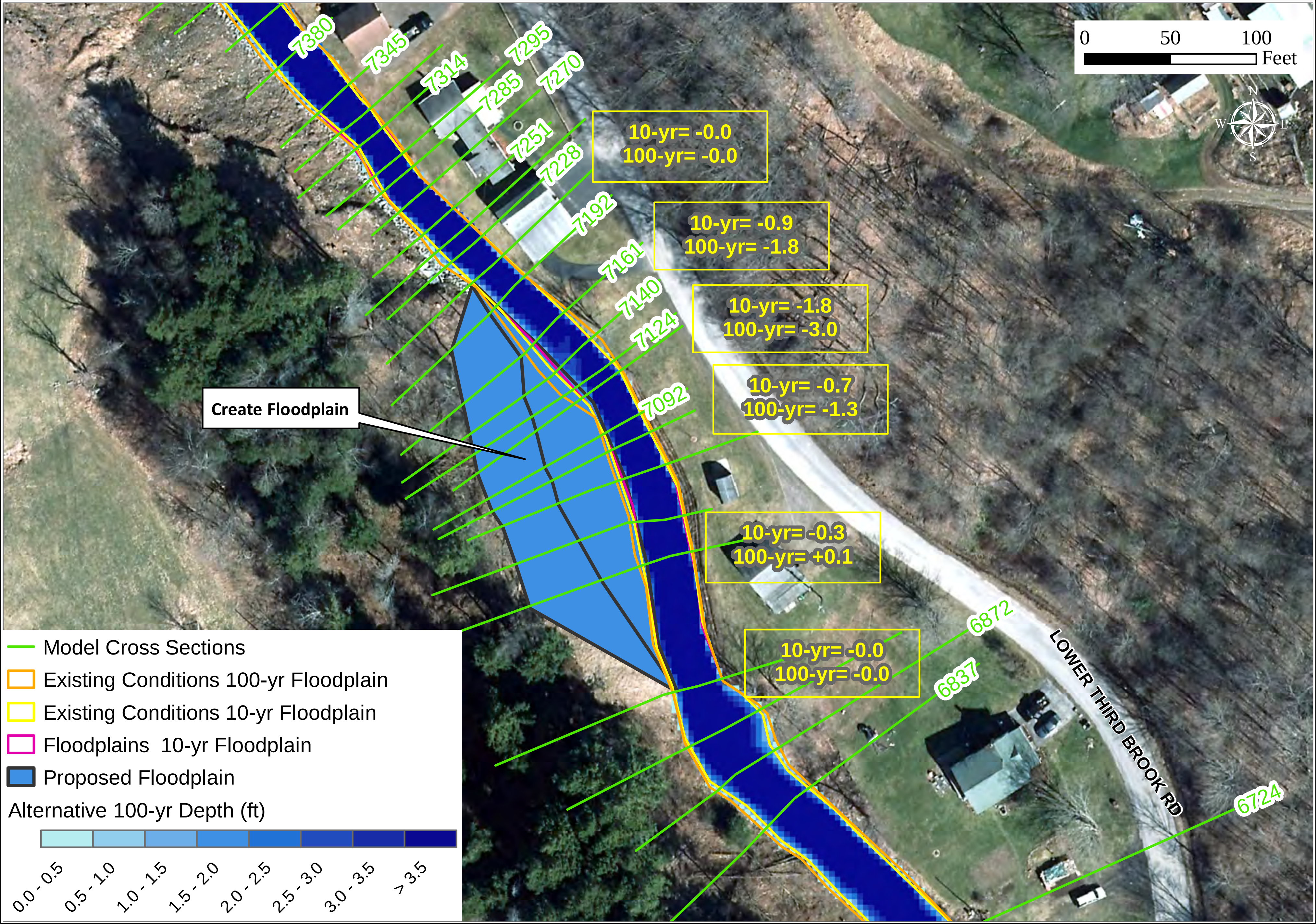

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FIG. 7-13: EWP SITES 8+9
FLOODPLAINS DEPTH MAPPING
THIRD BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 7-13 Third_FP-Site8-9_US_Depths.mxd

LOCAL FLOOD ANALYSIS
WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

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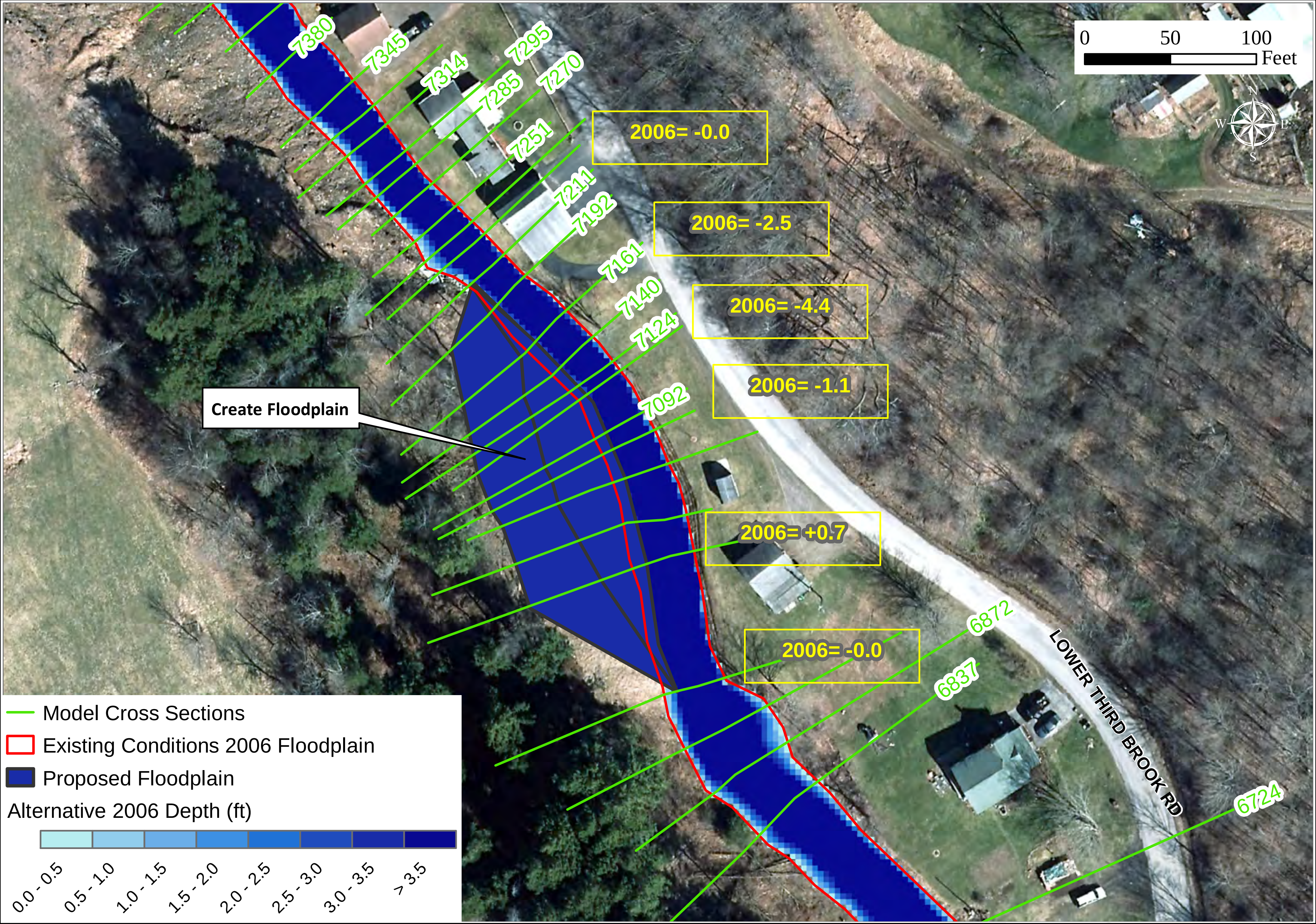

SOURCE(S):

NYSDOP
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FIG. 7-14: EWP SITES 8+9 FLOODPLAINS DEPTH MAPPING THIRD BROOK

MXD: Y:\5197-06\Maps\Report Figures\Fig 7-14 Third_FP-Site8-9_US_D-2006.mxd

LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

Map By: JCL
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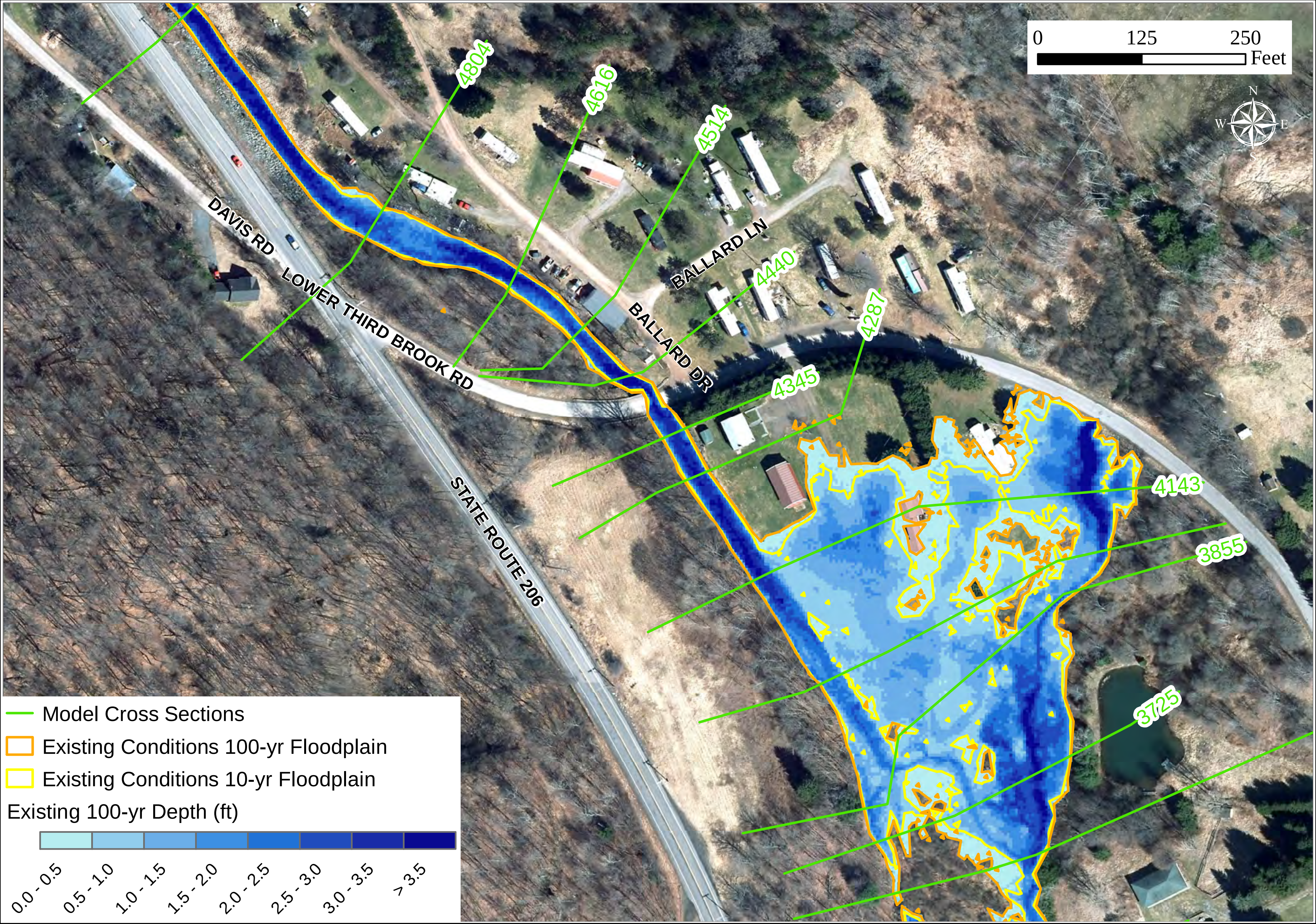
7.1.4 Third Brook Upper Crossings

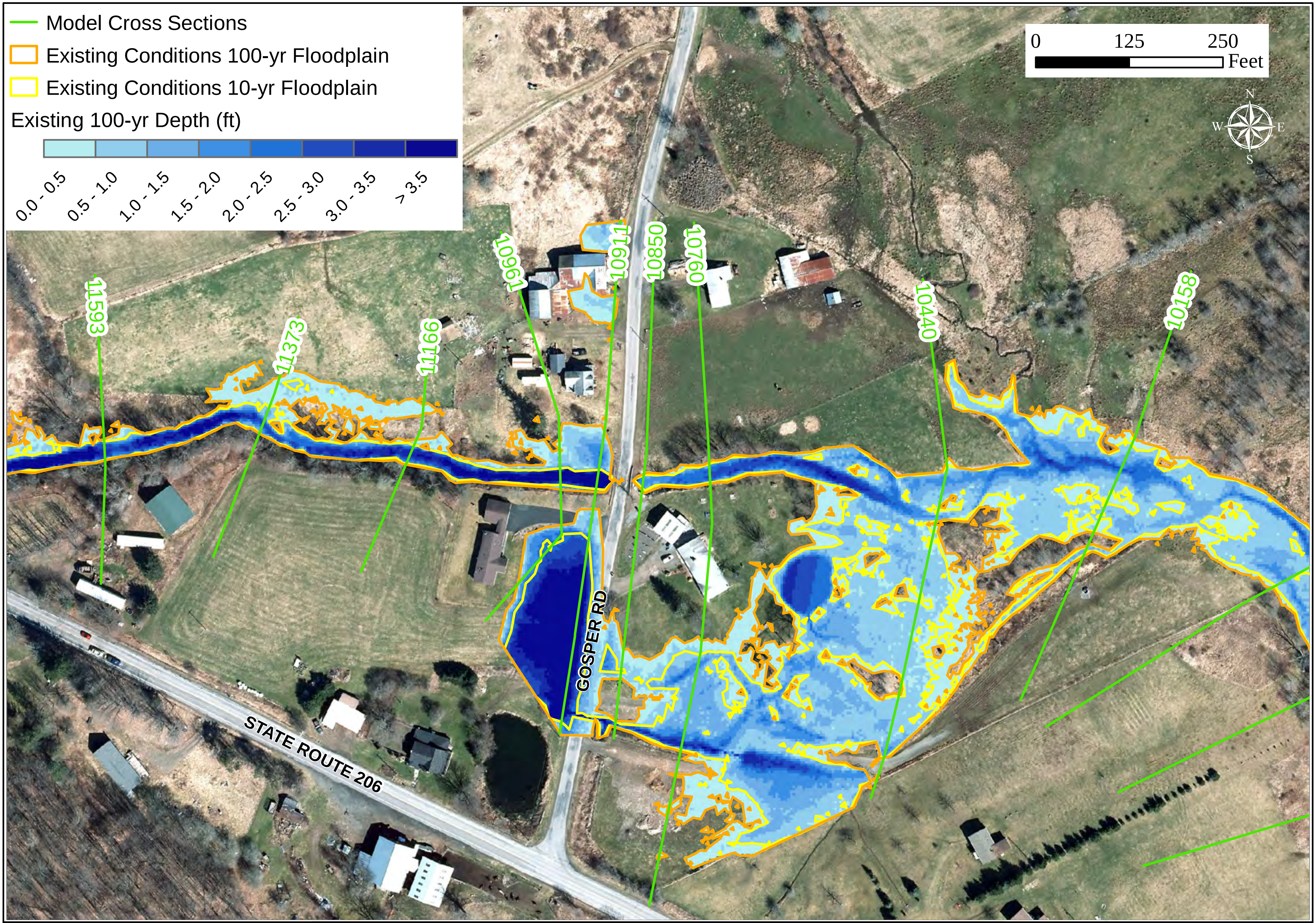
Two additional road crossing structures were examined on Third Brook, upstream of the project area. Upper Third brook was included in a detailed FEMA study completed as part of the NYCWOH study, separately from the model for the lower portion of the brook that included the rest of the analysis on Third Brook. The FEMA model was received from Phil Eskeli at NYC DEP February 3, 2016. A duplicate model was used with no changes from the received FEMA model.

Lower Third Brook Road crosses Third Brook almost 2 miles upstream of Ogden Street. This crossing is a 24 foot wide bridge and is included in the FEMA modeling. Modeling shows that all flows, including the 500-year discharge, are contained within the bridge and channel with significant freeboard. The FEMA mapping shows no nearby flooding. No alternatives were examined at the bridge. Existing conditions depth mapping has been included for the area around the bridge (Figure 7-15).

Gosper Road crosses Third Brook approximately 1 mile upstream of Lower Third Brook Road crossing. The crossing is a 6.7 foot diameter culvert with stone headwalls. This location has experienced flooding and the headwall required rehabilitation. The culvert is not located at a low point in the road. The low point is located to the south of the culvert. The modeling shows that the 50-year storm and all larger storms will flood over the road at the low point. The four downstream sections and two upstream sections all show overbank flow in the south floodplain. A larger structure could possibly reduce flooding over the road and in the two upstream sections. Replacement of the structure is not expected to reduce flooding at any buildings without increasing channel and floodplain capacity downstream, which would be challenging given the flat topography. Existing conditions depth mapping has been included for the area around the bridge (Figure 7-16).



SOURCE(S): NYSDOP MMI HECRAS	FIG. 7-15: LOWER THIRD BROOK RD EXISTING CONDITIONS DEPTH MAPPING MXD: Y:\5197-06\Maps\Report Figures\Fig 7-15 Lower_Third_Existing_Depth.mxd	LOCAL FLOOD ANALYSIS WEST BRANCH TRIBUTARIES LOCATION: WALTON, DELAWARE COUNTY, NY	Map By: JCL MMI#: 5197-06 Original: 6/27/2016 Revision: 10/3/2017 Scale: 1 in = 150 ft	MILONE & MACBROOM 99 Realty Drive Cheshire, CT 06410 (203) 271-1773 Fax: (203) 272-9733 www.miloneandmacbroom.com



SOURCE(S):

NYSDOP
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FIG. 7-16: THIRD BROOK EXISTING CONDITIONS GOSPER ROAD DEPTH MAPPING

MXD: Y:\5197-06\Maps\Report Figures\Fig 7-16 Third_Gosper_Existing_Depth.mxd

LOCAL FLOOD ANALYSIS
WEST BRANCH TRIBUTARIES

LOCATION: WALTON, DELAWARE COUNTY, NY

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MMI#: 5197-06
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7.2 Third Brook BCA

Along Third Brook, damage is caused only in the most severe floods. This does not allow the BCA program to correctly generate benefits. Therefore, BCA benefits were not calculated for the projects along Third Brook. The cost estimates in section 7.2.1 show that the majority of project costs for Alternatives 1 and 2 would come from the Delaware and Ogden Street bridge replacements.

7.2.1 Costs Associated with Floodplain Enhancement and Creation Projects

Conceptual cost estimates were prepared for the components of proposed alternatives 1 and 2. The building removal costs are a combination of the Assessor's building value and an estimated demolition cost. Cost estimate documentation is provided in Appendix B. Table 7-4 lists the individual costs.

TABLE 7-4
Summary of Costs for Individual Components

<table>
<tr><th colspan="2">Alternative</th><th>Partial Cost Estimate</th><th>Total Cost</th></tr>
<tr><td rowspan="6">1</td><td>Lower floodplain behind Klinger</td><td>$221,000</td><td rowspan="6">$662,000</td></tr>
<tr><td>Remove garages</td><td>$10,000</td></tr>
<tr><td>Middle floodplain along Del-Ton</td><td>$312,000</td></tr>
<tr><td>Remove garages</td><td>$10,000</td></tr>
<tr><td>Upper floodplain project behind Neale</td><td>$99,000</td></tr>
<tr><td>Remove garages</td><td>$10,000</td></tr>
<tr><td rowspan="4">2</td><td>Delaware Street bridge replacement</td><td>$1,100,000</td><td rowspan="4">$2,862,000</td></tr>
<tr><td>Ogden Street bridge replacement</td><td>$1,100,000</td></tr>
<tr><td>Upper, middle and lower floodplains</td><td>$632,000</td></tr>
<tr><td>Remove garages</td><td>$30,000</td></tr>
</table>

In all cases, the cost estimates should not be construed as likely construction costs. These are strictly for planning purposes and evaluating cost effectiveness.

8.0 FINDINGS, RECOMMENDATIONS, AND IMPLEMENTATION

8.1 Summary of Findings

The LFA completed for Walton has demonstrated that several flood mitigation projects have merit because they will reduce flood water surface elevations in the village. These projects largely depend on the enhancement of existing floodplains and creation of lower floodplains coupled with a handful of strategic building removals and business relocations.

Based on the BCA conducted for this LFA (and its underlying assumptions), two flood mitigation alternatives (Alternatives 1 and 2 on West Brook) have a BCR above 1.0 and one alternative (Alternative 7 on East Brook) has a BCR of approximately 1.0. If these alternatives are supported by the Village and the Town and there is consensus to pursue their execution, then they may be advanced for further design and funding.

The other projects described in this LFA report are not expected to have BCRs above 1.0. However, many of these are appropriate flood mitigation projects. Tables 8-1 through 8-3 summarize the recommended action for each project.

TABLE 8-1
Potential Flood Mitigation Alternatives - East Brook

Alternative	Description	BCR	Recommendations
1	Delaware Street bridge replacement and removal of one business	0.35	Consider this alternative when bridge is ready for replacement due to its age.
2	Delaware Street bridge replacement and floodplain bench (FP4)	0.39	Too intrusive relative to the benefits; do not pursue unless opportunities arise to acquire properties.
3	Benton Ave bridge replacement (90') and remove 2 homes	0.32	Too intrusive relative to the benefits; do not pursue unless opportunities arise to acquire properties.
4	Benton Ave bridge replacement (90') and remove 2 homes + floodplain at school (FP1)	0.31	Too intrusive relative to the benefits; do not pursue unless opportunities arise to acquire properties.
5	Benton Ave bridge replacement (120') and remove 4 homes	0.43	Too intrusive relative to the benefits; do not pursue unless opportunities arise to acquire properties.

Alternative	Description	BCR	Recommendations
6	Benton Ave bridge replacement (120') and remove 4 homes + floodplain at school (FP1)	0.40	Too intrusive relative to the benefits; do not pursue unless opportunities arise to acquire properties.
7	Benton Ave bridge removal and no replacement	0.98	Although the BCR is less than 1, consider this alternative as the bridge ages.
8	Benton Ave bridge removal and no replacement + floodplain at school (FP1)	0.67	This alternative does not provide substantial benefits and should not be pursued.
9	Griswold Street bridge replacement (includes 2 homes removed)	0.52	Consider this alternative when bridge is ready for replacement due to its age and opportunities arise to acquire properties.
10	Griswold Street bridge replacement and upstream floodplain (FP3) (includes four homes removed)	0.56	Consider this alternative when bridge is ready for replacement due to its age and opportunities arise to acquire properties.

TABLE 8-2
Potential Flood Mitigation Alternatives - West Brook

Alternative	Description	BCR	Recommendations
1	Floodplain Downstream of Delaware Street (FP1)	30.80	Pursue this alternative as funding becomes available unless Alternative 2 is preferred.
2	Floodplains Downstream and Upstream of Delaware Street, (FP 1+2) and Replace Delaware Street Bridge	1.43	Pursue this alternative as funding becomes available unless Alternative 1 is preferred.
3	Floodplains Upstream and Downstream of Mead Street (FP 3+4) and Replace Mead Street Bridge	0.47	Consider this alternative when bridge is ready for replacement due to its age and opportunities arise to acquire properties.

Alternative	Description	BCR	Recommendations
4	Mead Street Floodplains and Floodplain Between East Street and Mead Street (FP 3+4+5) and Replace Mead Street Bridge	0.52	Consider this alternative when bridge is ready for replacement due to its age and opportunities arise to acquire properties.
5	Replace East Street Bridge	0.59	Consider this alternative when bridge is ready for replacement due to its age.
7	Floodplain between East Street and park, and Replace East Street Bridge	0.55	Consider this alternative when bridge is ready for replacement due to its age.

TABLE 8-3
Potential Flood Mitigation Alternatives – Third Brook

Alternative	Description	BCR	Recommendations
1	Lower, Middle, and Upper Floodplains	--	Consider this alternative when opportunities arise to acquire various properties.
2	Lower, Middle, and Upper Floodplains with Delaware and Ogden Street Bridge Replacements	--	Expand the size of the bridges to improve conveyance and continue to follow-up with DOT.
3	Bypass Culvert and Channel by Kraft Building	--	Too costly and intrusive relative to the benefits.
4	Floodplain along Lower Third Brook Road	--	Consider this alternative if funding remains available in connection with other projects on upper Third Brook.

Creation of extensive floodwalls and levees is not supported by this LFA, nor is extensive sediment removal from the streams. Widespread removal of buildings from the downtown area and extending northward into the residential neighborhoods is also not supported by the LFA, as the community would suffer from the disruption.

Individual property owners will be required to elevate or floodproof their properties over time as substantial damage or substantial improvement thresholds are triggered. However, optional elevations and floodproofing may be desired in strategic locations where unacceptable flood risk remains after proposed alternatives are implemented. This will have the dual benefit of reducing flood risks while reducing flood insurance premiums for those properties that are insured.

Finally, key anchor businesses and critical facilities may wish to relocate out of zones of unacceptable flood risk. Examples include the Big M Supermarket and McAdams Lawnmower, both of which are located at relatively low elevations.

8.2 Recommendations

The following flood mitigation recommendations are offered:

1. Proceed with implementation of West Brook Alternatives 1 or 2 as funding allows. Refer to Section 8.3 below for additional discussion about implementation.
2. Study the feasibility of East Brook Alternative 7 including the viability of not maintaining a crossing of the brook at Benton Avenue and the tools that can be used to bolster the BCR for the alternative.
3. Re-instate the gauging station on East Brook. The data obtained from this gauging station was important in this LFA and will be important in other studies, and the existing data gap is unacceptable.
4. Consider establishing some type of gauging station on West Brook. If this is not a USGS-endorsed or maintained gauging station, a locally-operated informal gauging station may be effective for monitoring conditions during rain events. If discharges at East Brook and West Brook can be shown to be somewhat related or proportional, this information could help future studies.
5. Pursue floodproofing of commercial buildings in Walton. Floodproofing should include sealing of lower portions of buildings including doors and other openings, and elevation of building utilities. Ensure that floodproofing is viable under a set of potential future conditions.
6. Pursue elevation of homes on a case-by-case basis as property owners approach the Walton Flood Commission and/or the Village about mitigation. Ensure that elevations are conducted in accordance with the effective BFE at the time of the work.
7. When opportunities arise for acquisitions where floodplain projects may be effective in the future, support these acquisitions. Examples include the homes adjacent to East Brook at Benton Avenue that are a part of several alternatives evaluated in this LFA.
8. When opportunities arise to make progress with recommendations of the Third Brook Watershed Management Plan, they should be pursued. For example, one of the recommendations of the Third Brook Watershed Management Plan is "As funding allows, consider elevating on piers the homes located from 67 West Street to 757 Lower Third Brook Road. This will accomplish two things: the living spaces can be raised above potential future flood elevations, and the spaces beneath the homes will be able to convey floodwaters. Outbuildings and garages should be removed or relocated closer to the road, away from the brook…" One example is the barn and home located immediately downstream of the dam on Third Brook.
9. Ensure that future bridge replacements incorporate larger openings to reduce flooding. This is absolutely necessary for East Brook, West Brook, and Third Brook.

Numerous projects described in this report do not have BCRs above 1.0. However, many of these remain appropriate flood mitigation projects that could be eligible for funding by other State and

Federal programs such as the Department of Environmental Conservation Water Quality Improvement Project or the U.S. Army Corps of Engineers Water Resources Development Act.

The following procedural recommendations are offered:

- ❑ Continue to gather and file revenue information as provided by businesses. This may help improve future BCA determinations.

- ❑ During and after future floods, record and compile municipal, county, and state costs related to clean-up and recovery in Walton. This will help improve future BCA determinations for all three streams, especially given the current situation of bridges and roads overtopping.

- ❑ During and after future floods, record high water marks throughout the village. Track and record flood damage over time for anchor businesses and critical facilities. This will help improve future BCA determinations for Third Brook, especially given the current limitations of the BCA Flood Module for the Third Brook corridor.

8.3 Descriptions of Funding Sources

Several funding sources may be available to the Walton Flood Commission, the Village and Town of Walton, and Delaware County and its departments for the implementation of recommendations of this plan.

Stream Management Implementation Program Flood Hazard Mitigation Grants (SMIP-FHM)

FHM is a funding category in the SMIP for LFA communities and those participating in the NY Community Reconstruction Program. Municipalities may apply to implement one or more recommendations contained in their LFA and approved by the municipal board. All projects must have modeled off-site flood reduction benefits. Eligible projects include the following:

- ❑ Design/construction of floodplain restoration and reconnection
- ❑ Design/construction of naturally stable stream channel dimensions and sediment transport processes
- ❑ Design/construction of public infrastructure to reduce water velocity, flow path, and/or elevation
- ❑ Correction of hydraulic constrictions

Ineligible projects include construction of floodwalls, berms, or levees; stream dredging; routine annual maintenance; or replacement of privately owned bridges, culverts, or roads. Municipalities must apply to the Stream Management Program in their respective county. Contact information is as follows:

M Graydon Dutcher
Stream Program Coordinator
Delaware County Soil and Water Conservation District

Delaware Watershed Stream Management Program
44 West Street, Suite 1
Walton, NY 13856
Phone: (607) 865-7161
Fax: (607) 865-5535
graydon-dutcher@dcswcd.org

New York City Funded Flood Buyout Program

The New York City Funded Flood Buyout Program (NYCFFBO) is a voluntary program intended to assist property owners who were not eligible for or chose not to participate in the FEMA flood buyout program. It is intended to operate between flood events, not as an immediate response to one. Categories of eligible properties include the following:

1. Properties identified in community LFAs
2. Anchor businesses, critical community facilities, and LFA-identified properties applying to the CWC for relocation assistance
3. Properties needed for a stream project
4. Erosion hazard properties
5. Inundation properties

Risk assessments and BCA are required for these purchases. Municipalities may choose to own and manage the properties after they are purchased and cleared of structures. Conservation easements must be given to NYSDEC, and there are limits to what may be placed on these parcels. Allowed structures are public restrooms served by public sewers or by septic systems whose leach field is located outside the 100-year floodplain or open-sided structures.

The NYCFFBO is governed by the Water Supply Permit and the Property Evaluation and Selection Process document (Process document). Communities work through Outreach and Assessment Leads appointed by the municipality to inform potential applicants about the program and evaluate the eligibility of properties based on the program criteria established in the Process document.

Catskill Watershed Corporation Flood Hazard Mitigation Implementation Program (CWC FHMIP)

The CWC funds LFA-recommended projects to prevent and mitigate flood damage in the West of Hudson watershed, specifically to remedy situations where an imminent and substantial danger to persons or properties exists or to improve community-scale flood resilience while providing a water quality benefit.

Municipalities and individual property owners may apply directly to the CWC. Municipalities may apply for grants for projects identified in an LFA or New York Rising planning process.

Eligible LFA-derived projects could include the following:

- Alterations to public infrastructure that are expected to reduce/minimize flood damage as recommended in an LFA.
- Private property protection measures such as elevation or floodproofing of a structure as recommended by an LFA.
- Elimination of sources of man-made pollution such as the relocation or securing of fuel oil/propane tanks as recommended by an LFA.
- Stream-related construction as recommended by an LFA. Ineligible projects include construction of floodwalls, berms, or levees; stream dredging; or annual maintenance.
- Relocation assistance for residence or business recommended by an LFA.
- Relocation for anchor business or critical community facility currently in LFA study area.

Property owners may apply for the following assistance:

- Funds for relocation assistance of an anchor business. Anchor businesses must be located in a floodplain in a watershed hamlet where an LFA has been conducted though their relocation does not have to be recommended in the LFA. They include gas stations, grocery stores, lumberyard/hardware stores, medical offices, or pharmacies, which if damaged or destroyed would immediately impair the health and/or safety of a community.
- Funds for relocation of critical community facilities, such as a firehouse, school, town hall, public drinking water treatment or distribution facility, or wastewater treatment plant or collection system, which if destroyed or damaged would impair the health and/or safety of a community. Facilities must have been substantially damaged by flooding. They do not have to be recommended by an LFA but must be located in an LFA community.
- Funds for assistance to relocate homes and/or businesses within the same town where the NYCFFBO covers purchase of former property (does not have to be in an LFA community). The requirement to relocate the property within the same town may be waived by the town.
- Stream debris removal after a serious flood event (does not have to be in an LFA community).
- Tank anchoring (does not have to be in an LFA community).

Sustainable Community Planning Program

This CWC program is for municipalities that have prepared LFAs. It is intended to fund revisions to local zoning codes or zoning maps or to upgrade comprehensive plans in order to identify areas within those municipalities that can serve as new locations for residences and/or businesses to be moved after purchase under the voluntary NYCFFBP. Grants of up to $20,000 are available through this program, part of the CWC's Local Technical Assistance Program.

Emergency Watershed Protection Program (EWP)

Through the EWP program, the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) can help communities address watershed impairments that pose imminent threats to lives and property. Most EWP work is for the protection of threatened infrastructure from continued stream erosion. NRCS may pay up to 75 percent of the construction costs of emergency measures. The remaining costs must come from local sources and can be made in cash or in-kind services. EWP projects must reduce threats to lives and property; be economically, environmentally, and socially defensible; be designed and implemented according to sound technical standards; and conserve natural resources.

FEMA Pre-Disaster Mitigation (PDM) Program

The PDM program was authorized by Part 203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act), 42 U.S.C. 5133. The PDM program provides funds to states, territories, tribal governments, communities, and universities for hazard mitigation planning and implementation of mitigation projects prior to disasters, providing an opportunity to reduce the nation's disaster losses through PDM planning and the implementation of feasible, effective, and cost-efficient mitigation measures. Funding of pre-disaster plans and projects is meant to reduce overall risks to populations and facilities. The PDM program is subject to the availability of appropriation funding as well as any program-specific directive or restriction made with respect to such funds.

FEMA Hazard Mitigation Grant Program (HMGP)

The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. The HMGP provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. A key purpose of the HMGP is to ensure that any opportunities to take critical mitigation measures to protect life and property from future disasters are not "lost" during the recovery and reconstruction process following a disaster.

The HMGP is one of the FEMA programs with the greatest potential fit to potential projects in this LFA. However, it is available only in the months subsequent to a federal disaster declaration in the State of New York. Because the state administers the HMGP directly, application cycles will need to be closely monitored after disasters are declared in New York.

FEMA Flood Mitigation Assistance (FMA) Program

The FMA program was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the NFIP. FEMA provides FMA funds to assist states and communities with implementing measures that reduce or eliminate the long-term risk of flood damage to buildings, homes, and other structures insurable under the NFIP. The long-term goal of FMA is to reduce or eliminate claims under the NFIP through mitigation activities.

The Biggert-Waters Flood Insurance Reform Act of 2012 eliminated the Repetitive Flood Claims (RFC) and Severe Repetitive Loss (SRL) programs and made the following significant changes to the FMA program:

- The definitions of repetitive loss and severe repetitive loss properties have been modified.
- Cost-share requirements have changed to allow more federal funds for properties with RFC and SRL properties.
- There is no longer a limit on in-kind contributions for the nonfederal cost share.

One limitation of the FMA program is that it is used to provide mitigation for *structures* that are insured or located in SFHAs. Therefore, individual property mitigation options are best suited for FMA funds. Like PDM, FMA programs are subject to the availability of appropriation funding as well as any program-specific directive or restriction made with respect to such funds.

NYS Department of State

The Department of State may be able to fund some of the projects described in this report. In order to be eligible, a project should link water quality improvement to economic benefits.

U.S. Army Corps of Engineers (USACE)

The USACE provides 100 percent funding for floodplain management planning and technical assistance to states and local governments under several flood control acts and the Floodplain Management Services Program (FPMS). Specific programs used by the USACE for mitigation are listed below.

- Section 205 – Small Flood Damage Reduction Projects: This section of the 1948 Flood Control Act authorizes the USACE to study, design, and construct small flood control projects in partnership with nonfederal government agencies. Feasibility studies are 100 percent federally funded up to $100,000, with additional costs shared equally. Costs for preparation of plans and construction are funded 65 percent with a 35 percent nonfederal match. In certain cases, the nonfederal share for construction could be as high as 50 percent. The maximum federal expenditure for any project is $7 million.

- Section 14 – Emergency Streambank and Shoreline Protection: This section of the 1946 Flood Control Act authorizes the USACE to construct emergency shoreline and stream bank protection works to protect public facilities such as bridges, roads, public buildings, sewage treatment plants, water wells, and nonprofit public facilities such as churches, hospitals, and schools. Cost sharing is similar to Section 205 projects above. The maximum federal expenditure for any project is $1.5 million.

- Section 208 – Clearing and Snagging Projects: This section of the 1954 Flood Control Act authorizes the USACE to perform channel clearing and excavation with limited embankment construction to reduce nuisance flood damages caused by debris and minor shoaling of rivers. Cost sharing is similar to Section 205 projects above. The maximum federal expenditure for any project is $500,000.

- Section 206 – Floodplain Management Services: This section of the 1960 Flood Control Act, as amended, authorizes the USACE to provide a full range of technical services and planning guidance necessary to support effective floodplain management. General technical assistance efforts include determining the following: site-specific data on obstructions to flood flows, flood formation, and timing; flood depths, stages, or floodwater velocities; the extent, duration, and frequency of flooding; information on natural and cultural floodplain resources; and flood loss potentials before and after the use of floodplain management measures. Types of studies conducted under FPMS include floodplain delineation, dam failure, hurricane evacuation, flood warning, floodway, flood damage reduction, stormwater management, floodproofing, and inventories of floodprone structures. When funding is available, this work is 100 percent federally funded.

In addition, the USACE provides emergency flood assistance (under Public Law 84-99) after local and state funding has been used. This assistance can be used for both flood response and post-flood response. USACE assistance is limited to the preservation of life and improved property; direct assistance to individual homeowners or businesses is not permitted. In addition, the USACE can loan or issue supplies and equipment once local sources are exhausted during emergencies.

Other Potential Sources of Funding

New York State Grants – All New York State grants are now announced on the NYS Grants Gateway. The Grants Gateway is designed to allow grant applicants to browse all NYS agency anticipated and available grant opportunities.

Community Development Block Grant (CDBG) – The Office of Community Renewal administers the CDBG program for the State of New York. The NYS CDBG program provides financial assistance to eligible cities, towns, and villages in order to develop viable communities by providing affordable housing and suitable living environments as well as expanding economic opportunities, principally for persons of low and moderate income. It is possible that the CDBG funding program could be applicable for floodproofing and elevating residential and nonresidential buildings, depending on eligibility of those buildings relative to the program requirements.

Delaware County Industrial Development Agency (IDA) – The IDA works in conjunction with the Delaware County Department of Economic Development to "build a sustainable future for Delaware County" by meeting the needs of new and existing businesses through expertise, financial assistance, and continued support. The IDA offers a variety of programs and performance-based incentives to encourage businesses to expand or locate within Delaware County and create new jobs. The program primarily helps secure low-interest loans and Industrial Revenue Bonds (tax-exempt financing alternatives for large-scale investments in facilities and equipment). It is possible that the program could be applicable for floodproofing, elevating, or relocating nonresidential buildings, depending on the eligibility of those businesses relative to the program requirements.

Empire State Development – The state's Empire State Development program offers loans, grants, and tax credits as well as other financing and technical assistance to support businesses and encourage their growth. It is possible that the program could be applicable for floodproofing, elevating, or relocating nonresidential buildings, depending on eligibility of those businesses relative to the program requirements.

Private Foundations – Private entities such as foundations are potential funding sources in many communities. The Town and Village of Walton and the Walton Flood Commission will need to identify the foundations that are potentially appropriate for some of the actions proposed in this report.

In addition to the funding sources listed above, other resources are available for technical assistance, planning, and information. While the following sources do not provide direct funding, they offer other services that may be useful for proposed flood mitigation projects.

Land Trust and Conservation Groups – These groups play an important role in the protection of watersheds including forests, open space, and water resources.

As the recommendations of this LFA are implemented, the Town and Village of Walton will need to work closely with potential funders to ensure that the best combinations of funds are secured for the modeled alternatives and for property-specific mitigation such as floodproofing, elevations, and relocations. It will be advantageous for the town and village to identify combinations of funding sources in order to reduce their own requirement to provide matching funds.

8.4 Potential Funding Sources for Mitigation Projects

Table 8-4 lists potential funding sources for the alternatives that were advanced to the BCA. Note that in all cases, federal funds cannot be duplicated for any particular project. Potential funding sources described under the heading "Other Potential Sources of Funding" (above) have not been listed, as additional evaluation may be needed to determine their applicability.

Table 8-4
Potential Funding Sources for Mitigation Projects

		Federal	State	Other
East Brook Alternatives				
1	Delaware Street bridge replacement	None	NYSDOT	SMIP-FHM, CWC
	Excavation	None	NYSDOS	SMIP-FHM, CWC
	Acquisition and removal of business	FEMA	NYSDOS	NYCDFFBO, CWC
2	Delaware Street bridge replacement	None	NYSDOT	SMIP-FHM, CWC
	Floodplain bench (FP4)	USACE	NYSDOS	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC
3	Benton Ave bridge replacement (90')	None	NYSDOT	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC
	Excavation	None	NYSDOS	SMIP-FHM, CWC
4	Benton Ave bridge replacement (90')	None	NYSDOT	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC
	Floodplain bench at school (FP1)	USACE	NYSDOS	SMIP-FHM, CWC
5	Benton Ave bridge replacement (120')	None	NYSDOT	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC
	Excavation	None	NYSDOS	SMIP-FHM, CWC
6	Benton Ave bridge replacement (120')	None	NYSDOT	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC
	Floodplain at school (FP1)	USACE	NYSDOS	SMIP-FHM, CWC
7	Benton Ave bridge removal and no replacement	None	NYSDOT	SMIP-FHM, CWC
8	Benton Ave bridge removal and no replacement	None	NYSDOT	SMIP-FHM, CWC
	Floodplain at school (FP1)	USACE	NYSDOS	SMIP-FHM, CWC

		Federal	State	Other
9	Griswold Street bridge replacement	None	NYSDOT	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC
	Excavation	None	NYSDOS	SMIP-FHM, CWC
10	Griswold Street bridge replacement	None	NYSDOT	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC
	Upstream floodplain (FP3)	USACE	NYSDOS	SMIP-FHM, CWC
West Brook Alternatives				
1	Floodplain Downstream of Delaware Street (FP1)	USACE	NYSDOS	SMIP-FHM, CWC
2	Replace Delaware Street Bridge	None	NYSDOT	SMIP-FHM, CWC
	Floodplains downstream of Delaware Street (FP 1+2)	USACE	NYSDOS	SMIP-FHM, CWC
3	Replace Mead Street Bridge	None	NYSDOT	SMIP-FHM, CWC
	Floodplains Upstream and Downstream of Mead Street (FP 3+4)	USACE	NYSDOS	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC
4	Replace Mead Street Bridge	None	NYSDOT	SMIP-FHM, CWC
	Mead Street Floodplains and Floodplain between East Street and Mead Street (FP 3+4+5)	USACE	NYSDOS	SMIP-FHM, CWC
	Acquisition and removal of homes	FEMA	NYSDOS	NYCDFFBO, CWC
5	Replace East Street Bridge	None	NYSDOT	SMIP-FHM, CWC
7	Replace East Street Bridge	None	NYSDOT	SMIP-FHM, CWC
	Floodplain between East Street and park (FP 7)	USACE	NYSDOS	SMIP-FHM, CWC
Third Brook Alternatives				
1	Lower, Middle, and Upper Floodplains	USACE	NYSDOS	SMIP-FHM, CWC
	Acquisition and removal of garages	FEMA	NYSDOS	NYCDFFBO, CWC
2	Lower, Middle, and Upper Floodplains	USACE	NYSDOS	SMIP-FHM, CWC

		Federal	State	Other
	Acquisition and removal of garages	FEMA	NYSDOS	NYCDFFBO, CWC
	Delaware and Ogden Street Bridge Replacements	None	NYSDOT	SMIP-FHM, CWC
3	Bypass Culvert near Kraft Building	None	NYSDOT	SMIP-FHM, CWC
	Bypass Channel near Kraft Building	USACE	NYSDOS	SMIP-FHM, CWC
4	Floodplain along Lower Third Brook Road	USACE	NYSDOS	SMIP-FHM, CWC

Table 8-5 lists potential funding sources for property mitigation and relocations.

Table 8-5
Potential Funding Sources for Other Mitigation Projects

Option	Federal	State	Other
Floodproofing of individual non-residential buildings	FEMA	NYSDOS	CWC
Elevation of individual non-residential buildings in floodway	None	None	CWC
Elevation of individual residential buildings in floodway	None	None	CWC
Elevation of individual non-residential buildings outside of floodway	FEMA	NYSDOS	CWC
Elevation of individual residential buildings outside of floodway	FEMA	None	CWC
Relocation of anchor businesses and critical facilities	FEMA	NYSDOS	NYCDFFBO, CWC

As this LFA plan is implemented, the Walton Flood Commission will need to work closely with potential funders to ensure that the best combinations of funds are secured for the modeled alternatives and for the property-specific mitigation such as floodproofing, elevations and relocations. The Walton Flood Commission may also work closely with local lenders and the chamber of commerce to facilitate the provision of loan services for property mitigation and floodproofing. Because FEMA's mitigation funds are limited by Congress (PDM and FMA) or dependent on disaster declarations (HMGP), the State hazard mitigation officer should be kept apprised of Walton's efforts for mitigating flooding and flood damage.

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APPENDICES

APPENDIX A

MEETING PRESENTATIONS AND NOTES

DATE: September 3, 2015
MMI #: 5197-06
PROJECT: Walton WBDR Tributaries LFA

SUBJECT: Notes from Walton Flood Commission Meeting
LOCATION: DCSWCD, Walton, NY

ATTENDEES:

David Murphy, P.E., CFM, MMI
Members of the Walton Flood Commission (sign-in sheet available from DCSWCD)

The Walton Flood Commission held its regular meeting on September 3, 2015 at 10:00 AM at the DCSWCD office. Prior to the meeting, David Murphy from Milone & MacBroom, Inc. (MMI) asked Steve Dutcher to forward any FEMA Elevation Certificates (ECs) that may be available for buildings near the tributaries. At the beginning of the meeting, Graydon Dutcher explained that Nate Hendricks was now representing NYCDEP and therefore would be attending instead of Phil Eskeli.

Agenda item #1 was a presentation and discussion facilitated by Steve Dutcher regarding the participation of the Village and Town in the CRS program. ISO/CRS representatives met with the Village and Town on August 17 and the preliminary estimate for a rating is “8” which was the initial goal. The Walton Flood Commission agreed to become the adopting body for the CRS Program for Public Information (PPI). The Commission agreed to include a Repetitive Loss Area Analysis (RLAA) in the Walton WBDR LFA report. David Murphy agreed to prepare a brief scope of services and fee estimate for incorporating the RLAA into the LFA report.

The Walton WBDR Tributaries update was Agenda Item #2. David Murphy presented a slide show that focused mainly on East Brook. Graydon explained that the floodplain work near the upstream end of the East Brook study segment had reduced the extent of the 100-year floodplain in this area. One of the primary findings from the East Brook modeling is that the bridges at Delaware Street, Benton Avenue, and Griswold Street are also horizontal constrictions in addition to acting as vertical constrictions. Therefore, when the bridges are removed from the model, the constrictions still contribute to flooding.

Questions and comments from the meeting included the following:

- The bankfull width of East Brook should be restored for future conditions modeling near the school. The right and left banks can be used for this purpose.

- Can the school parking lot be lowered and become part of the floodplain project? This may be possible. We would need to carefully consider grade and access.

- Upstream of the recent floodplain work described by Graydon, there is a location near Nichols Road where floodwaters leave East Brook and affect a house and barn. Could a small floodplain project or bench help reduce this risk?

- Also near Nichols Road, could the large field floodplain be modified to serve as a catch for debris to reduce the movement of debris downstream?

- In the vicinity of Delaware Street, the East Brook alternatives should incorporate the effects of the WBDR main stem modeling. For example, the water surface elevations after the Water Street floodplain work should be used as the boundary conditions for East Brook.

- Homes along East Brook that remain in place but taken out of the 100-year floodplain will have reduced flood risk and may also see lower flood insurance premiums.

- Walt G. commented that we should focus on the best overall reduction of flood risk along East Brook.

- David noted that the level of detail needed for the refinement of the East Brook alternatives would likely require looking at lot lines and separation distances house-by-house. The constructability of different alternatives would need to be considered given the space constraints.

West Brook was briefly discussed. Immediately downstream of the bend at the park, the stream may have had a different channel in the past. This is visible on the FEMA map where a small island of non-floodplain is visible with the current floodway on its west side and a section of floodplain on its east side. The West Brook floodplain was described as “hanging” in this area.

The Commission directed MMI to focus on East Brook and present additional modeling at the October 1, 2015 meeting.

Local Flood Analysis
Initial Project Discussion
West Branch Tributaries

Walton Flood Commission Meeting
Village and Town of Walton

David Murphy, P.E., CFM

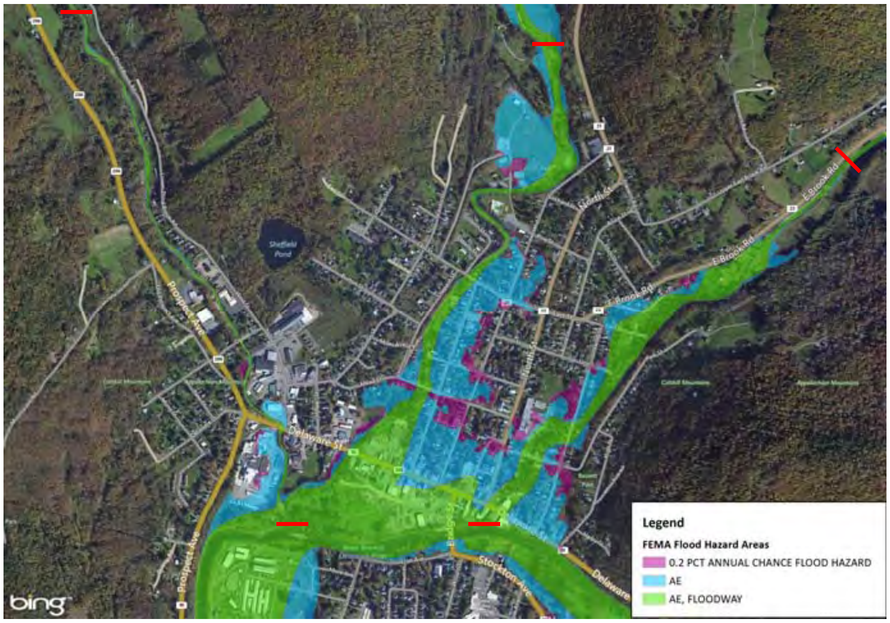


Delaware County Soil & Water Conservation District | September 3, 2015

Agenda

- Study Area
- FEMA Flood Insurance Study
- Review Public Comments
- Focus on East Brook
  - ✓ Existing Conditions
  - ✓ Initial Alternatives
- Next Steps

Study Area



FEMA Flood Insurance Study

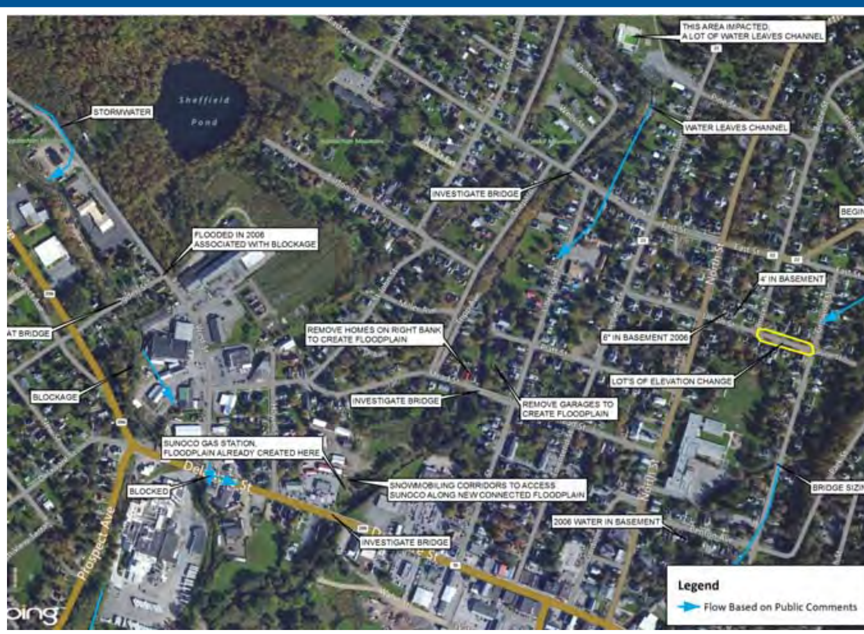
- USGS Report of 2006 Flood:
  - East Brook Flood Discharge = 7,110 cfs
  - West Branch Flood Discharge = 28,600 cfs
- FEMA Flood Insurance Study (FIS)

Flood	East Brook	West Brook	Third Brook
10% (10 yr)	1,980 cfs	2,480 cfs	549 cfs
2% (50 yr)	3,300 cfs	3,600 cfs	831 cfs
1% (100 yr)	3,720 cfs	4,110 cfs	961 cfs
0.2% (500 yr)	4,270 cfs	5,320 cfs	1,280 cfs

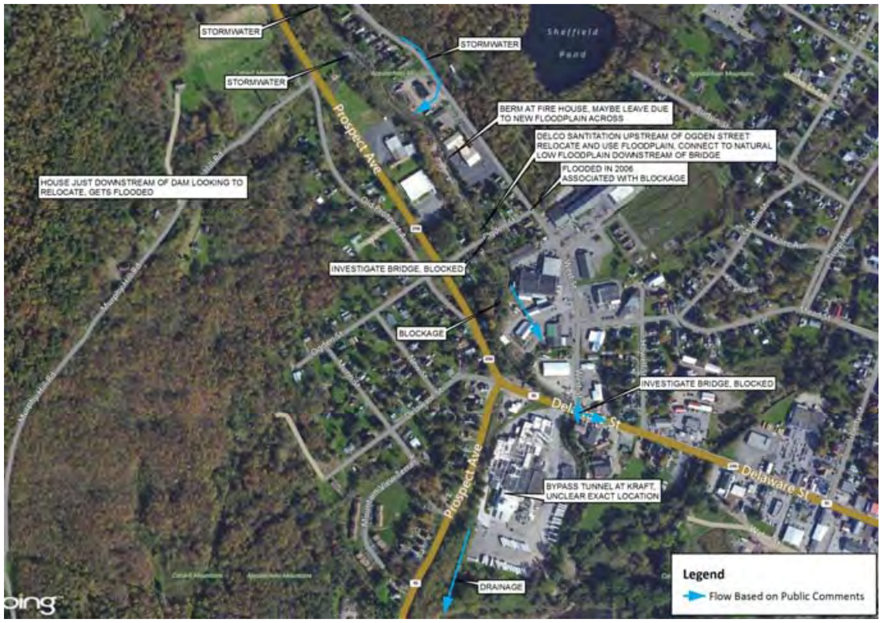
Milone & MacBroom

Review Public Comments – East Brook

Review Public Comments – West Brook

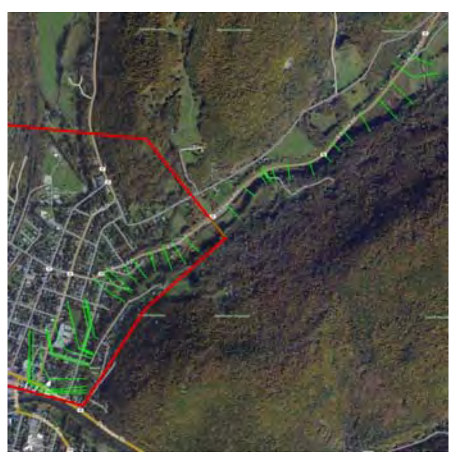


Review Public Comments – Third Brook



Focus for the Remainder of Meeting

East Brook identified by the Walton Flood Commission as the initial focus for the Tributaries LFA



MILONE & MACBROOM

Existing Conditions

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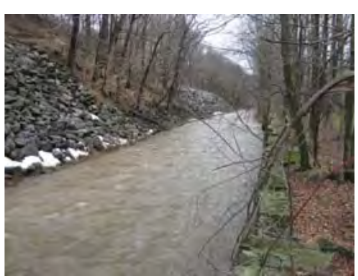
Existing Conditions



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Existing Conditions

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Existing Conditions

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Existing Conditions

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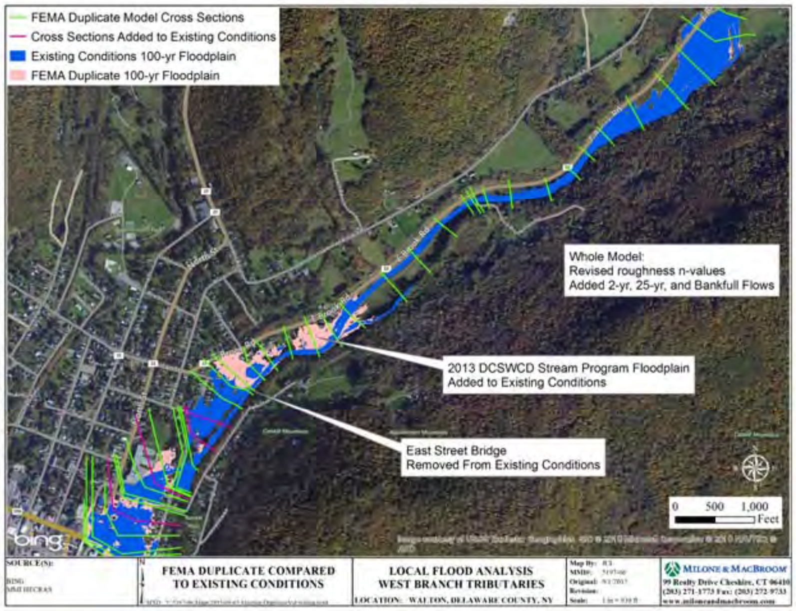
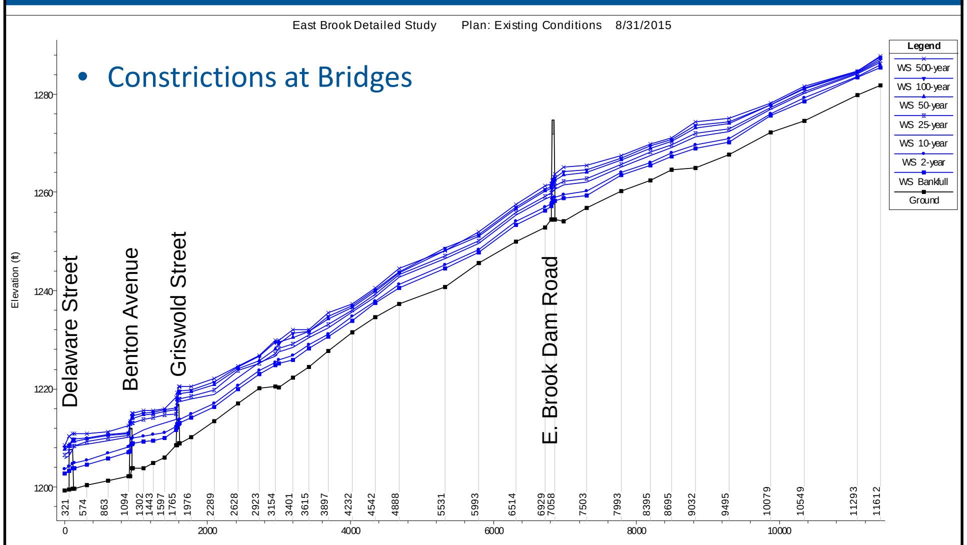
Existing Conditions

MILONE & MACBROOM

Existing Conditions Modeling



Existing Conditions Profile



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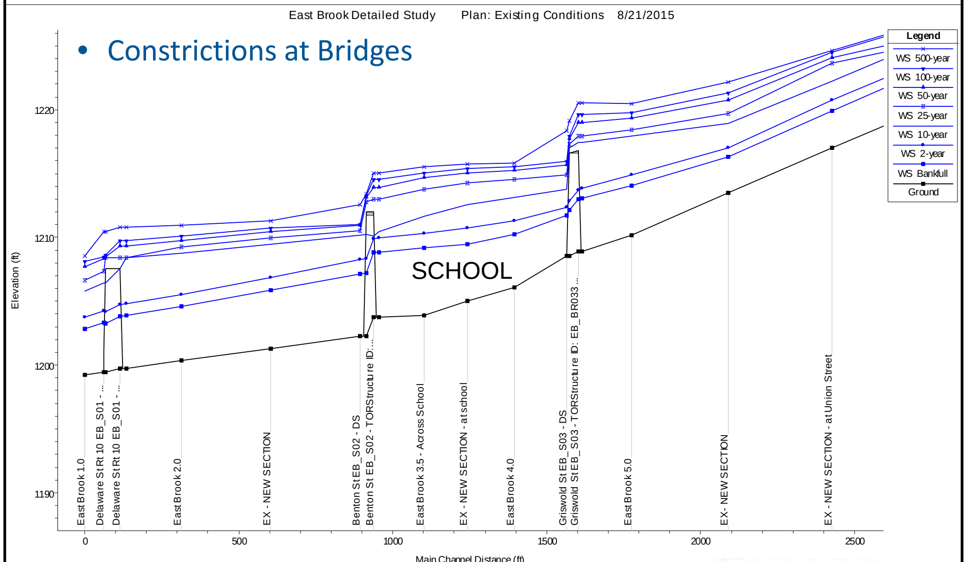
Existing Conditions Profile (Focus Area)

- Constrictions at Bridges



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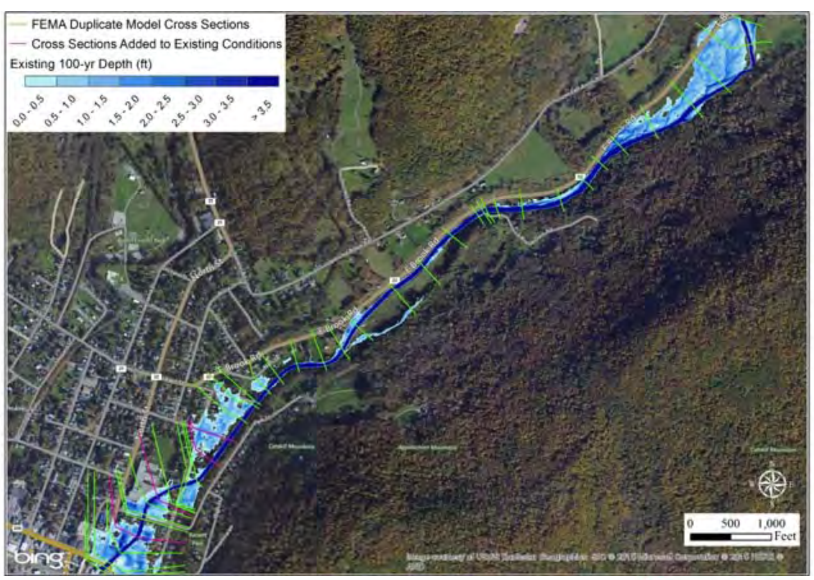
Existing Conditions Depth Map



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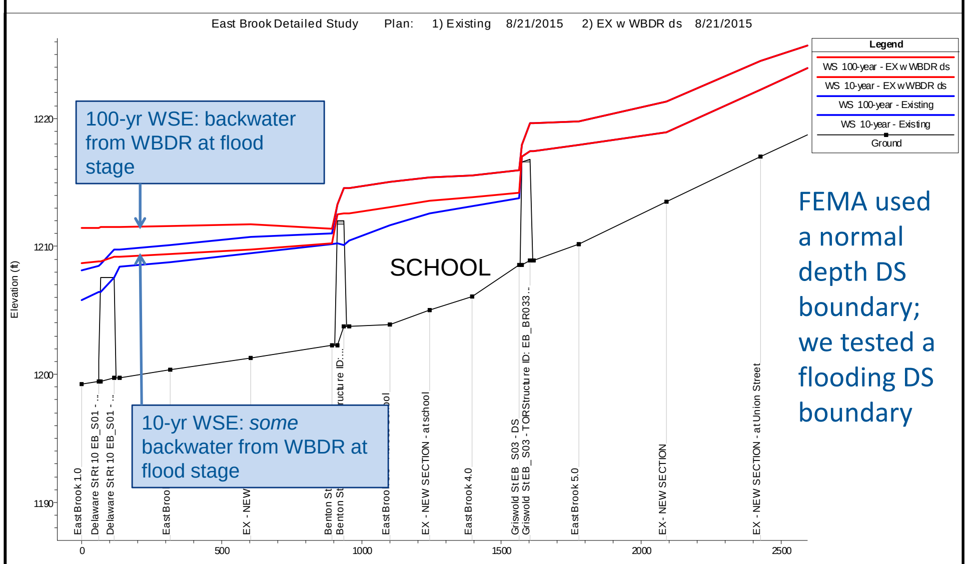
Existing Conditions Depth Map (Focus Area)

MILONE & MACBROOM

Backwater from West Branch Delaware River



FEMA used a normal depth DS boundary; we tested a flooding DS boundary

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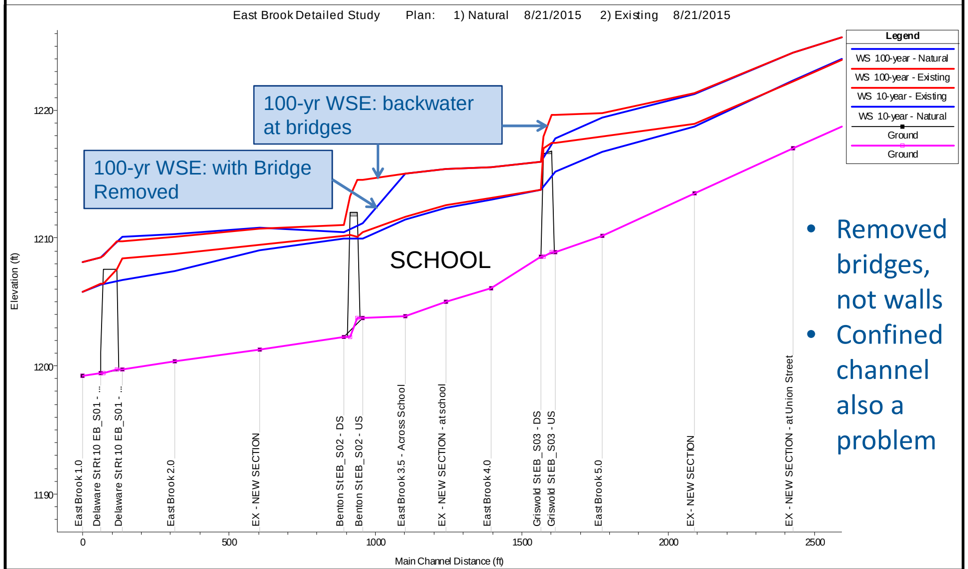
Effects of Bridges vs. Constrictions



- Removed bridges, not walls
- Confined channel also a problem

MILONE & MACBROOM

Preliminary Alternatives

- **FP1:** Floodplain creation at school parking lot; includes wider bankfull channel
  - This action alone does not reduce flood levels because the Benton Avenue bridge controls water surface elevations in the area of the school
- **BAB45:** Replace Benton Avenue Bridge with 45’ span
  - No buildings removed; channel widened adjacent to bridge, but wall closer to buildings
  - This action alone does not reduce flood levels
- **BAB90:** Replace Benton Avenue Bridge with 90’ span
- **FP2:** Creation of small floodplain along right bank; removal of two houses would be required for this alternative
- **FP3:** Creation of long floodplain upstream of Griswold Street
- **GSB120:** Replace Griswold Street bridge with 120’ span and remove two houses

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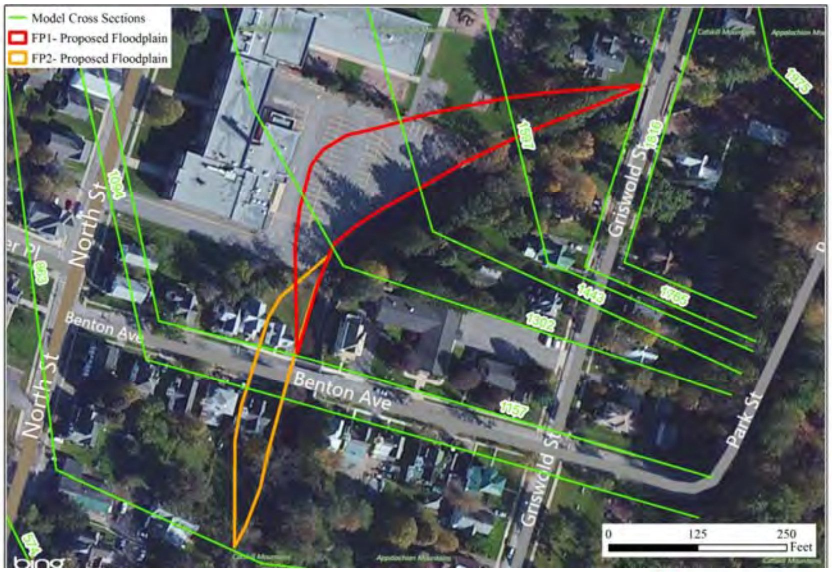
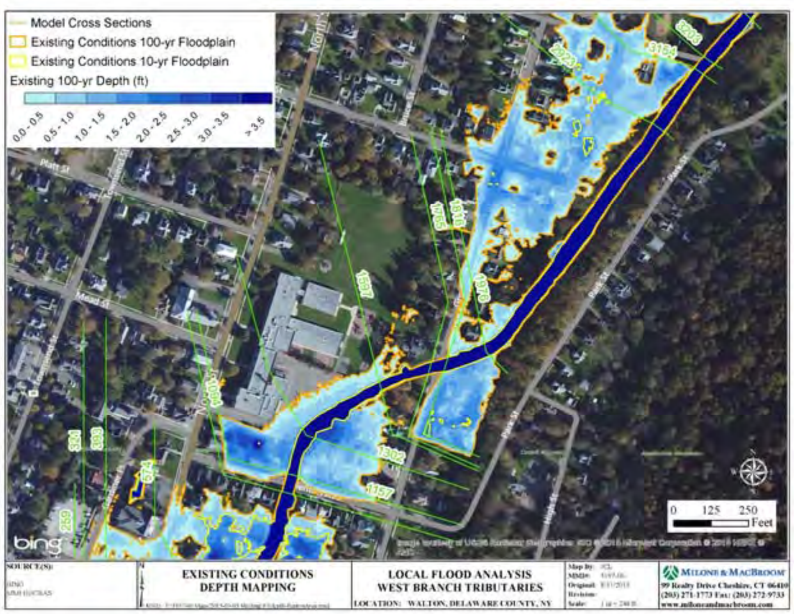
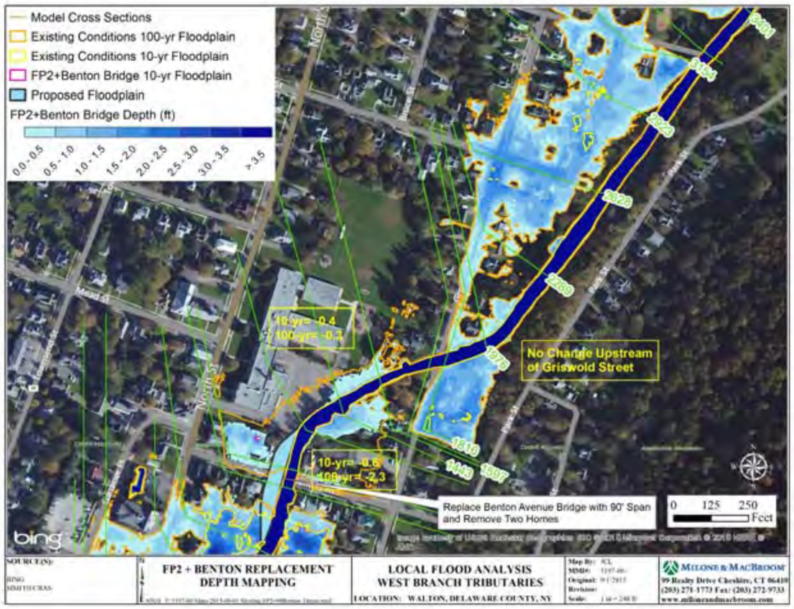
Preliminary Alternatives near School



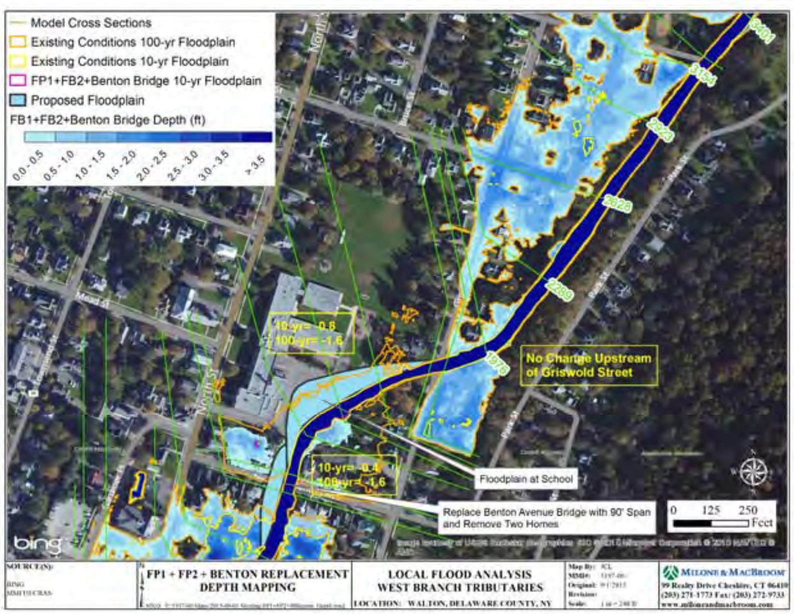
Existing Depth Mapping near School



Combination: FP2 & 90’ Benton Ave Bridge

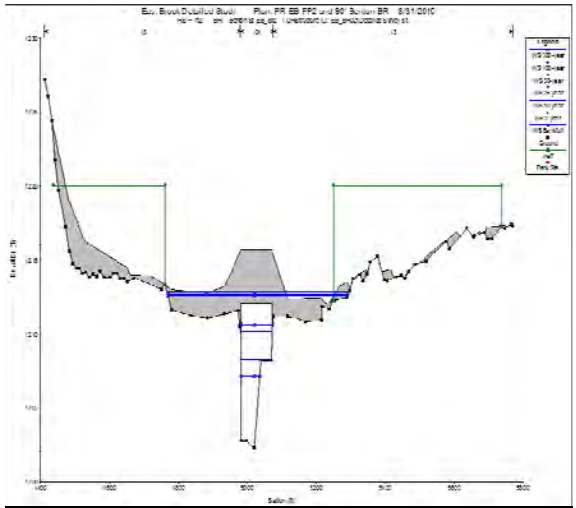


Combination: FP1, FP2, 90’ Benton Ave Bridge



Key Findings

- Bankfull width at school is 57 feet; this is wider than the space between the walls.
- FP2 is modeled as bankfull width channel and a flood bench at 2-yr WSE beneath the bridge.
- Note that a new 90’ Benton Ave bridge does not pass the 50-yr flow



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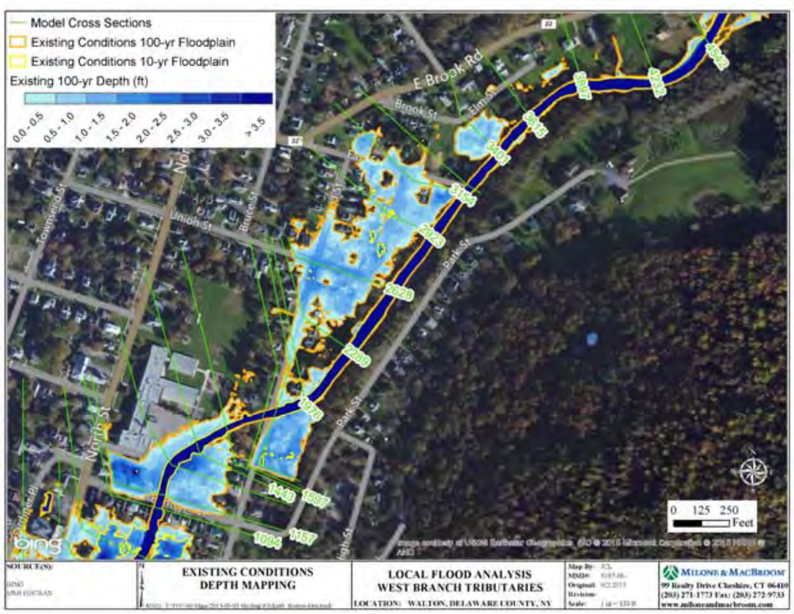
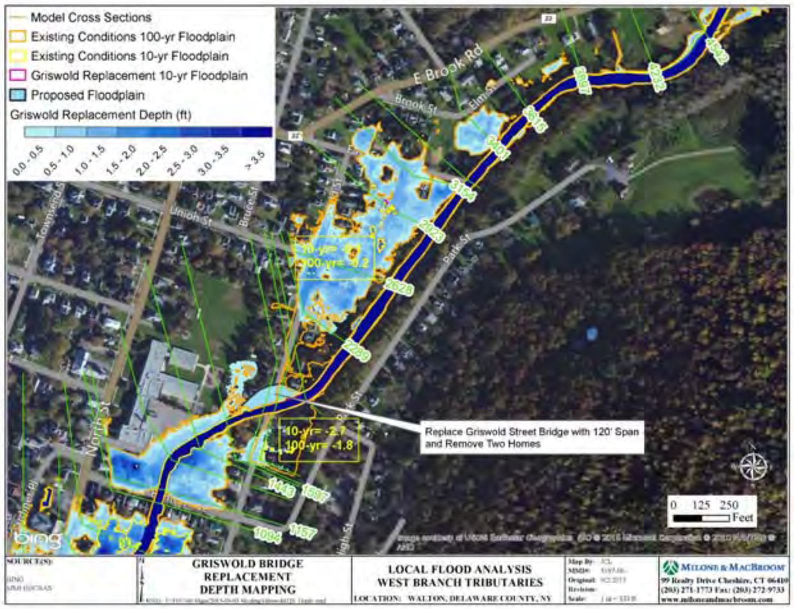
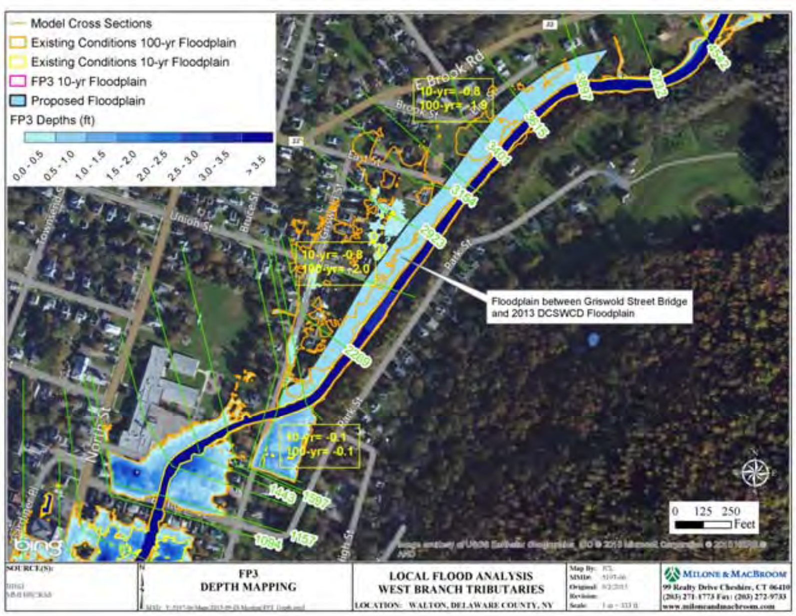
Existing Depth Mapping upstream of Griswold



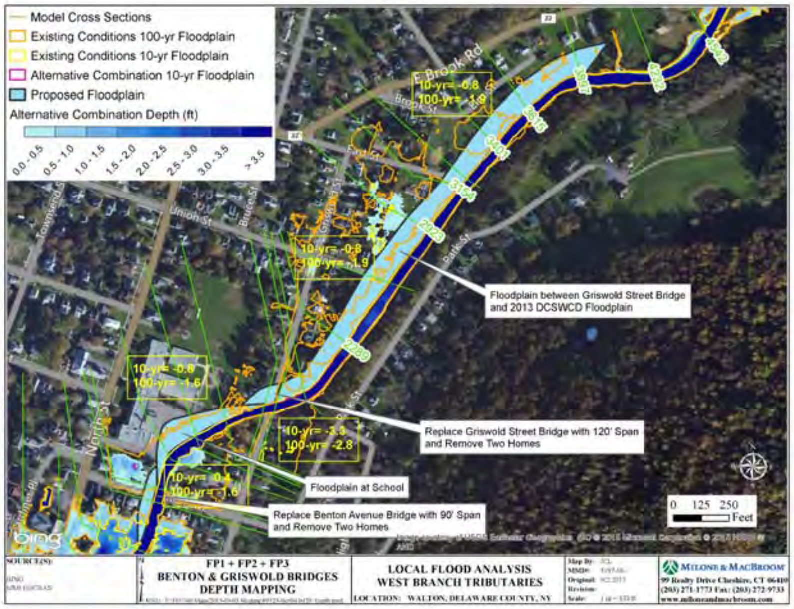
Replace Griswold Street Bridge



Floodplain FP3 alone (no bridge replacement)



Combination: FP1,2,3 and 2 new Bridges



Discussion and Next Steps

- Challenges posed by the confined channel near school
  - It is less than bankfull width
  - Is it prudent to evaluate a narrow bench if bankfull width is insufficient?
- Refine the modeling presented today
- Evaluate options for Delaware Street
- Other ideas from Walton Flood Commission?

MILONE & MACBROOM

DATE: October 1, 2015
MMI #: 5197-06
PROJECT: Walton WBDR Tributaries LFA

SUBJECT: Notes from Walton Flood Commission Meeting
LOCATION: DCSWCD, Walton, NY

ATTENDEES:

David Murphy, P.E., CFM, MMI
Members of the Walton Flood Commission (sign-in sheet available from DCSWCD)

The Walton Flood Commission held its regular meeting on October 1, 2015 at 10:00 AM at the DCSWCD office. At the beginning of the meeting, Supervisor Dolph reported that $20,000 in additional funding had been secured for restoration of the Reporter Building site, and $120,000 in additional funding had been secured for Third Brook.

David Murphy presented a slide show that focused on East Brook. Additional modeling of alternatives was presented for the Benton Avenue and Griswold Street areas, extending upstream. New modeling was presented for the area between Delaware Street and Benton Avenue.

Attendees inquired why the kindergarten wing of the school did not appear to be affected by flooding in any of the existing conditions or alternatives. Mr. Murphy said there could be a few reasons including the possibility that the model does not account for water leaving the stream and flowing down roadways. In particular, the Union/Griswold intersection appears to flood in the existing conditions model whereas it does not in the FEMA model. This may be due to changes in manning's 'n' (roughness) plus the three new cross sections that were added near Union Street. This places more water on Griswold Street than previously understood, and this water could have flowed across the fields to the school. More obviously, debris blocking the Griswold Street bridge could have caused floodwaters to flow over the road and directly to the school, and debris blocking the Benton Avenue bridge could have caused more extensive and deeper floodwaters at the school. Anecdotal evidence for the complex hydraulics includes the home at the northeast corner of Griswold Street and East Brook; this home suffered major damage during the flood of 2006, including damage to its foundation. Attendees discussed the importance of including school damage figures in the benefit-cost analysis (BCA), despite the lack of flooding observed in the modeling.

Attendees were curious about which projects should be pursued first. Mr. Murphy stated that the Benton Avenue and Griswold Street bridges should be prioritized because the existing constrictions would reduce the effectiveness of floodplain projects (if any were completed separately). This led to a robust discussion about the bridges. Attendees noted that bridges were costly and would be challenging in the BCA. Repair of damage to bridges, cleanup near bridges, and debris removal will need to be included in the BCA. Wayne Reynolds should be contacted for these figures, because the County is responsible for the Benton Avenue and Griswold Street bridges. DOT should be contacted for figures related to the Delaware Street bridge. Mr. Weidenbach raised the concept of using incremental costs for bridges when the BCA is conducted, but Mr. Eskeli replied that this was inappropriate because the full cost would be realized upon execution of the particular overall flood mitigation project.

Steve Dutcher suggested that one alternative should consider elimination of the Benton Avenue bridge *without* replacing the bridge. The two parts of the road would then be converted to dead ends. This would not be a disruption to school-related traffic; indeed, attendees noted that elimination of the Griswold Street bridge would be worse and therefore would be unacceptable.

Relocation of residents was discussed. The LFA should identify potential locations in the village for people to move if their houses were acquired for flood mitigation projects. Some of the houses on Benton Avenue are single-family but some are multi-family, which will affect the total number of people displaced.

The area between Benton Avenue and Delaware Avenue was discussed at length. Attendees believe that the timing of flooding is not aligned, and East Brook may be at the 100 year flood when the river is not. The modeling should look at the actual conditions from the 1996 and 2006 floods to see if the peaks of the floods on each stream were aligned. The BCA will be challenging here. There was a general consensus that floodplain projects would be warranted here despite the limited benefits when the WBDR was in flood stage.

The status of the East Brook gauge was discussed at length. The USGS does not currently support this gauge, but it is critically important for the community. The Walton Flood Commission should have a stronger role in pushing for the restoration of funding for this gauge.

In summary, the following are the contacts for gathering information for the BCA:

1. School administration for school damage figures
2. Wayne Reynolds of the County Public Works for Griswold Street and Benton Avenue bridges
3. DOT for the Delaware Street bridge
4. Roger Hoyt of the Village for road damage near bridges
5. NYC Sanitation Department for debris removal
6. EMS for additional costs
7. Fire Department for basement pump-outs

Numbers 1 and 2 will be the most important to obtain.

West Brook modeling and/or East Brook BCA will be discussed at the November 5, 2015 meeting.

Local Flood Analysis
2nd Project Discussion
West Branch Tributaries

Walton Flood Commission Meeting
Village and Town of Walton

David Murphy, P.E., CFM

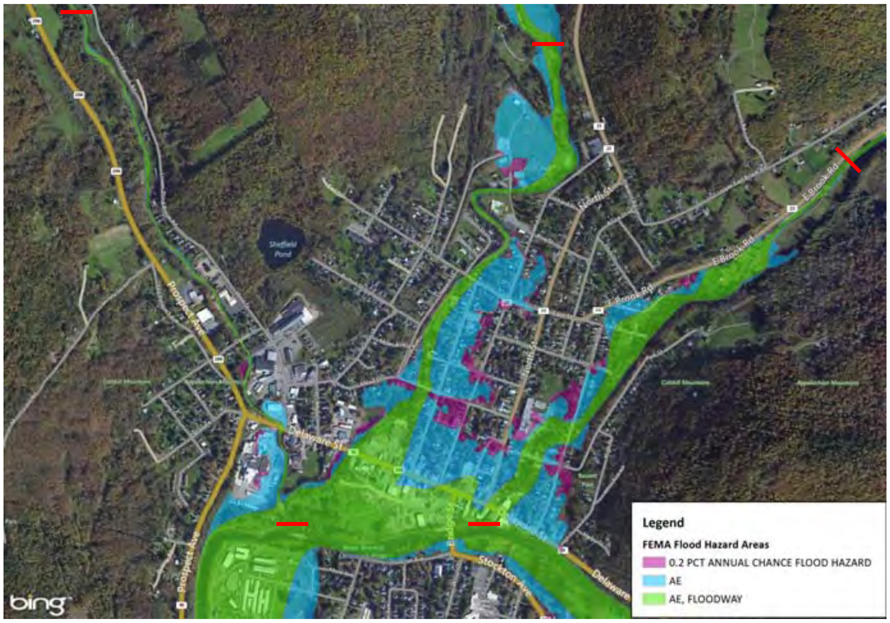


Delaware County Soil & Water Conservation District | October 1, 2015

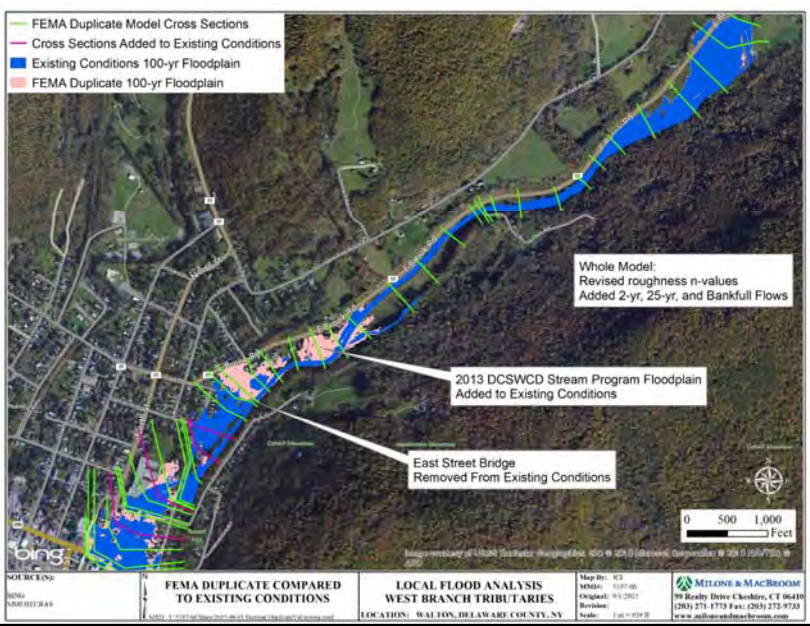
Agenda

- Continue the East Brook Alternatives Discussion
- Next Steps

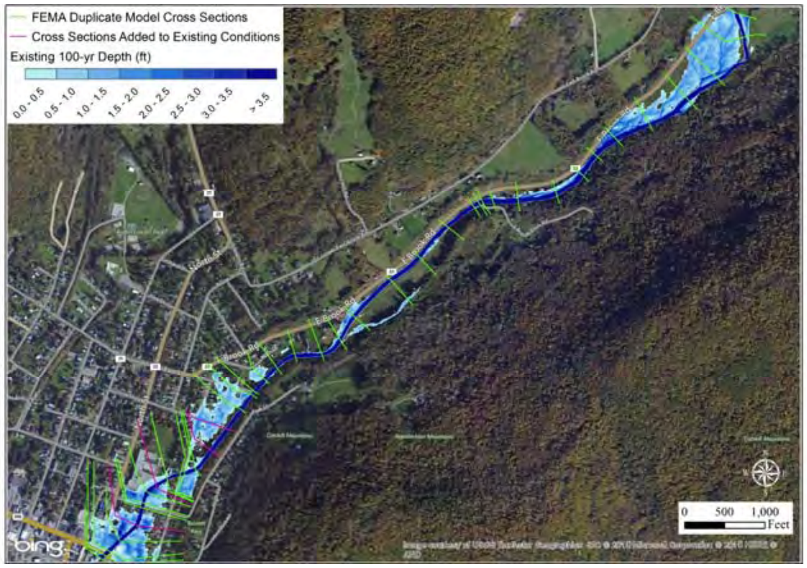
Study Area



Review Existing Conditions Modeling



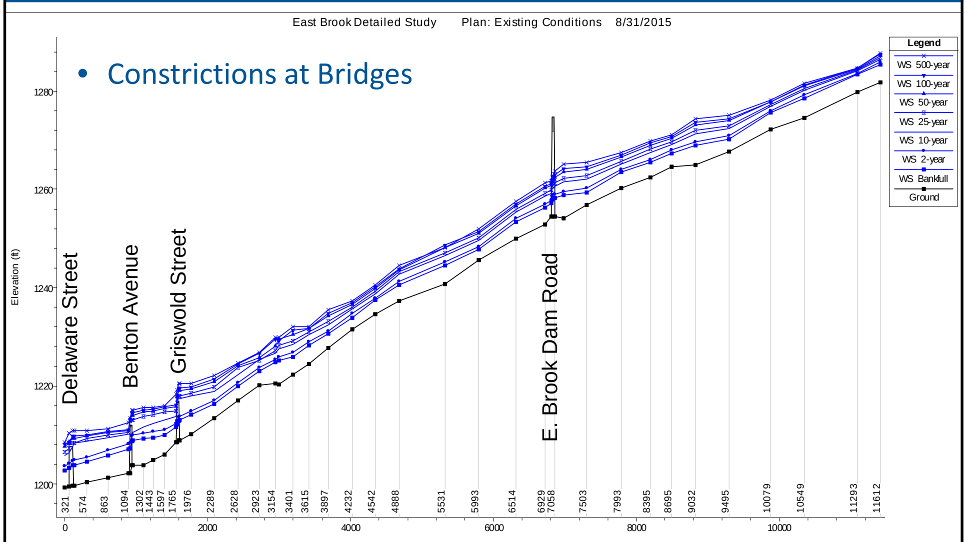
Review Existing Conditions Depth Map



MILONE & MACBROOM

Review Existing Conditions Profile

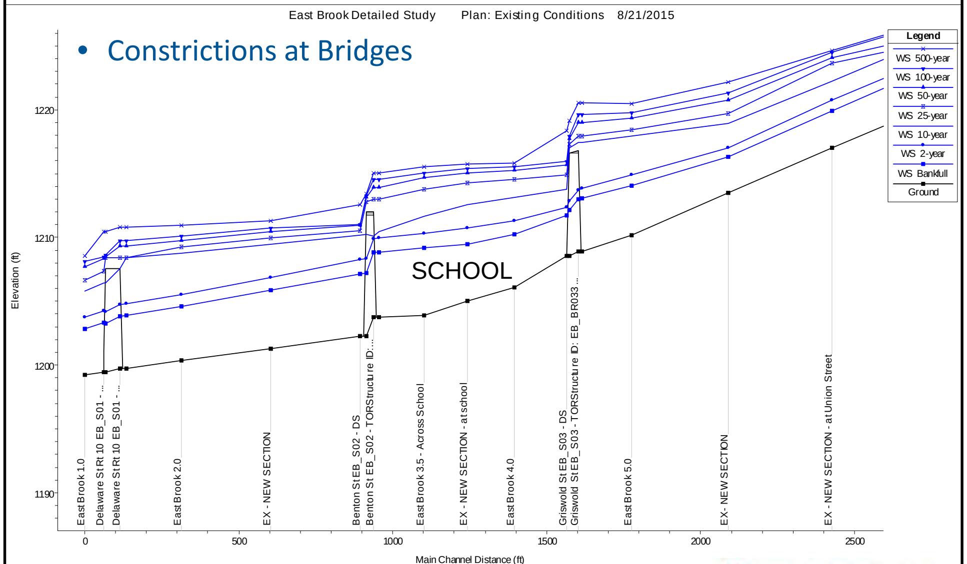
- Constrictions at Bridges



MILONE & MACBROOM

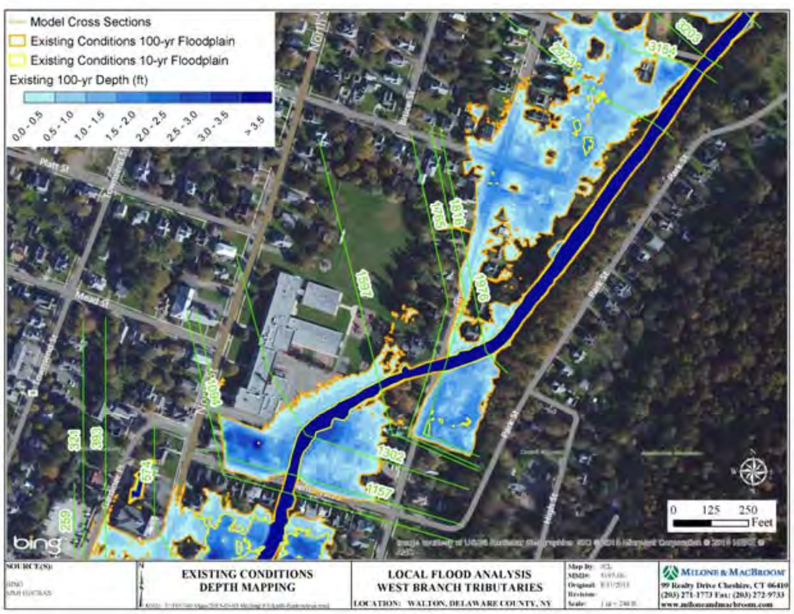
Review Existing Conditions Profile (School)

- Constrictions at Bridges

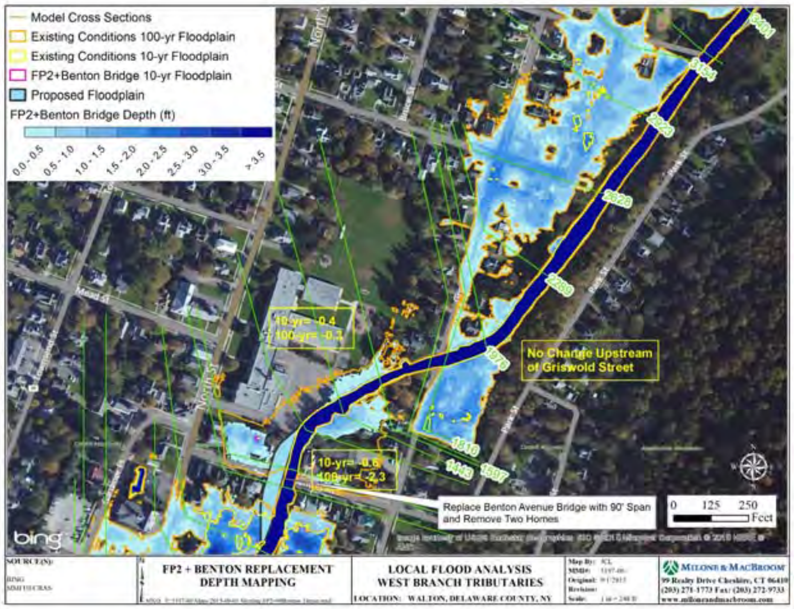


MILONE & MACBROOM

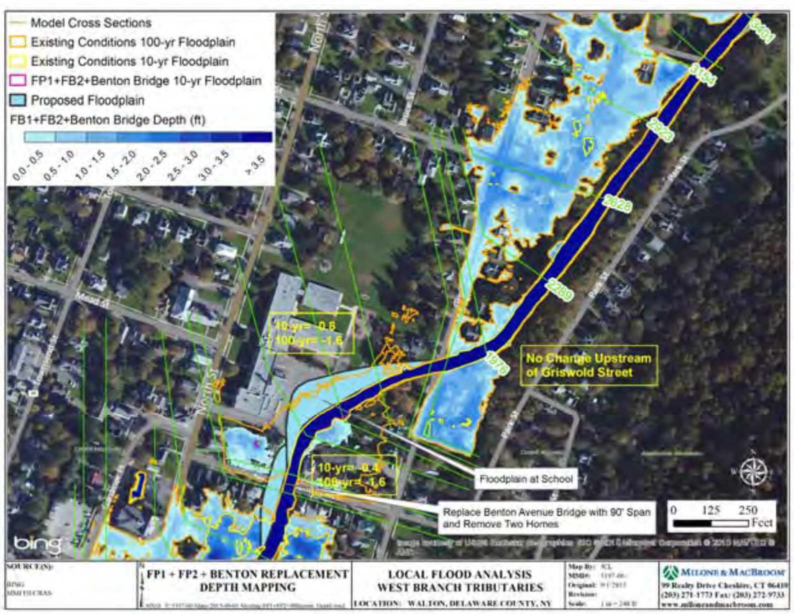
Existing Depth Mapping near School



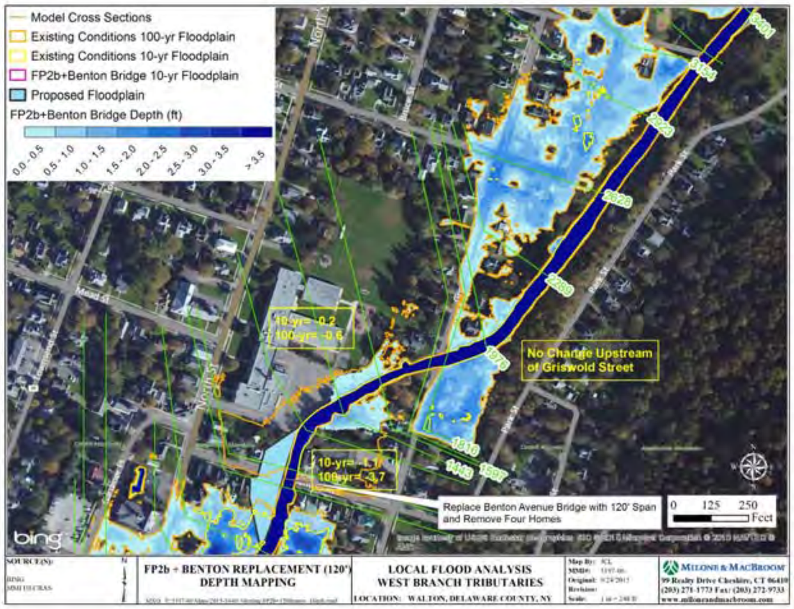
Combination: FP2 & 90' Benton Ave Bridge



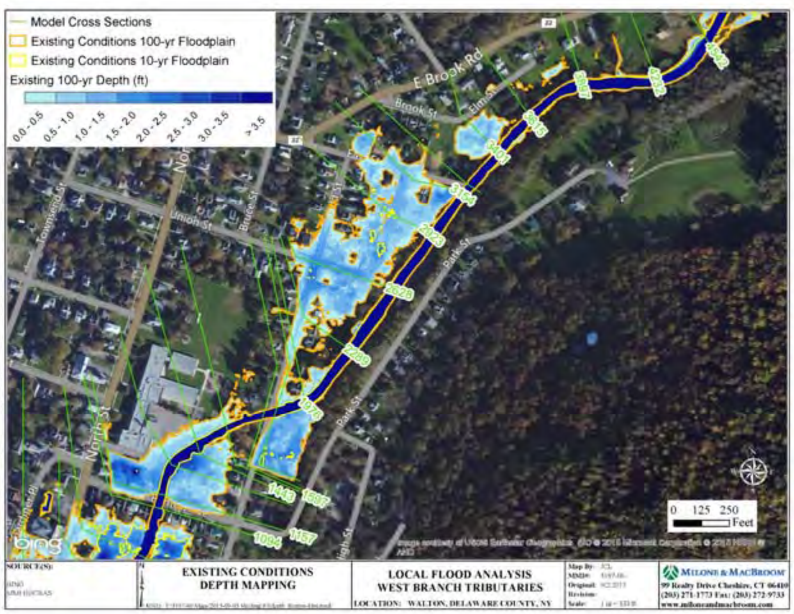
Combination: FP1, FP2, 90' Benton Ave Bridge



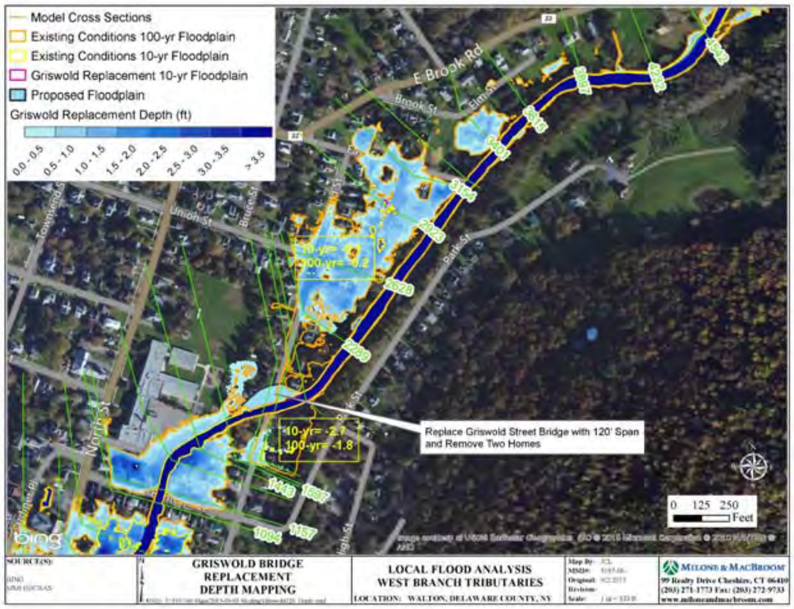
Combination: FP2b & 120’ Benton Ave Bridge



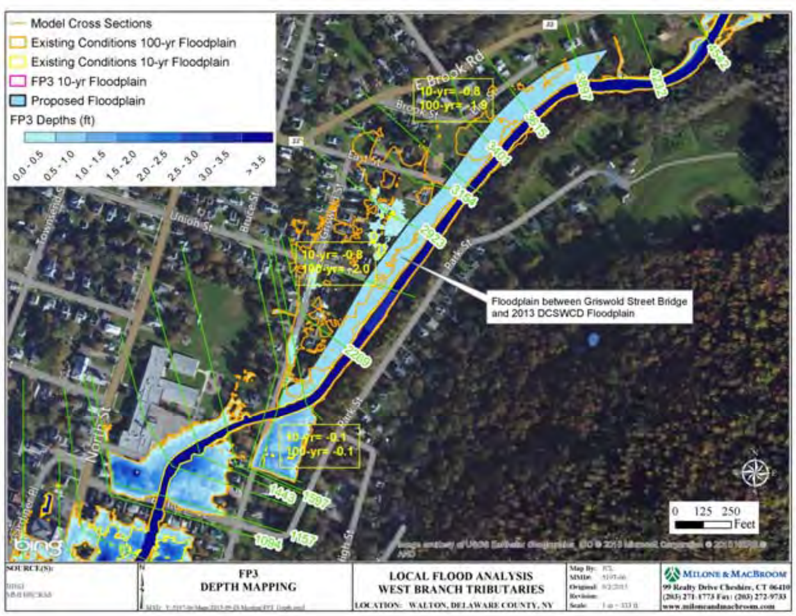
Existing Depth Mapping upstream of Griswold



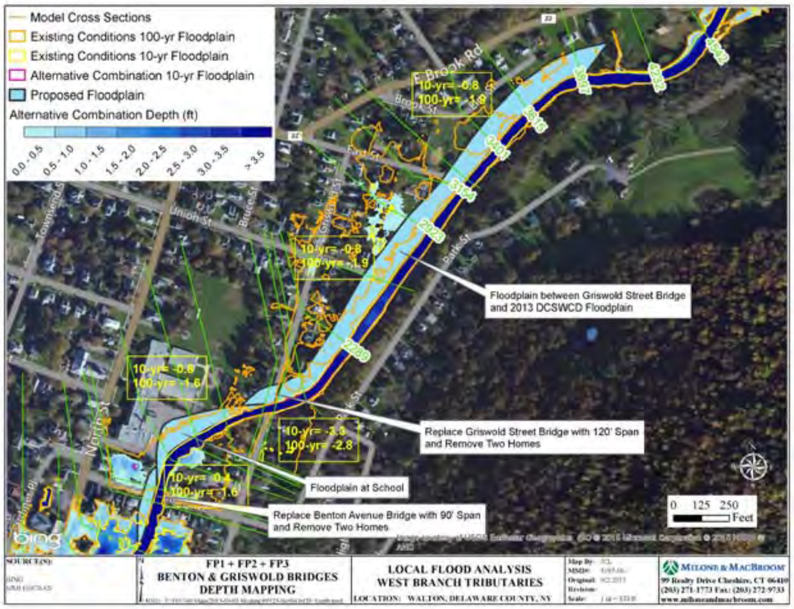
Replace Griswold Street Bridge



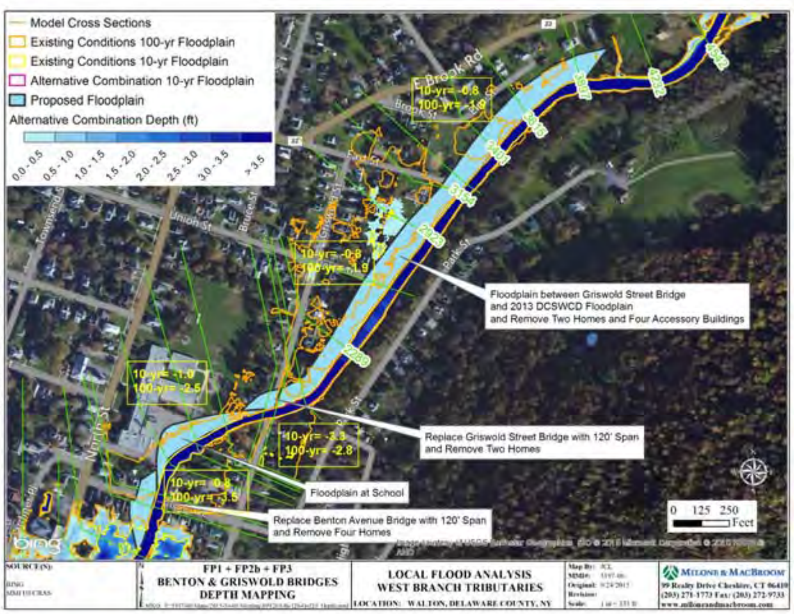
Floodplain FP3 alone (no bridge replacement)



Combination: FP1,2,3 and 2 new Bridges



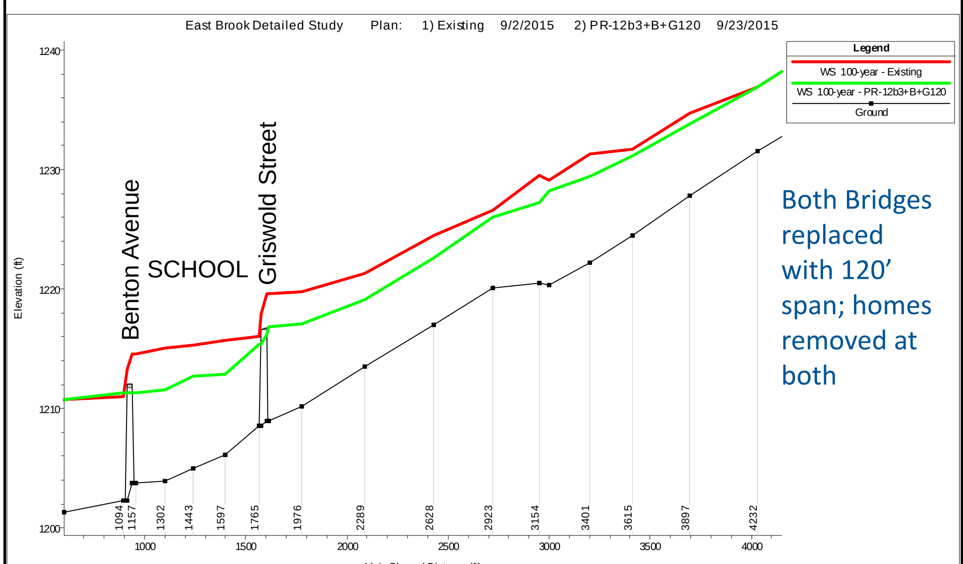
Combination: FP1,2b,3 and 2 new Bridges



Combination: FP1,2b,3 and 2 new Bridges

Challenging area – probably water pooled in low spot. However, mainly outbuildings are affected

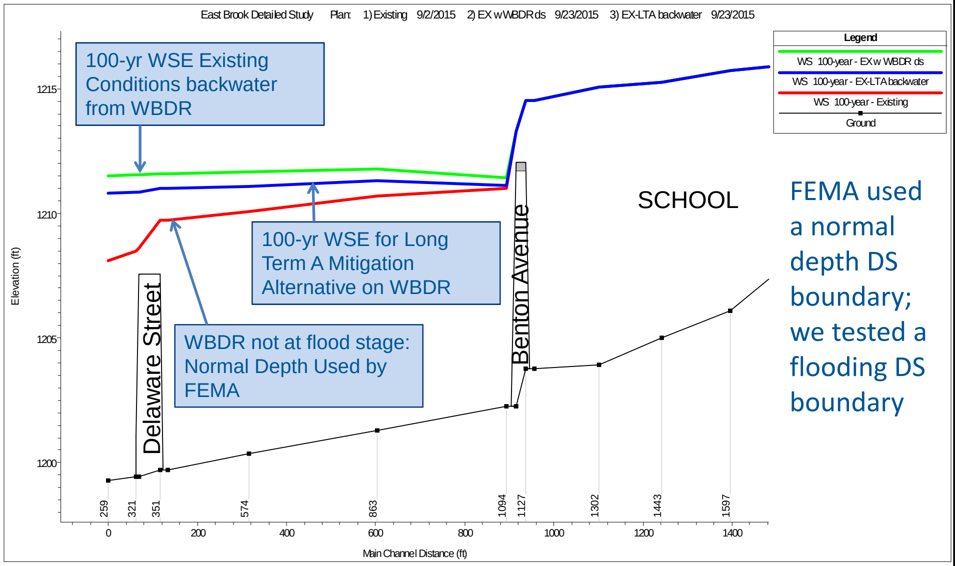
Combination: FP1,2b,3 and 2 new Bridges



Both Bridges replaced with 120' span; homes removed at both

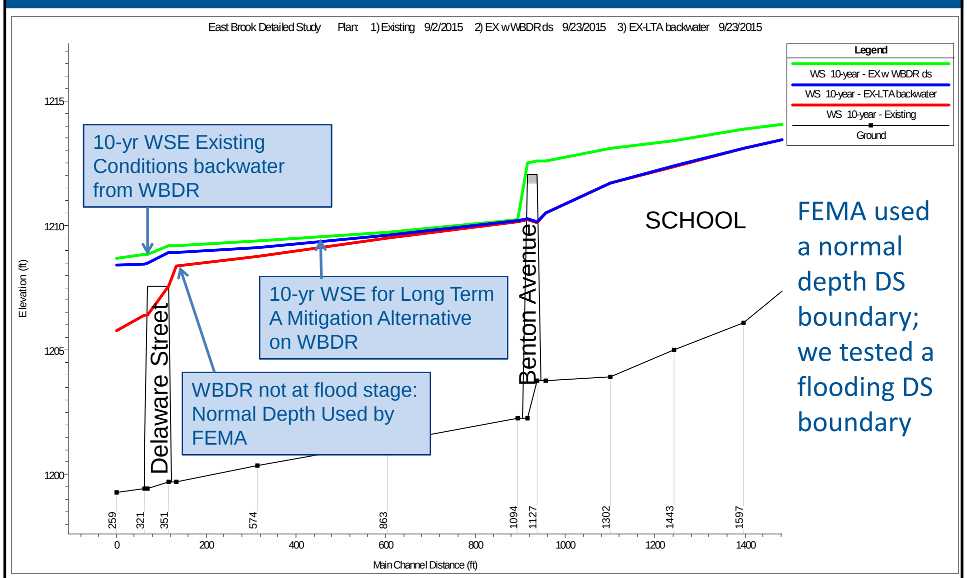
MILONE & MACBROOM

Backwater from West Branch Delaware River



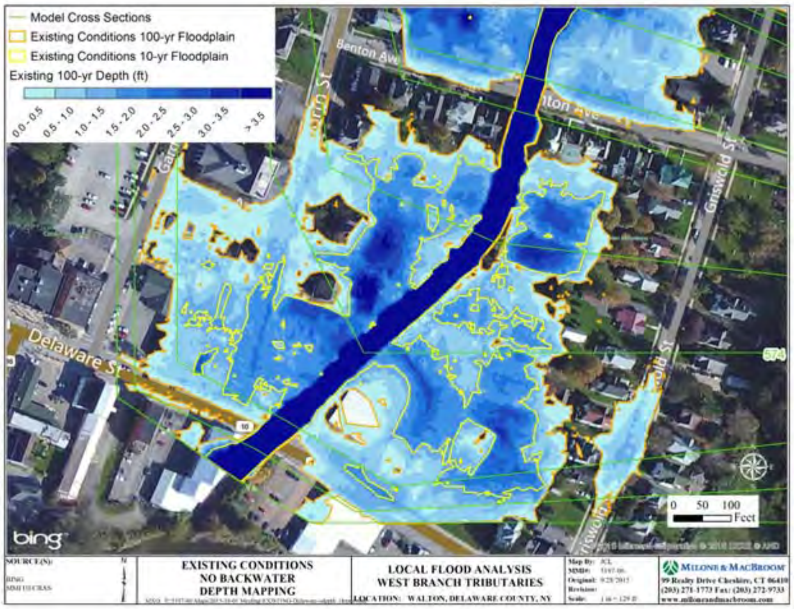
Milone & MacBroom

Backwater from West Branch Delaware River

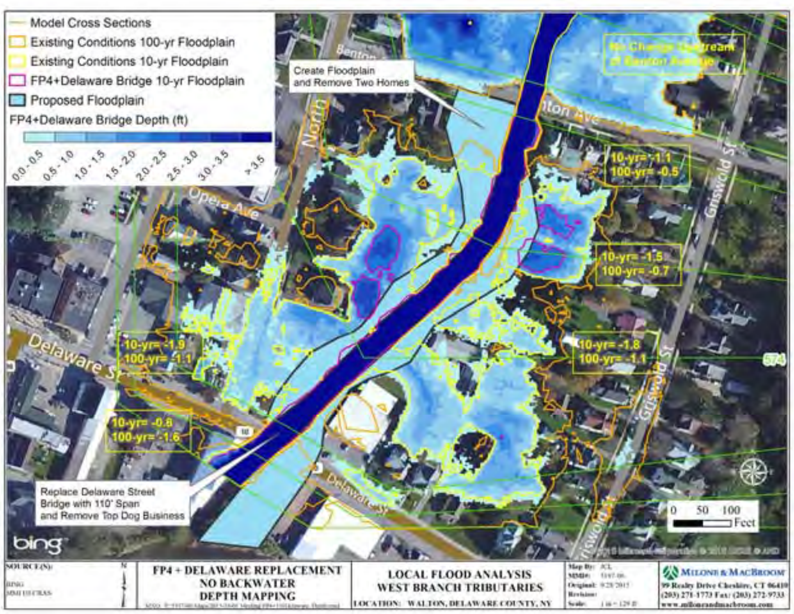


Milone & MacBroom

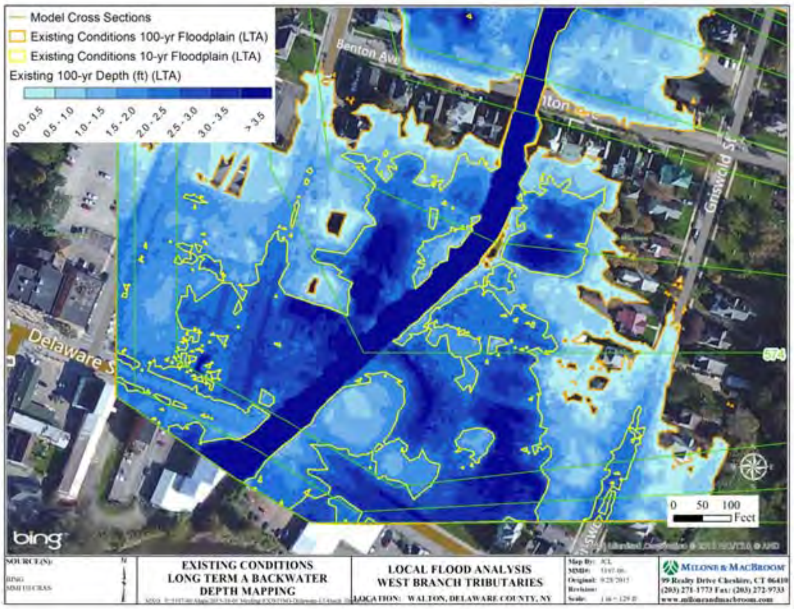
Existing near Delaware Street, No Backwater



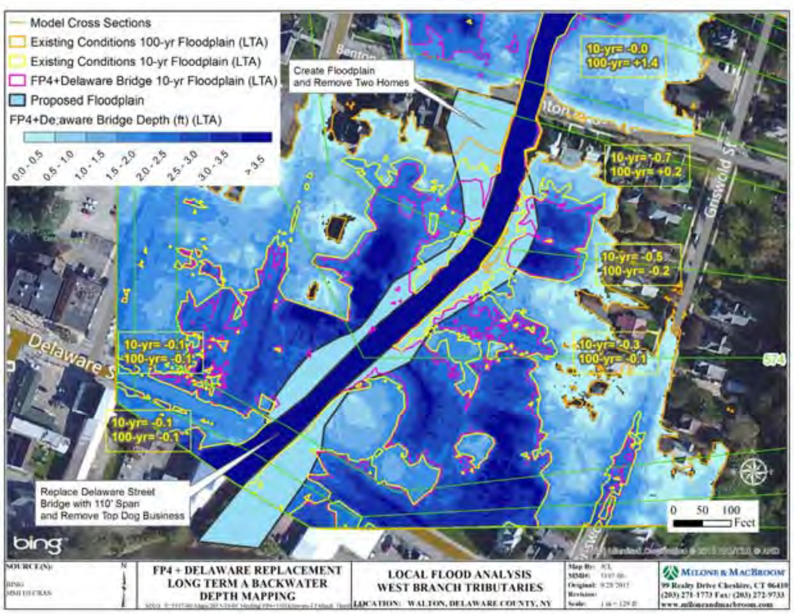
Combination: FP4 + Replace Delaware Bridge



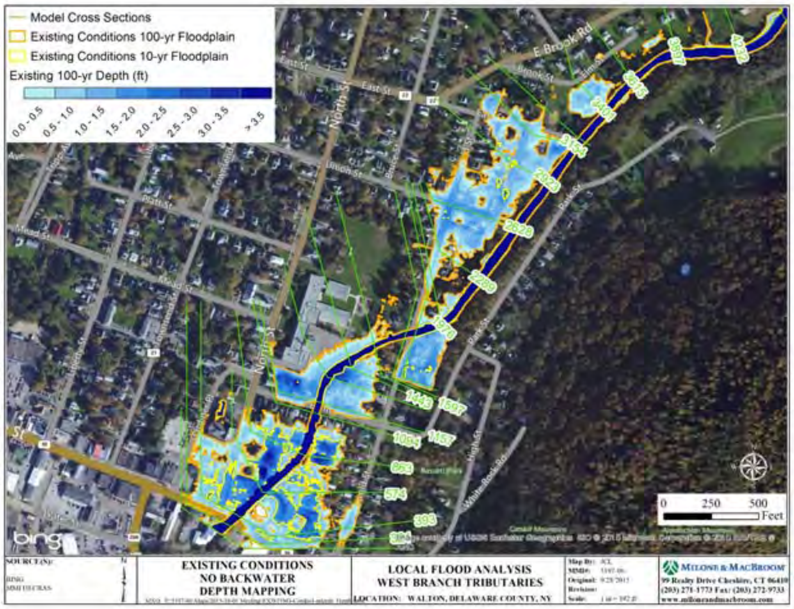
Existing near Delaware Street, LTA Backwater



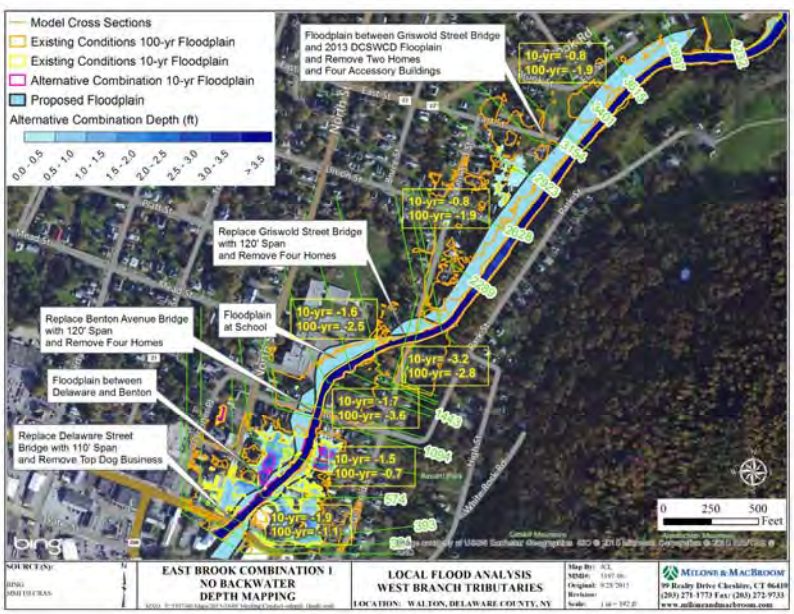
Combination: FP4 + Replace Delaware Bridge



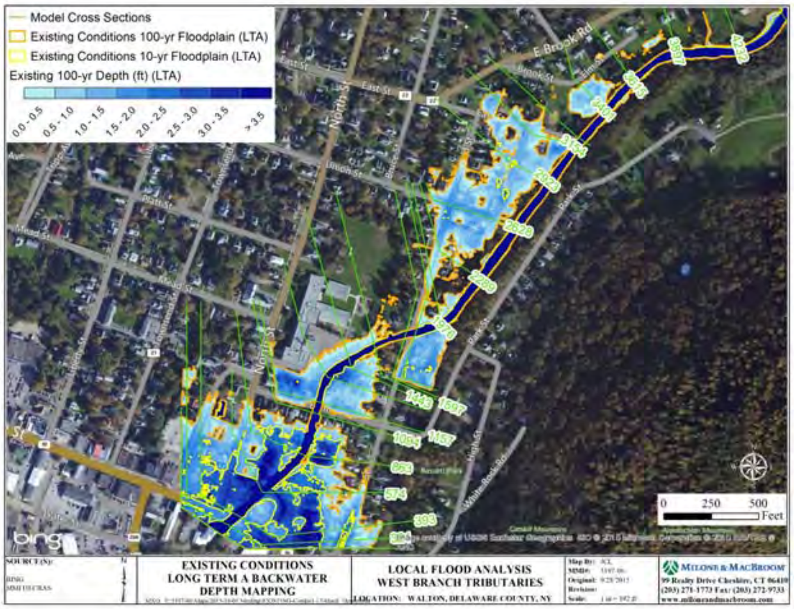
Existing Conditions, East Brook, No Backwater



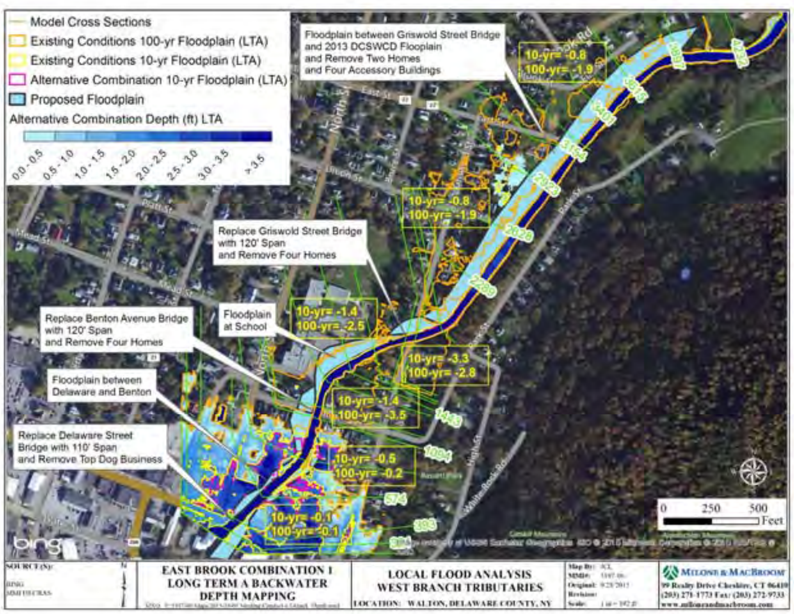
Combination 1, East Brook, No Backwater



Existing Conditions, East Brook, LTA Backwater



Combination 1, East Brook, LTA Backwater



Next Steps

- Benefit-cost analysis for East Brook alternatives
- Modeling of West Brook alternatives

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Minutes of Meeting

DATE: November 5, 2015
MMI #: 5197-06
PROJECT: Walton WBDR Tributaries LFA

SUBJECT: Notes from Walton Flood Commission Meeting
LOCATION: DCSWCD, Walton, NY

ATTENDEES:

David Murphy, P.E., CFM, MMI
Members of the Walton Flood Commission (sign-in sheet available from DCSWCD)

The Walton Flood Commission held its regular meeting on November 5, 2015 at 10:00 AM at the DCSWCD office. Students from the high school presented their findings from stream work from 10:00 to 10:30, at which point the LFA discussion commenced.

David Murphy presented a slide show that focused on West Brook. Baseline modeling was presented first, followed by modeling of preliminary mitigation alternatives extending from East Street to Delaware Street.

Attendees asked for a model scenario with the Mead Street bridge replaced but the Delaware Street bridge not replaced, which would more accurately represent the timing associated with replacing local and State-owned bridges. The alternative in the presentation is a combination of both bridges replaced.

Attendees asked for an evaluation of flooding when West Brook and the West Branch are not aligned in their flood stage. This could involve looking at historical floods to see how the peaks are aligned or not aligned. David mentioned that this had been considered for East Brook, on a preliminary basis, by looking at East Brook flooding at the 100-year storm while the river was at a lower stage, and vice versa.

Attendees discussed the backyards of the homes along Liberty Street. Although there is some concern among Flood Commission members that backyard uses might be impaired by a floodplain grading project, all attendees recognize that these properties are *already* in the FEMA SFHA and therefore are already subject to the requirement of the NFIP regulations and the local flood damage prevention code. Most uses (for example, gardening) would still be allowed. David also noted that the village or town could end up holding an easement for the floodplain project, and the easement could specify allowances or restrictions.

Attendees would like a brief evaluation of whether a floodplain bench could be construction on the west side of West Brook at the base of the slope where the footpath extends north from the end of Tripp Avenue. David believes the grade is too steep here, but stated that this will be checked.

Noting that modeling near the park was not complete yet, David asked if anyone had ideas about this part of the stream. Mayor Snow noted that bank failures were possibly a problem along Townsend Street, and said the Village was already looking at these areas with an engineering firm.

Kraft was discussed. Various news reports have noted that the business may leave Walton within five years. Attendees believe that another business will relocate to the property, and therefore flood mitigation alternatives must continue to include protection of the property. Likewise, benefits from the property will still be available to offset costs from the "C" alternatives (floodplain projects at the fairgrounds). Attendees reminded David that the bypass around the Kraft site should be modeled when Third Brook is addressed.

Issues related to acquisitions of private properties were discussed. Members of the commission from Delaware County Planning expressed the importance of getting in front of the potential acquisitions soon, prior to any public discussions or presentations outside the context of the Flood Commission meetings. David indicated that he would prepare a list of the properties that would be affected under the East Brook and West Brook alternatives discussed to date.

Additional modeling and/or BCA will be discussed at the December 3, 2015 meeting. David will try collecting information for the BCA for all three tributaries (East, West, and Third) simultaneously to avoid going back for more information later.

Local Flood Analysis
Third Project Discussion
West Branch Tributaries

Walton Flood Commission Meeting
Village and Town of Walton

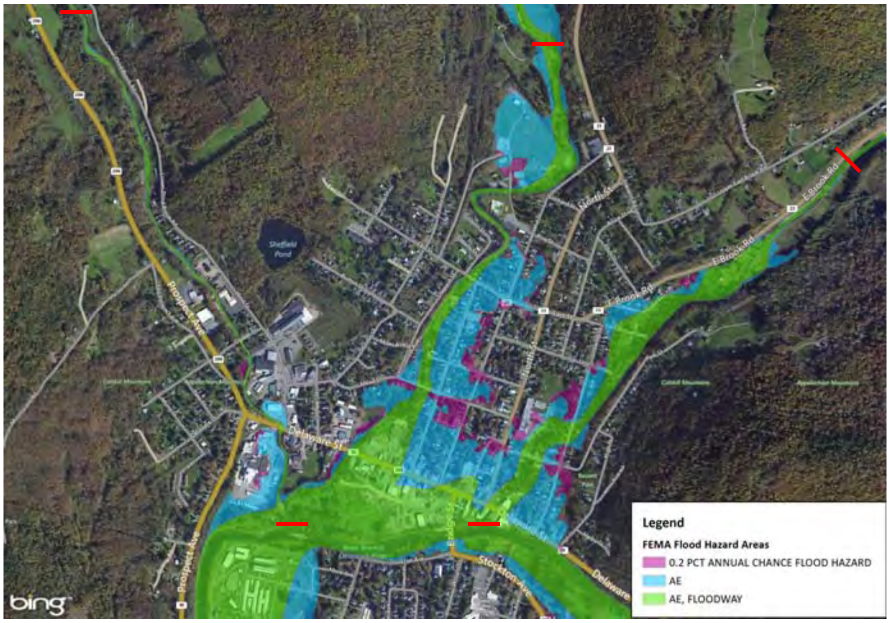
David Murphy, P.E., CFM

Delaware County Soil & Water Conservation District | November 5, 2015

Agenda

- Focus on West Brook
  - ✓ Existing Conditions
  - ✓ Initial Alternatives
- Next Steps

Study Area



FEMA Flood Insurance Study

- USGS Report of 2006 Flood:
  - East Brook Flood Discharge = 7,110 cfs
  - West Branch Flood Discharge = 28,600 cfs
- FEMA Flood Insurance Study (FIS)

Flood	East Brook	West Brook	Third Brook
10% (10 yr)	1,980 cfs	2,480 cfs	549 cfs
2% (50 yr)	3,300 cfs	3,600 cfs	831 cfs
1% (100 yr)	3,720 cfs	4,110 cfs	961 cfs
0.2% (500 yr)	4,270 cfs	5,320 cfs	1,280 cfs

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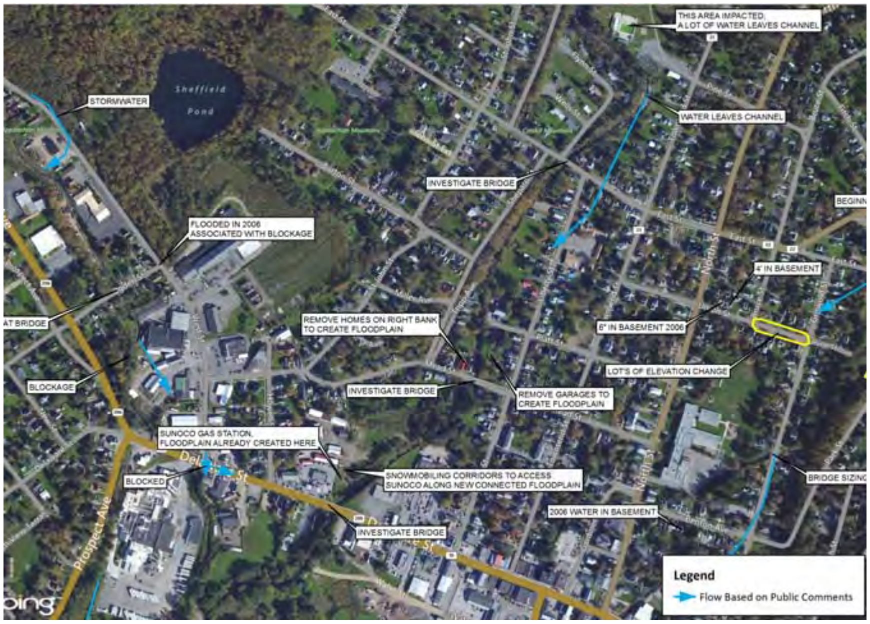
Review Public Comments – West Brook



Existing Conditions

Confluence with Third Brook and WBDR

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Existing Conditions

Delaware Street Bridge and Downstream Channel

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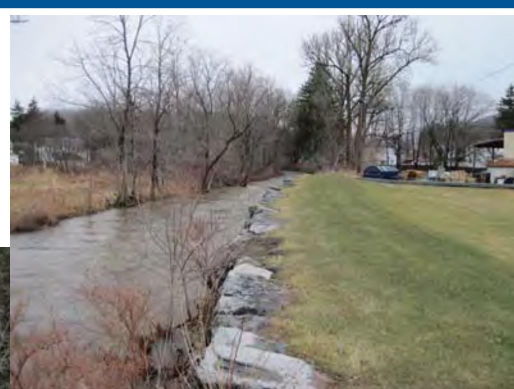
Existing Conditions

New Floodplain and Upstream Channel



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Existing Conditions

Mead Street Bridge and Downstream Channel

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Existing Conditions

Mead Street Bridge and Upstream Channel

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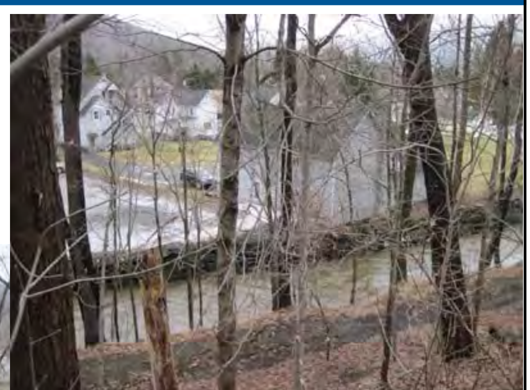
Existing Conditions

Near Tripp Avenue and Platt Street

Existing Conditions

Looking down from Shepard Street to backs of homes on Liberty Street



Existing Conditions

Downstream of East Street

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Existing Conditions

East Street Bridge

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Existing Conditions

Upstream of East Street and Downstream of Park

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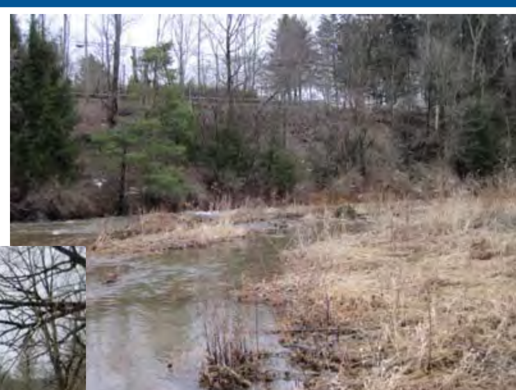
Existing Conditions

Sharp bend at Park



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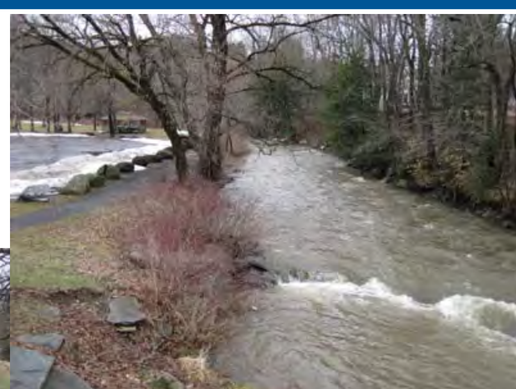
Existing Conditions

Sharp bend at Park

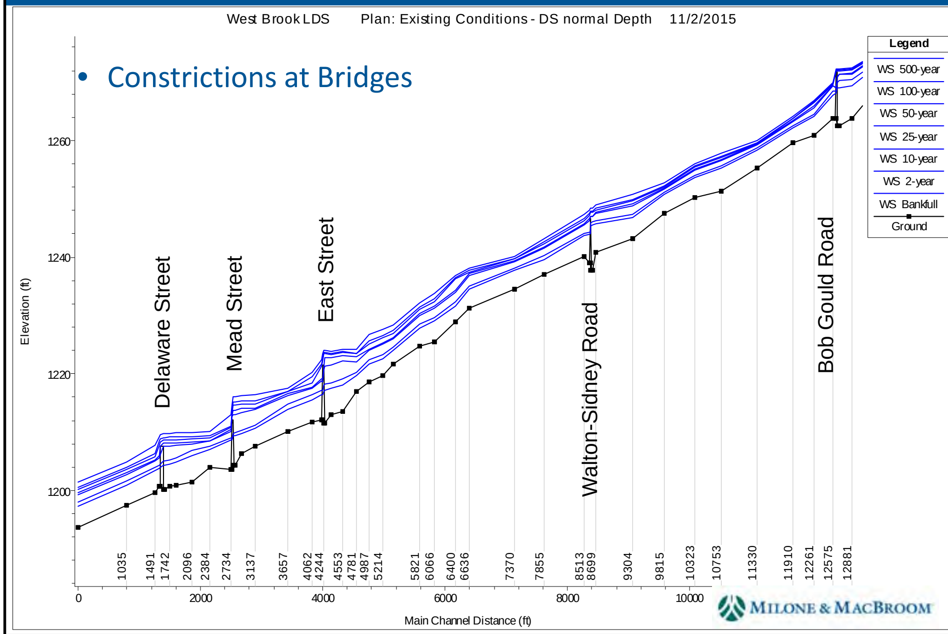
Existing Conditions

New bridge in park

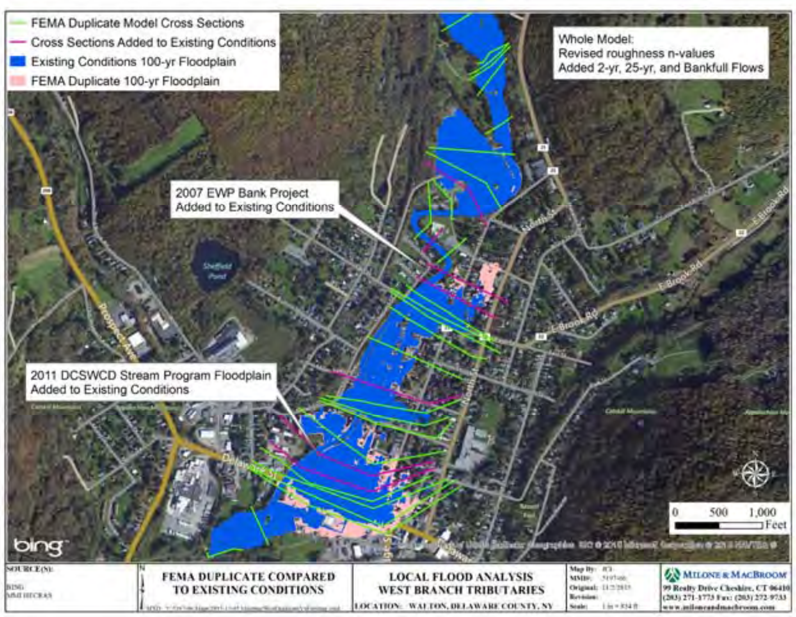


Existing Conditions Profile

- Constrictions at Bridges

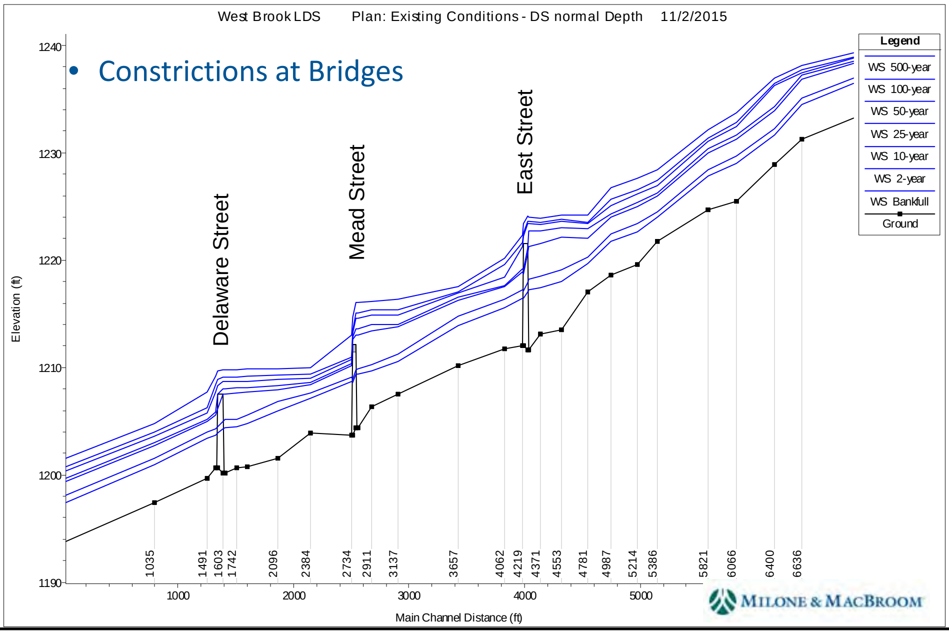


Existing Conditions Modeling



Existing Conditions Profile (Focus Area)

- Constrictions at Bridges



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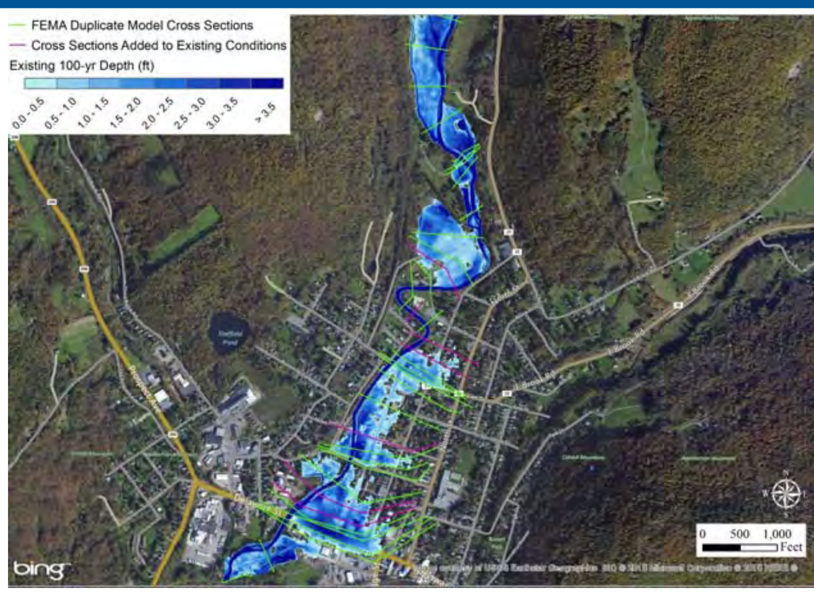
Existing Conditions Depth Map



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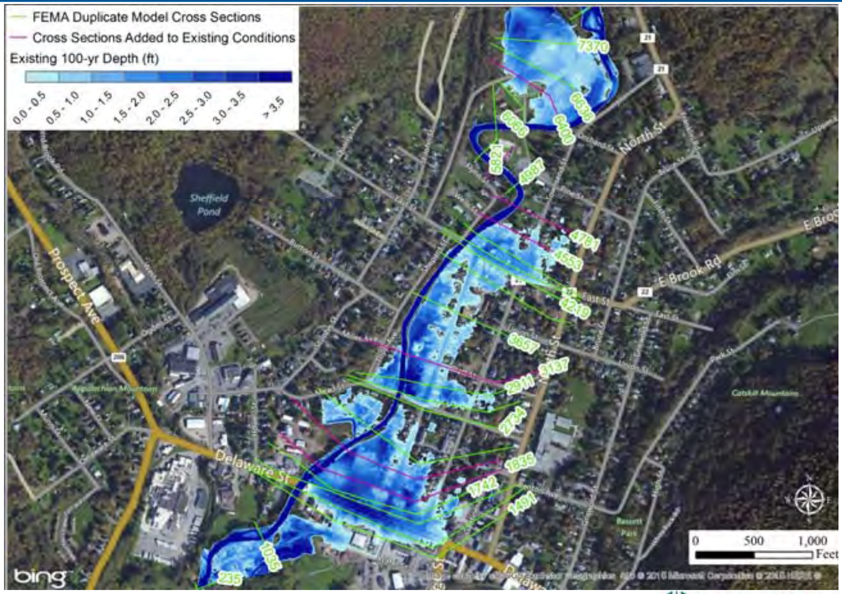
Existing Conditions Depth Map (Focus Area)



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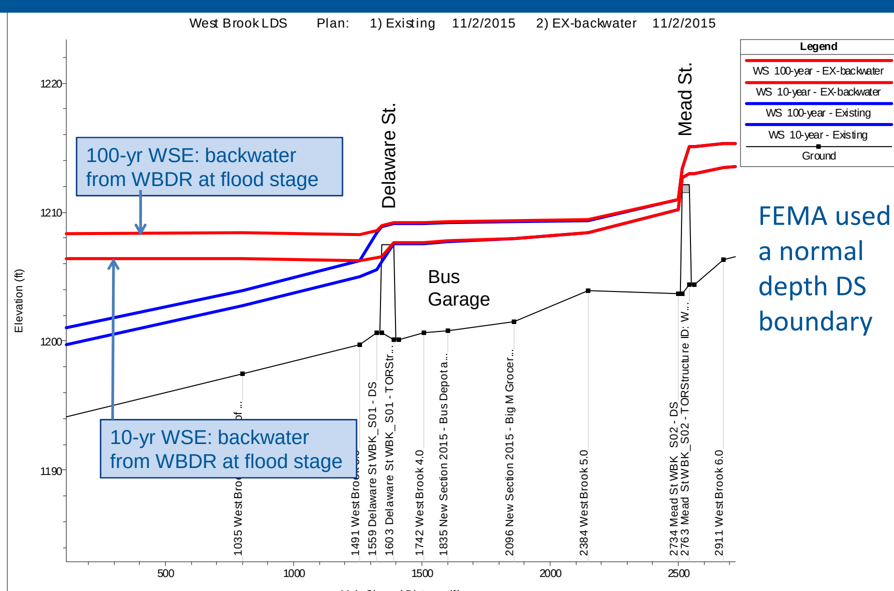
Backwater from West Branch Delaware River



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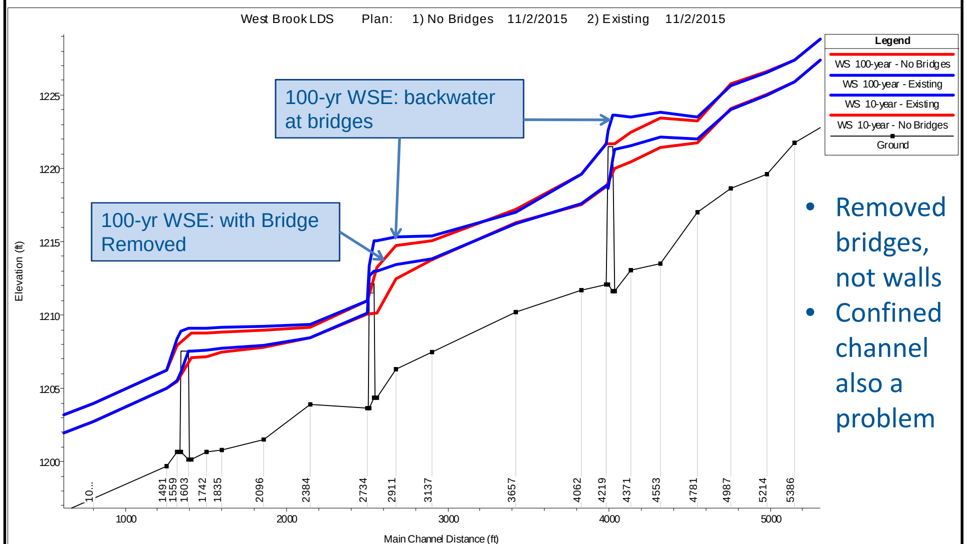
Effects of Bridges vs. Constrictions



- Removed bridges, not walls
- Confined channel also a problem

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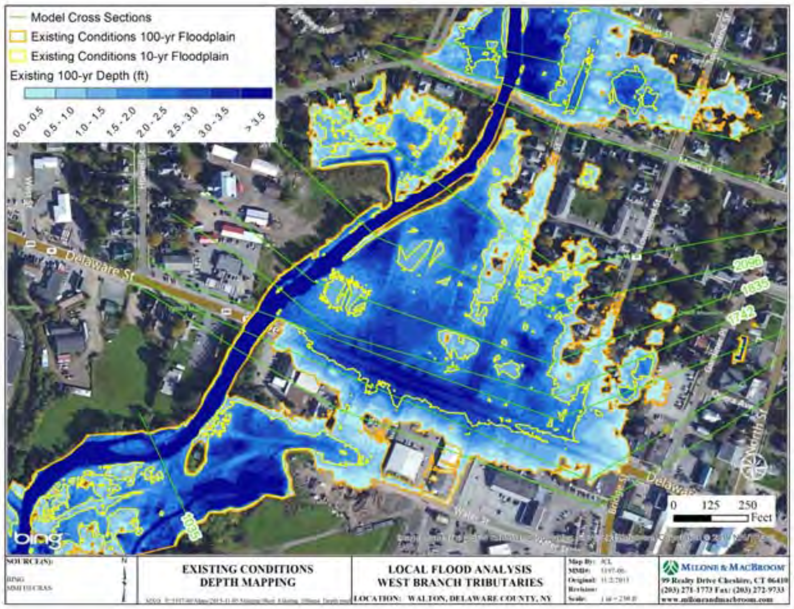
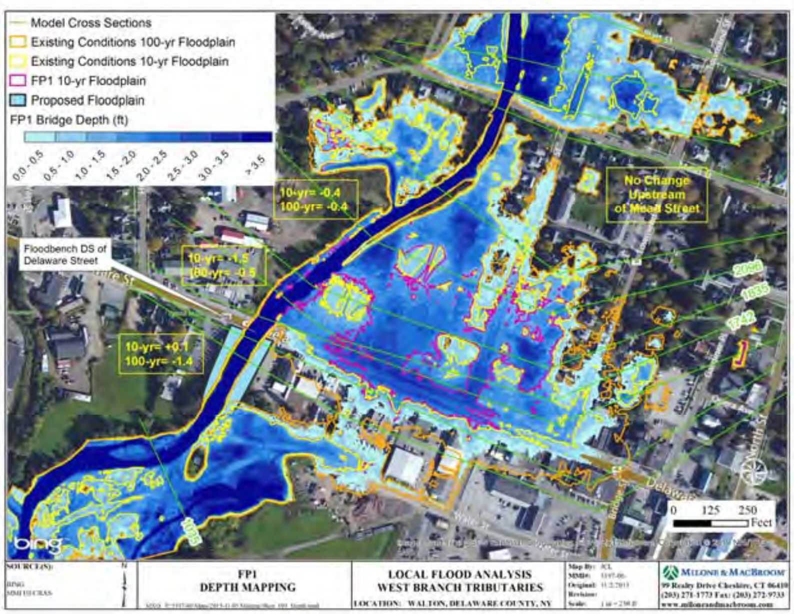
Preliminary Alternatives

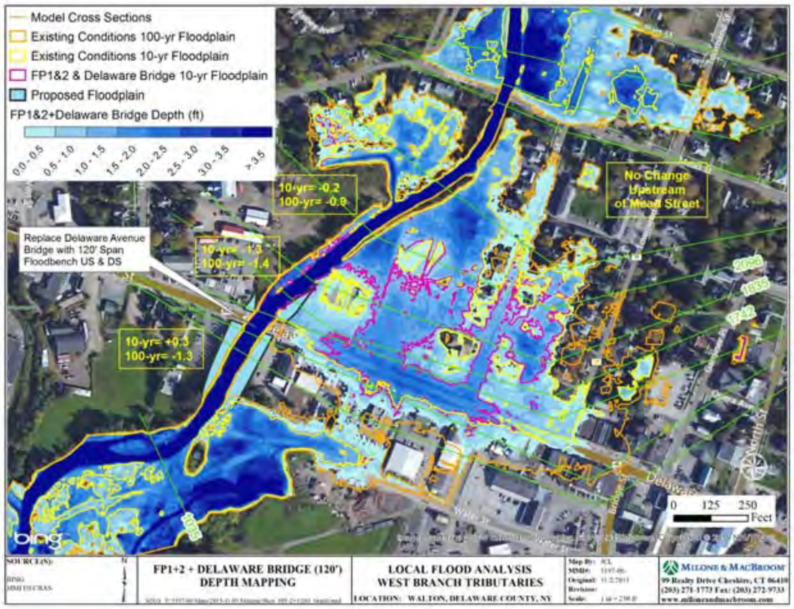
Existing Depth Mapping near Delaware St.



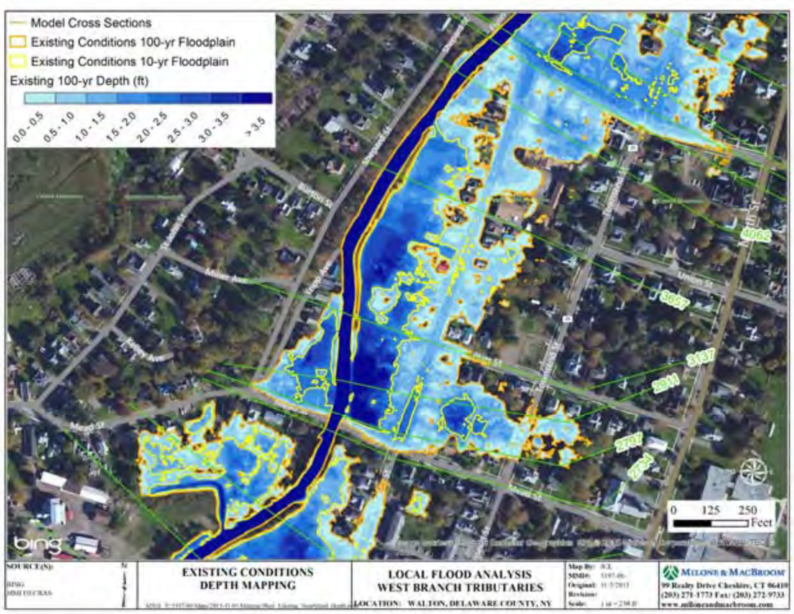
Floodplain 1



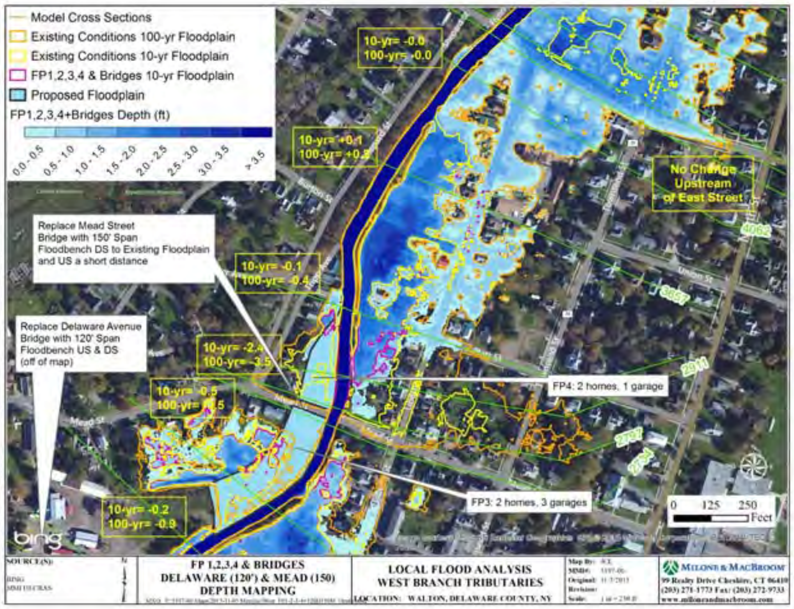
Floodplains 1 &2 & New Delaware St. Bridge



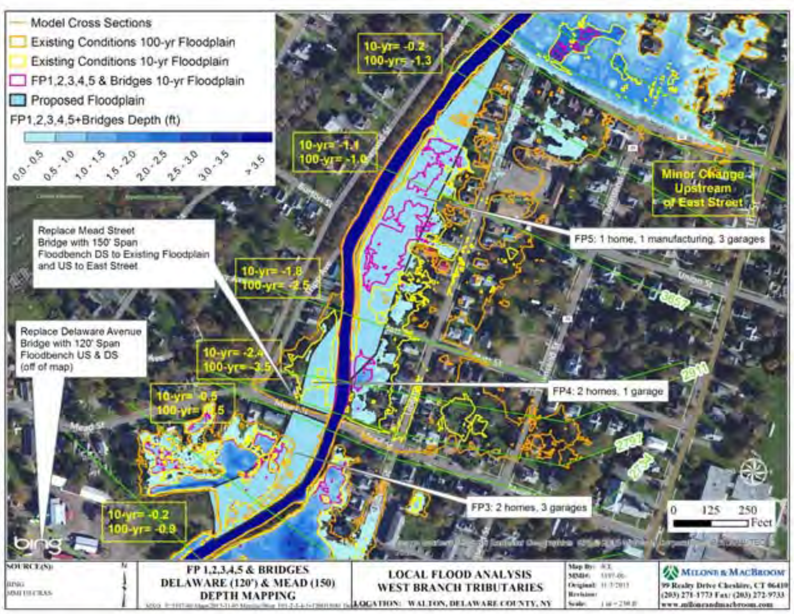
Existing Depth Mapping near Mead St.



FP 1,2,3,4 and Replace Delaware and Mead



FP 1,2,3,4,5 and Replace Delaware and Mead



Discussion and Next Steps

- Refine the modeling presented today
- Test other options, including bridges and floodplain benches at and upstream of East Street
- Damages, losses, and cleanup expenses are needed for East Brook before we can do the East Brook BCA
  - Might as well collect the same information for West Brook and Third Brook!

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DATE: January 7, 2016
MMI #: 5197-06
PROJECT: Walton WBDR Tributaries LFA

SUBJECT: Notes from Walton Flood Commission Meeting
LOCATION: DCSWCD, Walton, NY

ATTENDEES:

David Murphy, P.E., CFM, MMI
Members of the Walton Flood Commission (sign-in sheet available from DCSWCD)

The Walton Flood Commission held its regular meeting on January 7, 2016 at 10:00 AM at the DCSWCD office. David Murphy presented a slide show that focused on a few remaining questions about East Brook and West Brook followed by preliminary modeling of Third Brook.

East Brook

County Planning staff inquired about a model scenario with the Benton Avenue bridge removed (not replaced) but leaving either two or four homes from the right bank. Would the benefits be similar? If so, this could allow the homes to remain.

Attendees discussed how to segregate elements of the benefit cost analysis (BCA). While everyone would like to see a BCA for the entire combination of projects, representing a best-case flood mitigation scenario, it is possible that future applications to the program will include only some components. Some ideas are: groups of home acquisitions, school-related projects, each bridge replaced individually, and the entire flood bench upstream of Griswold Street.

West Brook

Attendees were concerned that the floodplain bench near Delaware Street has a benefit that is not visible on the depth mapping. This is because the topography (LiDAR or DEM) does not include a floodplain bench whereas the model does. Attendees asked MMI to verify that the bench *is* in the model. Prior to the public meeting, we will need to determine the best method of depicting the change in this area.

The bend upstream of East Street was discussed. Strong direction was received regarding the choice of floodplain bench alternative: replacing the EWP project with a floodplain bench will be advanced to the next step but the right bank floodplain bench will not be (the purple alternative in the presentation is preferred instead of the yellow). The BCA may be complicated here because the 100-year flood is contained in the channel. The damage frequency module of BCA may provide a better methodology.

Attendees did not discuss how to segregate elements of the BCA. David will look at this and determine the best approach.

Third Brook

Existing conditions modeling was reviewed and attendees discussed the challenges associated with depicting flood reductions when the depth mapping shows water confined to the channel. Attendees noted that the flood of 1973 caused water to inundate the feed mill behind the old Agway.

Ogden Street cannot be modeled as a no-bridge alternative like we did with Benton Avenue. A bridge must remain at Ogden Street to enable appropriate egress, evacuation, etc.

BCA will be very challenging for Third Brook. Including debris will be important, and the damage frequency module should be used. The damage frequency module would also allow use of the 2006 flood damage, whereas the flood module would not. Overall, modeling the 2006 flood may provide the decision support needed for making choices along Third Brook.

Attendees would like to include Gosper Road and Lower Third Brook Road in the set of alternatives.

Summary

East Brook BCA and the Third Brook modeling will be presented at the February meeting. In order for the BCA to be presented, attendees must obtain the requested information for the BCA within 1.5 weeks (approximately January 19).

Local Flood Analysis
4th Project Discussion
West Branch Tributaries

Walton Flood Commission Meeting
Village and Town of Walton

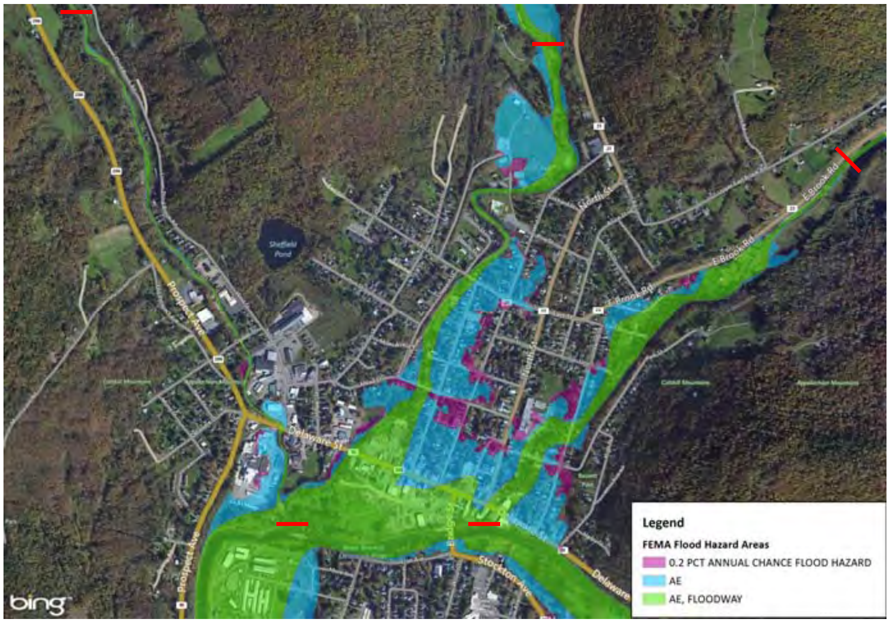
David Murphy, P.E., CFM

Delaware County Soil & Water Conservation District | January 7, 2016

Agenda

- Wrap up the East Brook Discussion
- Continue with West Brook Discussion
  - ✓ Loose Ends downstream of East Street
  - ✓ New Modeling Upstream of East Street
- Initial Third Brook Discussion
  - ✓ Existing Conditions
  - ✓ Initial Alternatives
- Next Steps

In case you forgot, this is the Study Area…



… and these are the flood discharges

- USGS Report of 2006 Flood:
  - East Brook Flood Discharge = 7,110 cfs
  - West Branch Flood Discharge = 28,600 cfs
- FEMA Flood Insurance Study (FIS)

Flood	East Brook	West Brook	Third Brook
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0.2% (500 yr)	4,270 cfs	5,320 cfs	1,280 cfs

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East Brook – Where Are We?

- In September and October we discussed existing conditions and all combinations of alternatives
- Additional modeling was requested with Benton Avenue bridge *not* replaced – see next two slides
  - Approximately 0.5 foot additional benefit (WSE decrease) relative to the benefit from the bridge replacement/floodplain combination
- Questions on timing of East Brook vs. WBDR peak flood
- Blocked bridges at Benton and Griswold – did this contribute to flooding that was worse than depicted by our depth mapping? What else could have caused the difference between modeled vs. actual damage?

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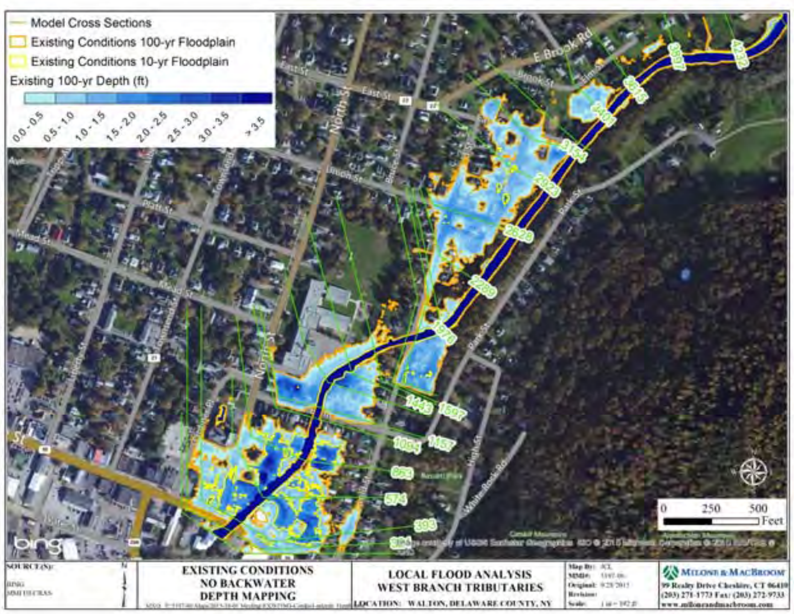
Existing Conditions – East Brook



Combination 2 + Benton bridge not replaced

East Brook – Remaining Questions

- Questions on timing of East Brook vs. WBDR peak flood
  - In some cases the peak of a storm is not coincident on a mainstem and tributary, allowing the water from one source to recede from the floodplain prior to the peak arriving from the other flood source
  - The timing of the WBDR 2006 flood peak was 28,600 cfs at 6/28/06 at 0330
  - The timing of the East Brook flood peak was 7,110 cfs at 6/28/06 at 0315
  - The difference in discharge during those 15 minutes is 280 cfs (4%) on East Brook and 500 cfs (2%) on the West Branch
  - A 15 minute difference in timing is negligible

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East Brook – Remaining Questions

- Questions on timing of East Brook vs. WBDR peak flood
  - Nevertheless, we tested two combinations:
    - (1) East Brook at 100-yr and WBDR at 50-yr
    - (2) East Brook at 50-yr and WBDR at 100-yr
  - The depth maps were barely different

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East Brook – Remaining Questions

- Blocked bridges at Benton and Griswold were evaluated. We blocked the bridges with 2.5' of "stuff" at the bottom of the channel and found:
  - Blockage at Benton Avenue causes part of the school building to be directly flooded (100-year WSE changes from 1215.1' to 1216.2')
  - Floodwaters could have left the channel at Griswold and flowed across the school field to indirectly flood the school
- Also, the 2006 flood was higher than the 100-year flood

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East Brook – Next Steps

- Select the single alternatives or combination(s) of alternatives to advance to BCA

West Brook – Where Are We?

- In November we discussed the following:
  - Existing conditions modeling
  - Alternatives downstream of East Street
- The committee requested:
  - Look at timing of floods (West Brook vs. WBDR)
  - Combination of alternatives without the Delaware Street bridge replacement (since it may occur much later in the future)
  - Floodplain bench on right bank along footpath
  - Complete modeling upstream of East Street (add pedestrian bridge, test other alternatives)

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West Brook – Lower Area

- The timing of peaks is assumed to be the same as on East Brook (in the 2006 flood, there was negligible difference in WBDR vs. East Brook).
- Additional modeling of combined alternatives, but without the Delaware Street Bridge replaced, because this may happen far in the future.
  - Includes floodplains 1-5 and the new Mead Street Bridge
  - Same results from section 2734 and upstream
  - Downstream of section 2734:
    - no change in benefit for 10-yr
    - reduced benefit for 100-yr, but still something

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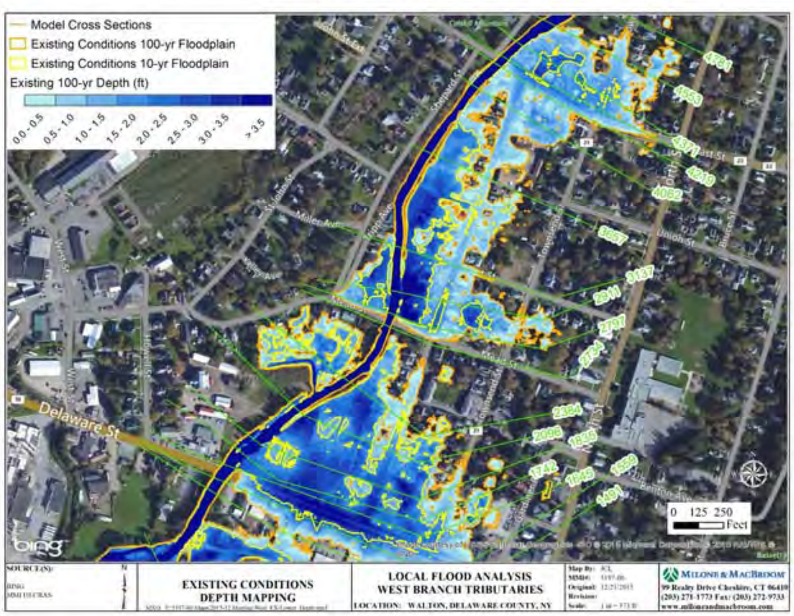
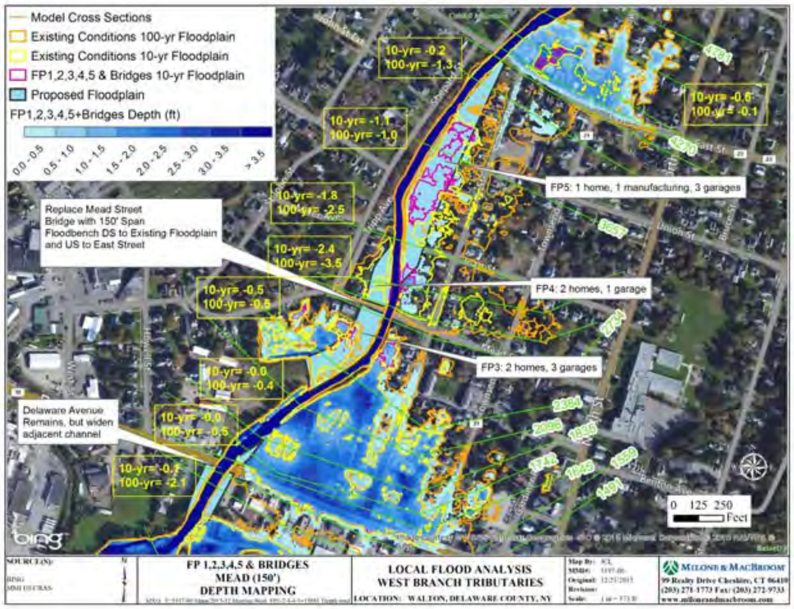
Lower West Brook Existing Depth Mapping



FP 1,2,3,4,5 and Replace Mead, not Delaware



West Brook – Flood bench on RB (DS East St)

- A flood bench is not recommended for the base of the slope on the west bank between Tripp Ave and East St
- The forested bank is very steep with slopes varying between 1:1 and 3:1.
- Approximately 60 feet between edge of Shepard Street and edge of river, elevation drop of ~30 feet

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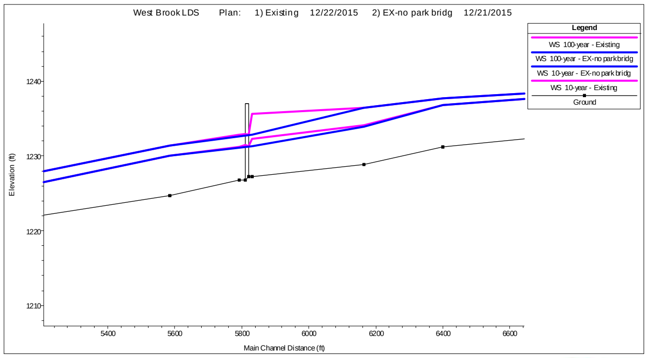
West Brook – Pedestrian Bridge at Park

- The pedestrian bridge at the park was added to the model based on as-built plans
  - 2.8' increase in 100-yr WSE, 1.0' increase in 10-yr WSE
  - The flooded area is park/ball fields – this is typically OK
  - Alternatives were not tested



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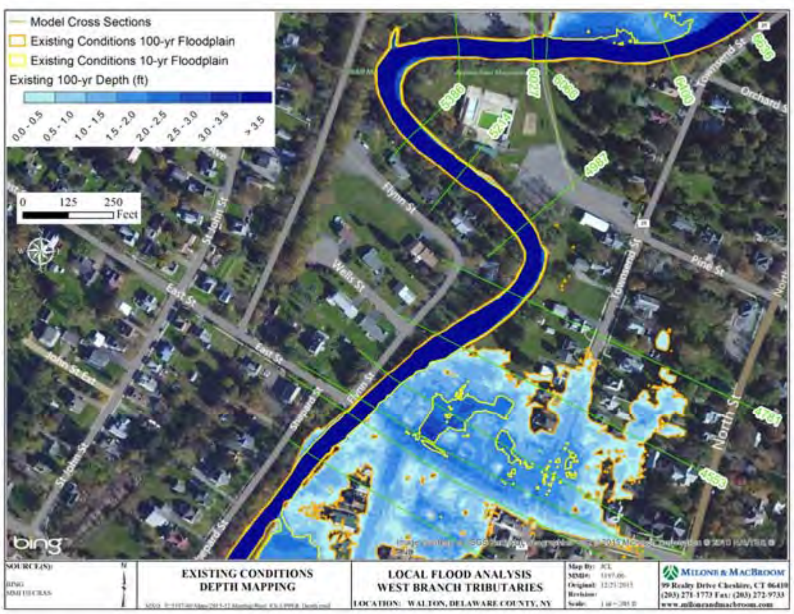
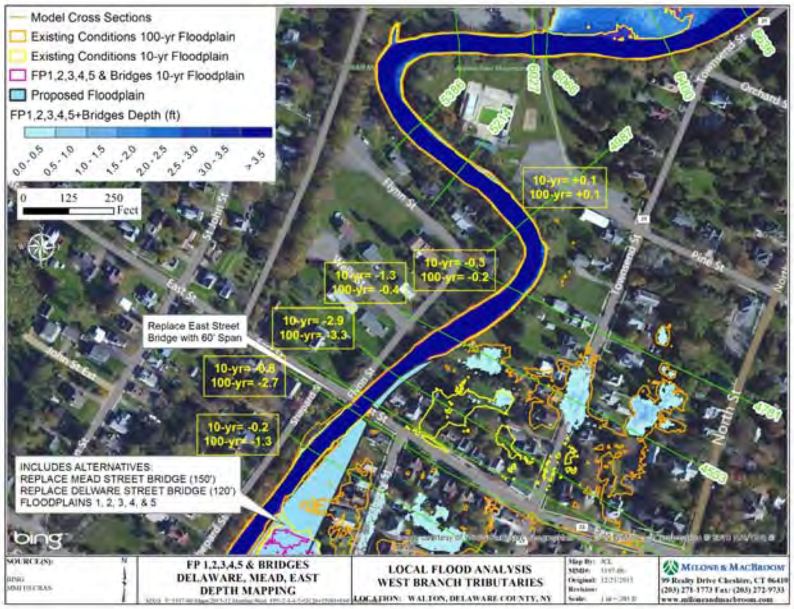
Upper West Brook Existing Depth Mapping

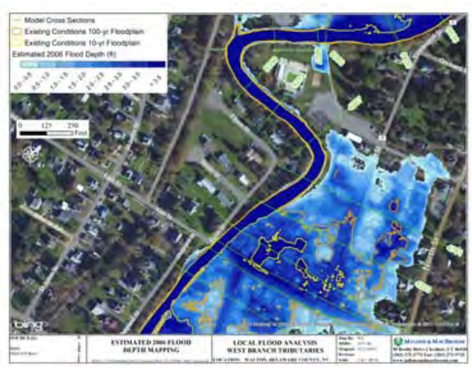


Upper West Brook – East Street bridge



West Brook – Floodplain Bench DS of Park?

- A comparison of the 100-year and 2006 flood depth shows that water may be able to break out of this area
- The goal would be to reduce this potential



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West Brook – Floodplain Bench DS of Park?

No great options here

- A floodplain bench at the base of the slope on the right (west) bank at the bend downstream of the park would be intrusive
  - The slope is approximately 16 feet tall and steep, with slopes varying between 2:1 and 3:1
  - A home is at the top of the slope, between 0 and 35 feet back from the top

- However, the left (east) bank has been armored with an EWP project

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West Brook – Floodplain Bench DS of Park

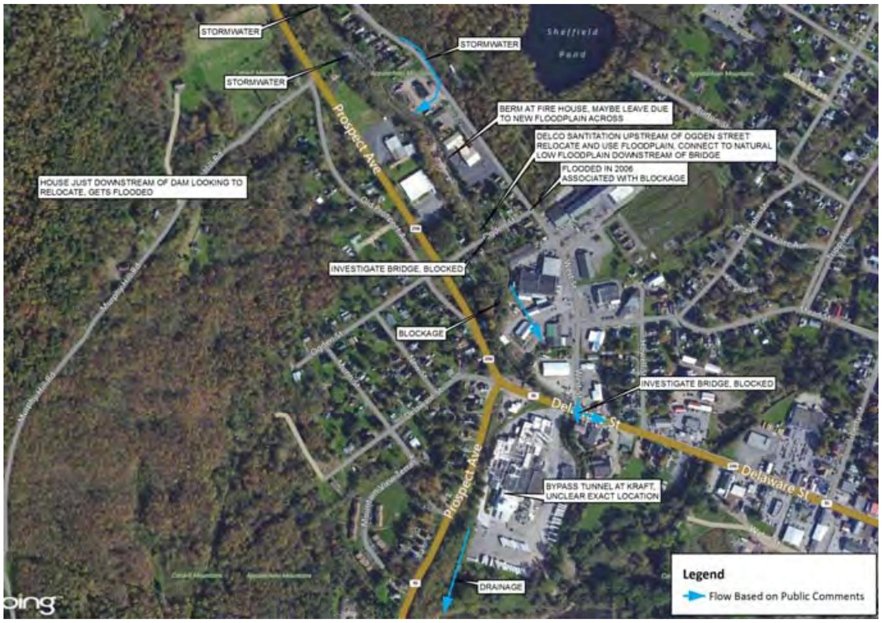
West Brook – Next Steps

- Choose a floodplain bench between the park and East Street – or none at all
- Select the single alternatives or combination(s) of alternatives to advance to BCA

Third Brook – Initial Discussion

- The Third Book Watershed Management Plan provided the basic set of alternatives to test
- A fundamental challenge with Third Brook is that the 100-year flood is *modeled as* contained in the channel between the old reservoir and the auction house
- Viewing the benefits of alternatives will therefore be challenging!

Review Public Comments for Third Brook



Existing Conditions

Confluence with West Brook and WBDR

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Existing Conditions

Near Kraft

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Existing Conditions

Delaware Street Bridge

MILONE & MACBROOM

Existing Conditions

Delaware Street Bridge

MILONE & MACBROOM

Existing Conditions

Upstream of Delaware Street Bridge

MILONE & MACBROOM

Existing Conditions

Ogden Street Bridge

MILONE & MACBROOM

Existing Conditions

Ogden Street Bridge

MILONE & MACBROOM

Existing Conditions

Upstream of Ogden Street Bridge


MILONE & MACBROOM

Existing Conditions

Upstream of Ogden Street Bridge


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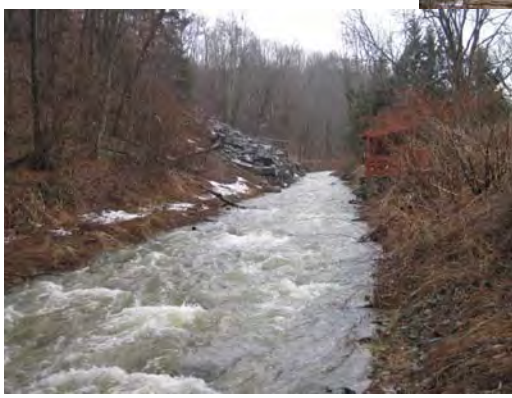
Existing Conditions

Upstream Area



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Existing Conditions

Upstream Area

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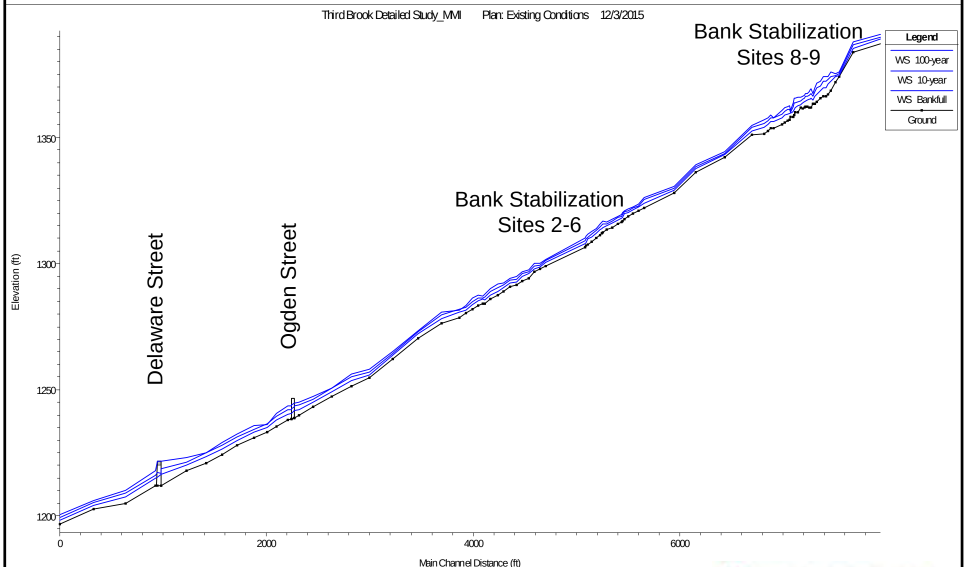
Existing Conditions Profile



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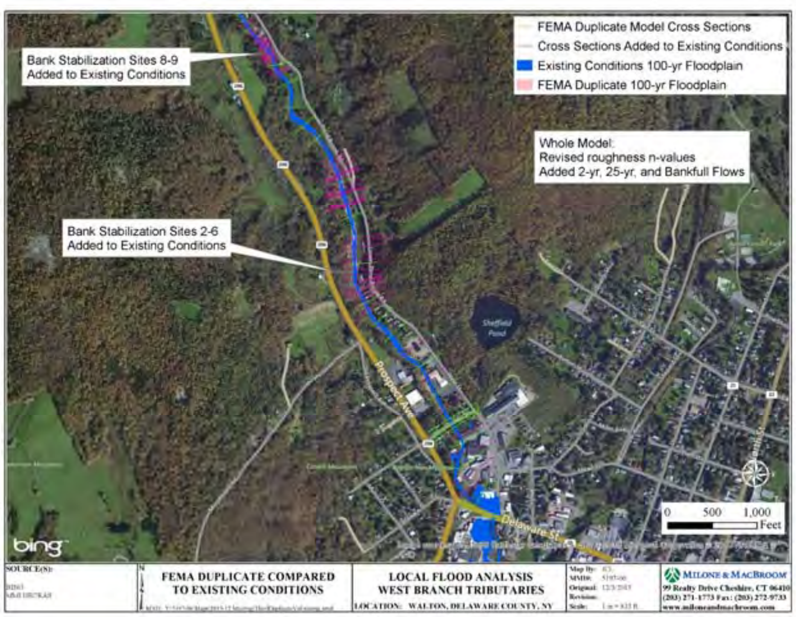
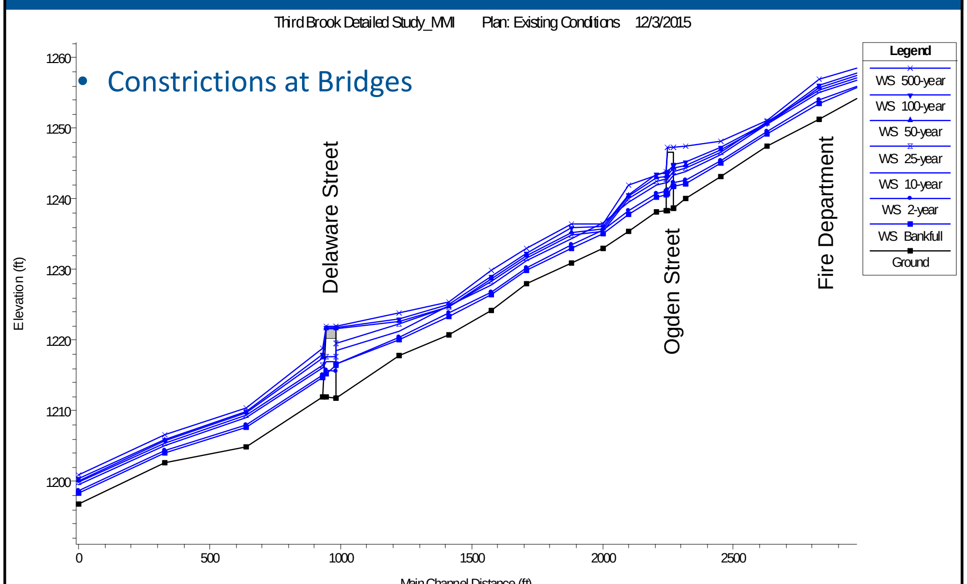
Existing Conditions Modeling



Existing Conditions Modeling

Existing Conditions Profile (Focus Area)

- Constrictions at Bridges



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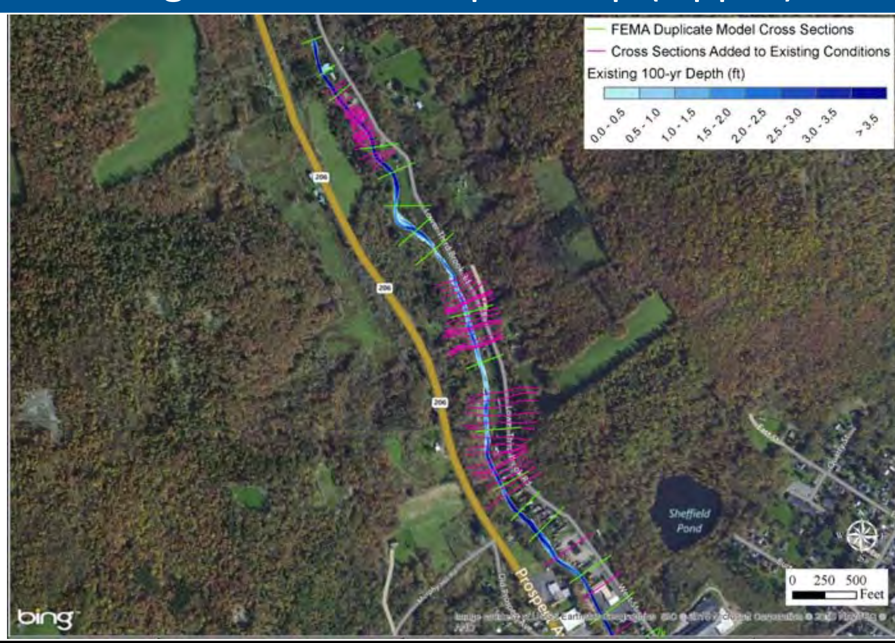
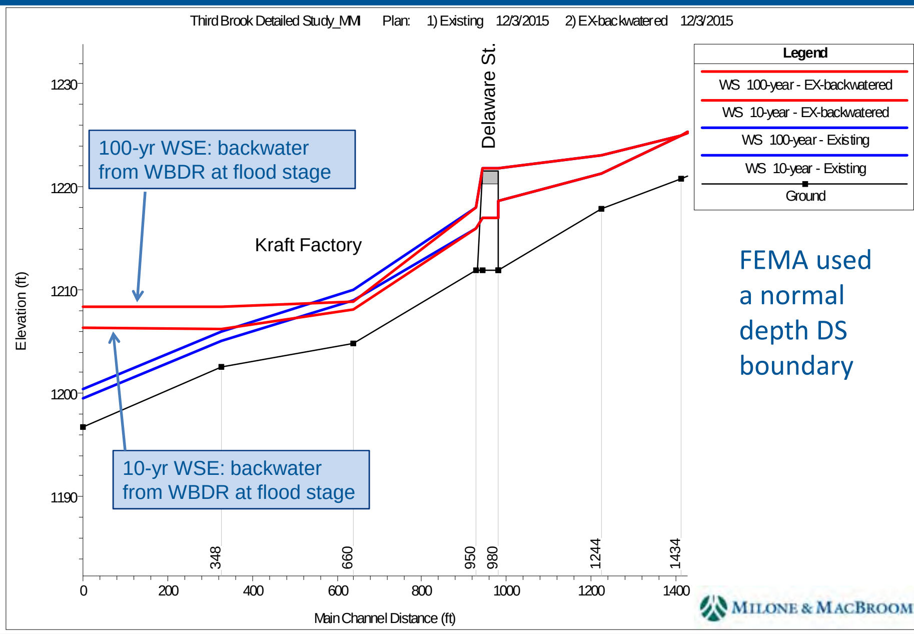
Existing Conditions Depth Map (Lower)

Existing Conditions Depth Map (Upper)

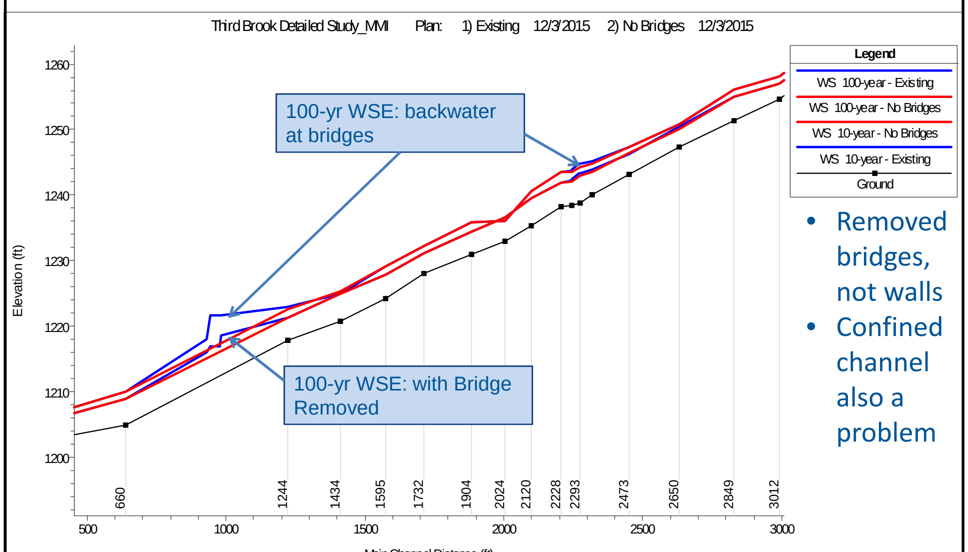


Backwater from West Branch Delaware River



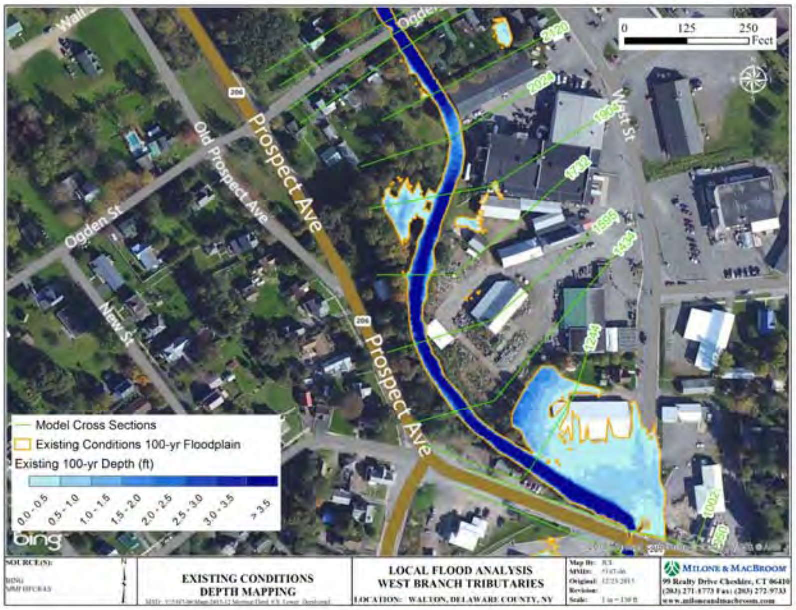
FEMA used a normal depth DS boundary

Effects of Bridges vs. Constrictions

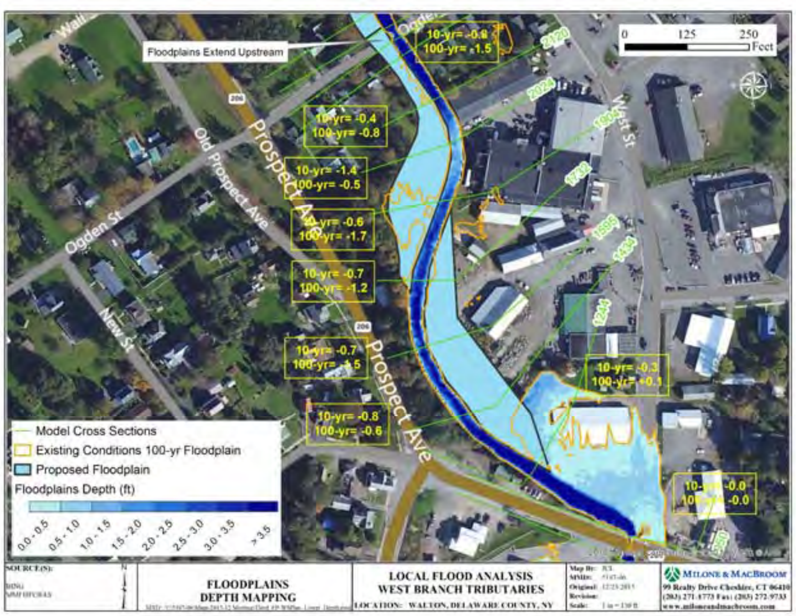


- Removed bridges, not walls
- Confined channel also a problem

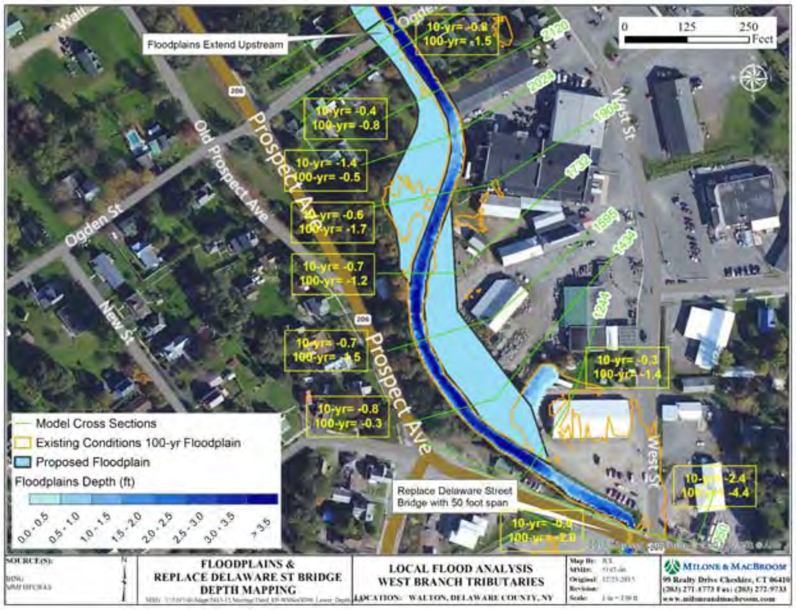
Lower Third Brook Existing Depth Map



Lower Third Brook- Floodplain Alternative

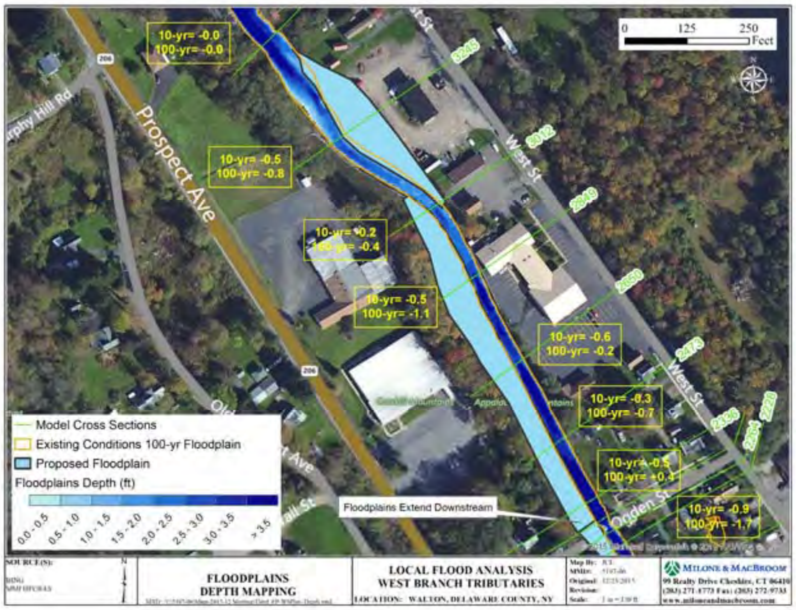


Floodplain + Replace Delaware Street Bridge

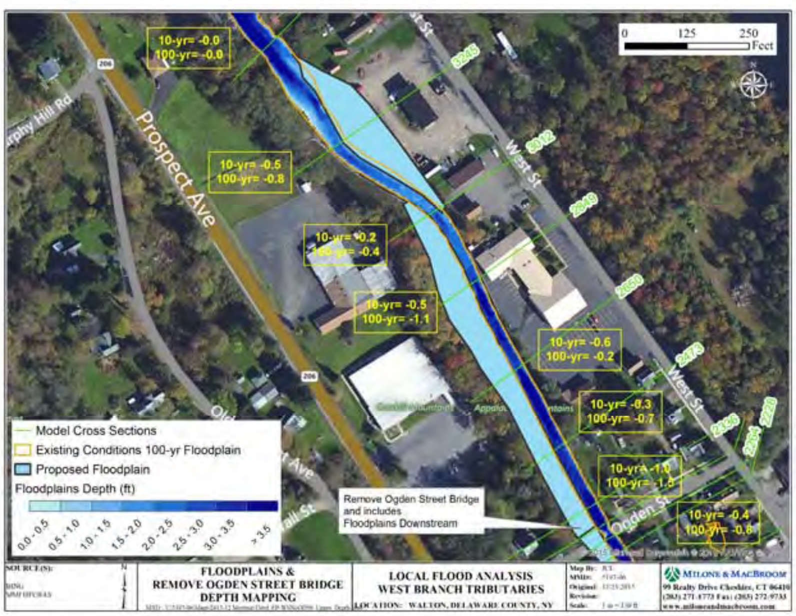


Upper Third Brook Existing Depth Map

Upper Third Brook – Floodplain Alternative



Floodplains & Remove Ogden Street Bridge



Third Brook – Next Steps

- Try to simulate the extent of the inundation area during the 2006 flood
- See if the modeled floodplain benches would have contributed to benefits during the 2006 flood
- Look at alternatives between the old reservoir and Del-Ton Sanitation
- Look at alternatives upstream of the old reservoir and at Lower Third Brook Road (is this desired?)
- Bypass along the west side of Kraft

Summary of Next Steps

- For East Brook and West Brook, select the single alternatives or combination(s) of alternatives to advance to BCA
- For Third Brook, additional modeling is needed
- Damages, losses, and cleanup expenses are needed for BCA

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DATE: February 4, 2016
MMI #: 5197-06
PROJECT: Walton WBDR Tributaries LFA

SUBJECT: Notes from Walton Flood Commission Meeting
LOCATION: DCSWCD, Walton, NY

ATTENDEES:

David Murphy, P.E., CFM, MMI
Members of the Walton Flood Commission (sign-in sheet available from DCSWCD)

The Walton Flood Commission held its regular meeting on February 4, 2016 at 10:00 AM at the DCSWCD office. David Murphy presented a slide show that focused on modeling of Third Brook and the preliminary East Brook BCA.

General

A revaluation is imminent in Walton. Dean asked if the LFAs will affect the new property value estimates. Attendees stressed the importance of working with the revaluation consultants to understand the flood studies underway in Walton.

Third Brook

The Commission is concerned that the 2006 flood is not depicted correctly along Third Brook. They understand why this is the case. However, we will need to carefully explain to the public why this occurs. The 1973 and 1996 floods also do not simulate the correct lateral dimensions of flooding. In addition to the influence of blocked bridges, it is possible that the actual 2006 flood discharge is higher than the discharge estimated from the East Brook gauge.

Attendees expressed the important of the floodplain bench projects upstream of Ogden Street for ther ability to catch or convey debris. Attendees were pleased to see the results of floodplain projects downstream of Ogden Street when the 2006 flood depth maps were compared.

Attendees had specific questions about the costs and construction of the Kraft bypass and David explained that the details were not developed at this point. They can be explored further if there is interest. Attendees understand that flooding from the West Branch Delaware River will reach the rear of the property, and understand that a flood wall may continue to be an effective means of flood damage reduction at the facility.

BCA for East Brook

Kevin believes that the bridge replacement cost estimates are too low. David explained that this may be the case, but they are for planning purposes at this time and will be refined in the BCRs need additional scrutiny.

Attendees discussed the damage frequency methodology at length, and understood that frequent damage is needed to generate the highest benefits. Graydon raised a few quick observations such as the lack of damage reported (to the consultant) from the October 2010 flood (which may have had a recurrence interval of ten years), and the fact that the wall at the school has been repaired at least three times in the last 10-15 years. Emergency declarations should be checked because the dates of the declarations can indicate when damage occurred and thus when costs were incurred. **Attendees will complete their homework by March 3 and compile information at the next Walton Flood Commission meeting.**

Going forward, we should conduct East Brook and West Brook BCA for floodplain projects that do not have bridge replacements as components, thereby allowing the use of the flood module. After we have the necessary data for the bridge/road pairs, the BCA should be revisited. If the costs are still too high, we should look for situations where bridges will be replaced in the next decade and then determine what the BCRs would be if the bridge replacement cost were not included.

This spurred a discussion about the timing and/or phasing of flood mitigation projects vs. needing to have a BCR of 1.0 of greater. The Commission will be looking to utilize water quality benefits and alternate ways of handling costs in order to have beneficial BCRs. Rick stated that appropriately completing the homework of compiling more damage figures will help the Commission push NYCDEP to consider good, effective flood mitigation projects even when BCA can be challenging to complete.

Local Flood Analysis
5th Project Discussion
West Branch Tributaries

Walton Flood Commission Meeting
Village and Town of Walton

David Murphy, P.E., CFM

Delaware County Soil & Water Conservation District | February 4, 2016

Agenda

- Continue the Third Brook Discussion
- Preliminary East Brook Benefit Cost Analysis
- Data Needs
- Next Steps

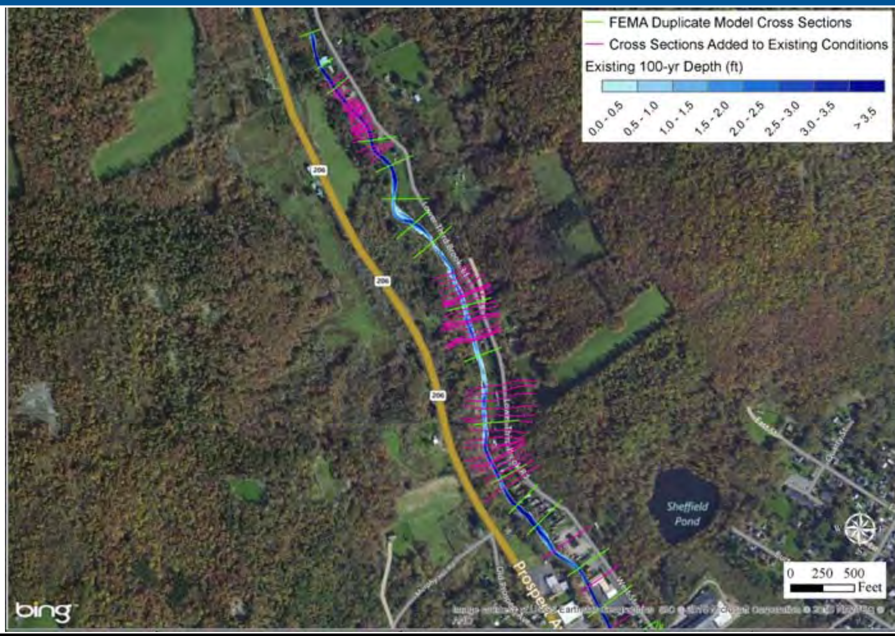
Third Brook Summary

- The Third Book Watershed Management Plan provided the basic set of alternatives to test
- A fundamental challenge with Third Brook is that the 100-year flood is *modeled as* contained in the channel between the old reservoir and the auction house
- Viewing the benefits of alternatives will therefore be challenging!

Recall these "Next Steps" from Last Meeting

- Try to simulate the extent of the inundation area during the 2006 flood
- See if the modeled floodplain benches would have contributed to benefits during the 2006 flood
- Bypass along the west side of Kraft
- Look at alternatives between the old reservoir and Del-Ton Sanitation
- Look at alternatives upstream of the old reservoir and at Lower Third Brook Road and Gosper Road

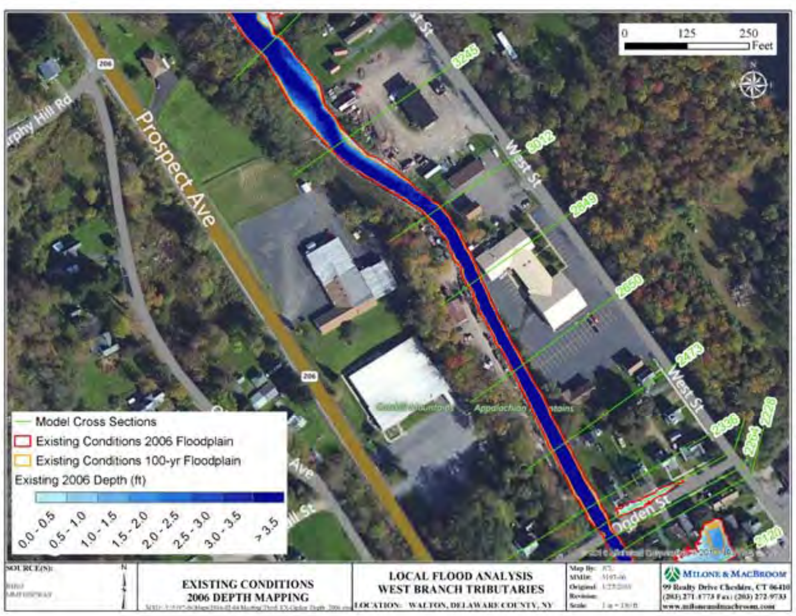
Existing Conditions Depth Map (Upper)



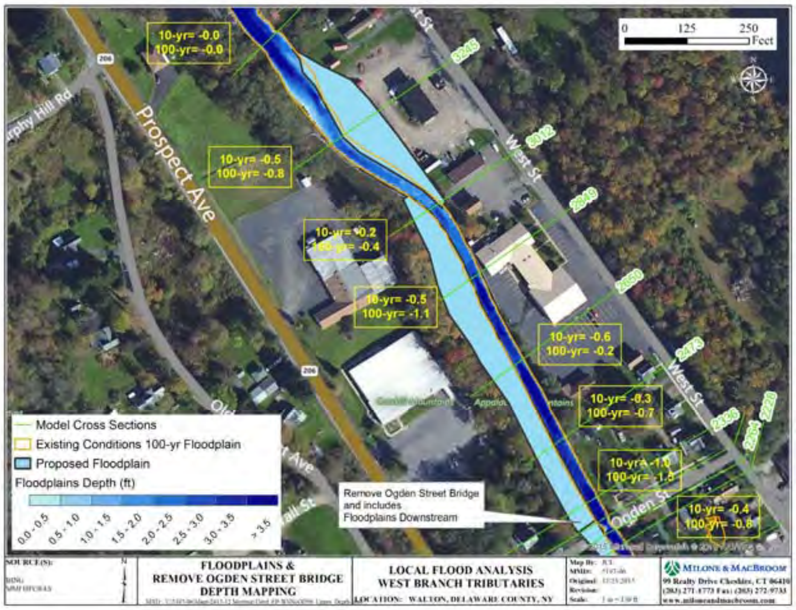
Existing Conditions Depth Map (Lower)

Middle Third Brook Depth Map – 100-Yr

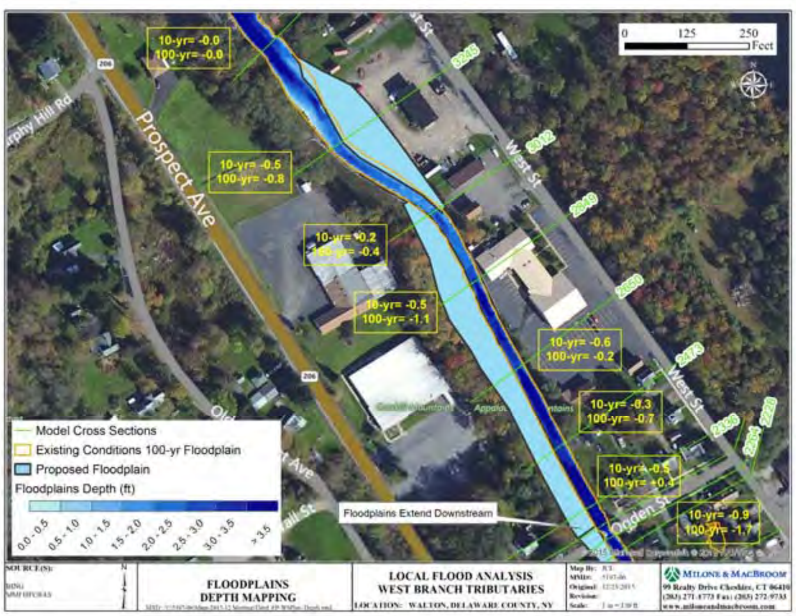
Middle Third Brook Depth Map – 2006 Flood



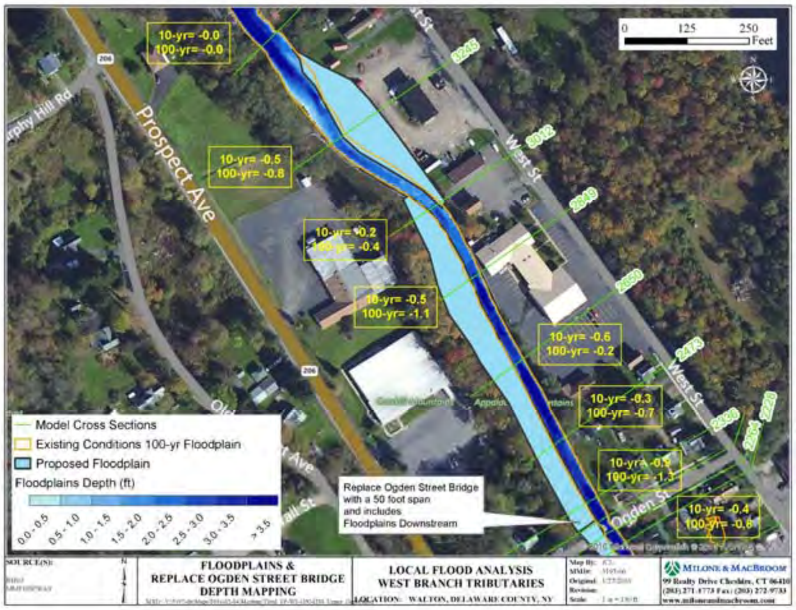
Ogden St Bridge and Floodplains (100-Yr)



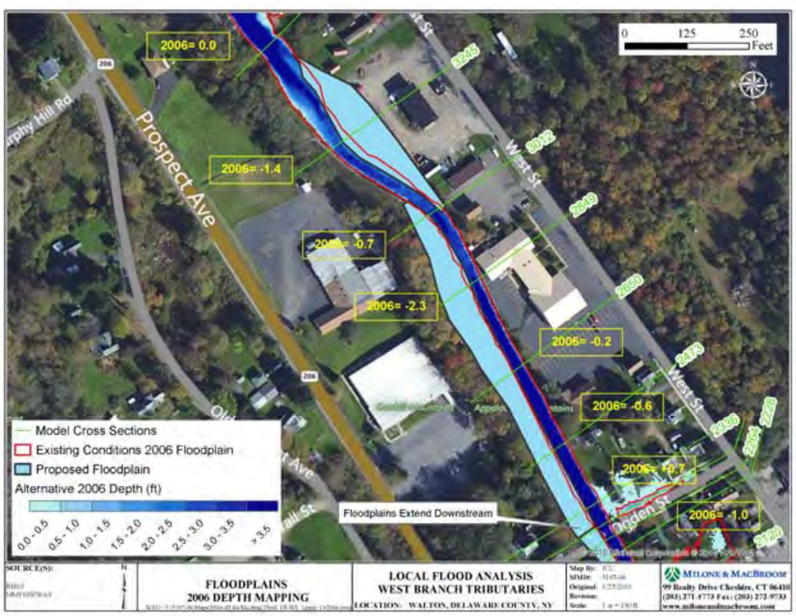
Ogden St Bridge and Floodplains (100-Yr)



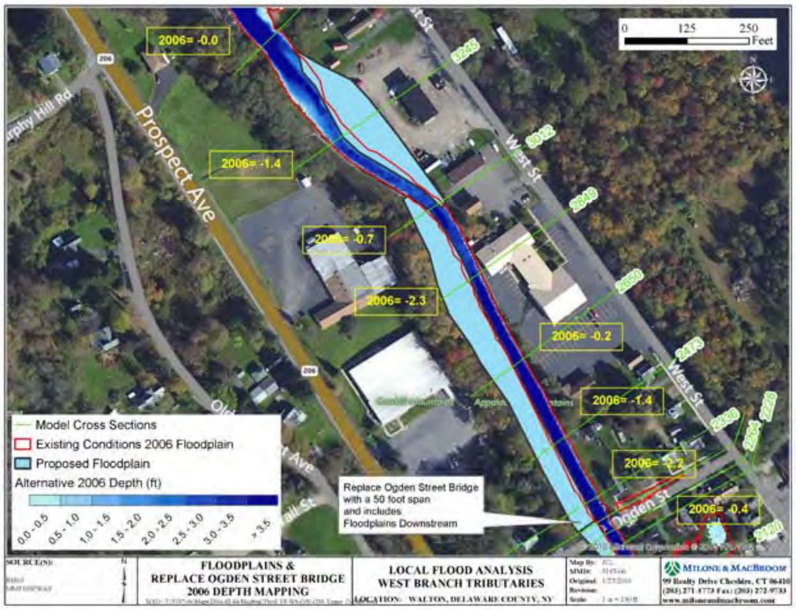
Ogden St Bridge and Floodplains (100-Yr)



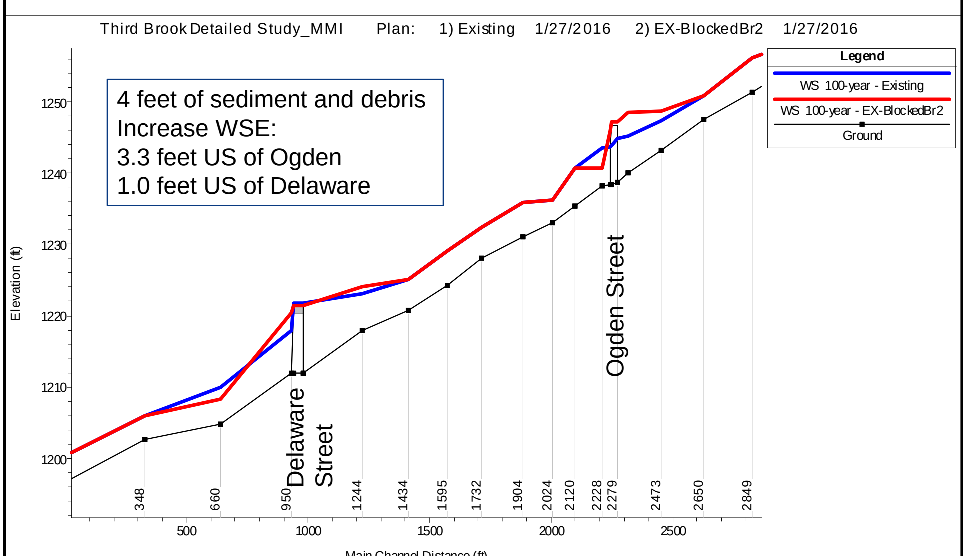
Ogden St Bridge and Floodplains (2006)



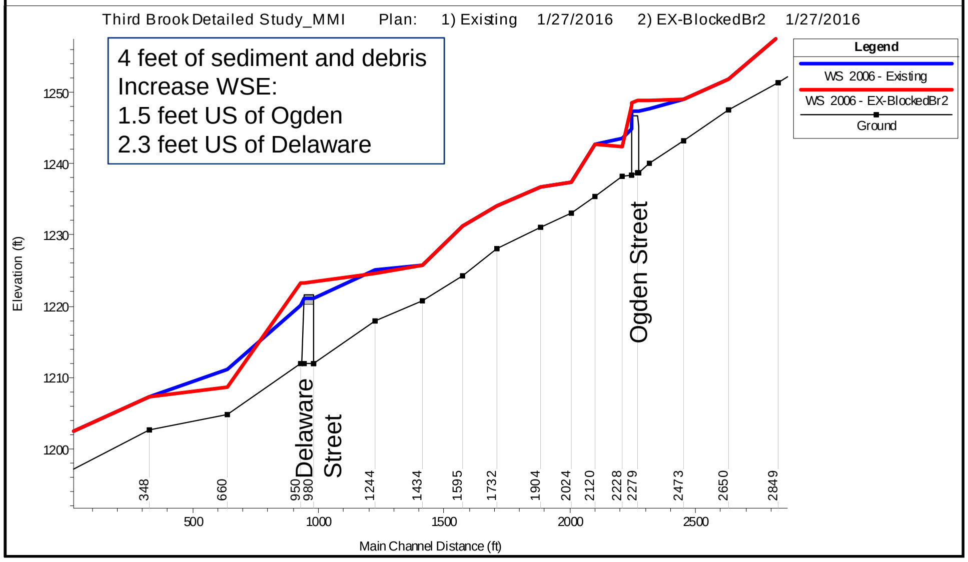
Ogden St Bridge and Floodplains (2006)



Third Brook – Debris at Bridges – 100-year

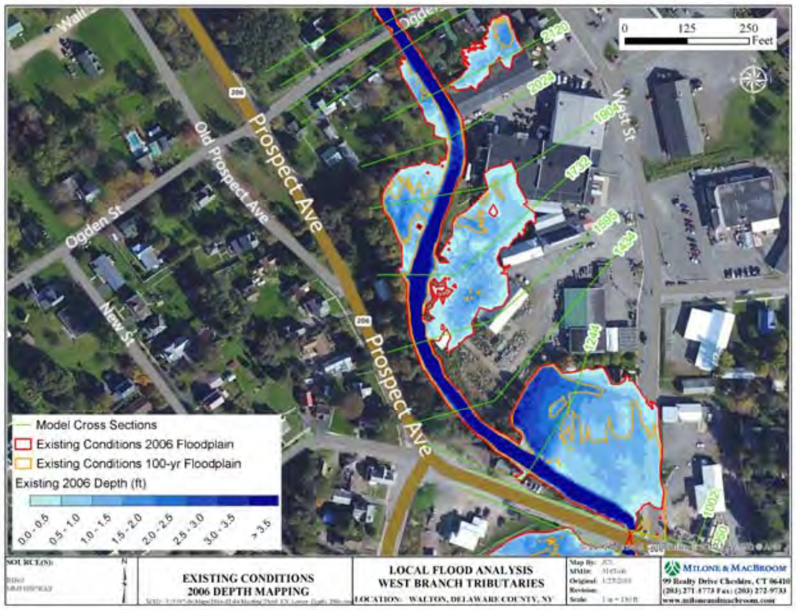


Third Brook – Debris at Bridges – 2006 Storm

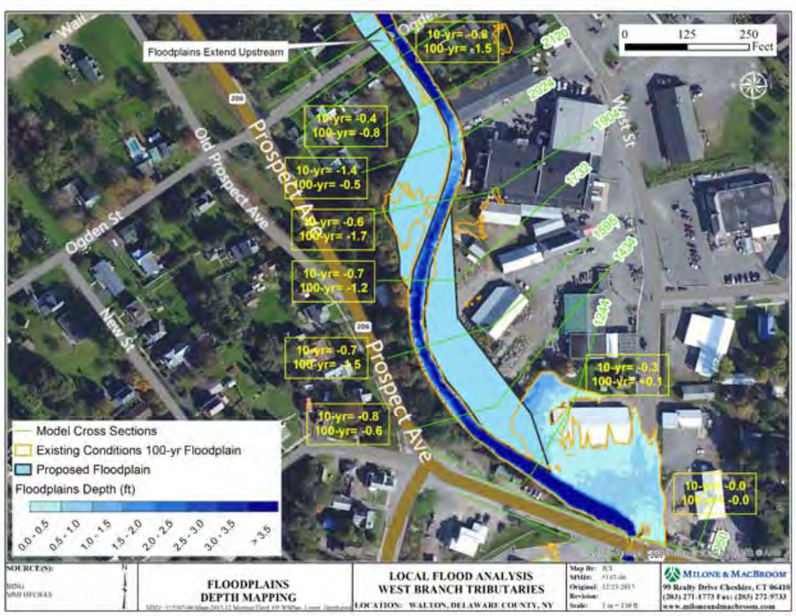


Lower Third Brook Depth Map (100-Yr)

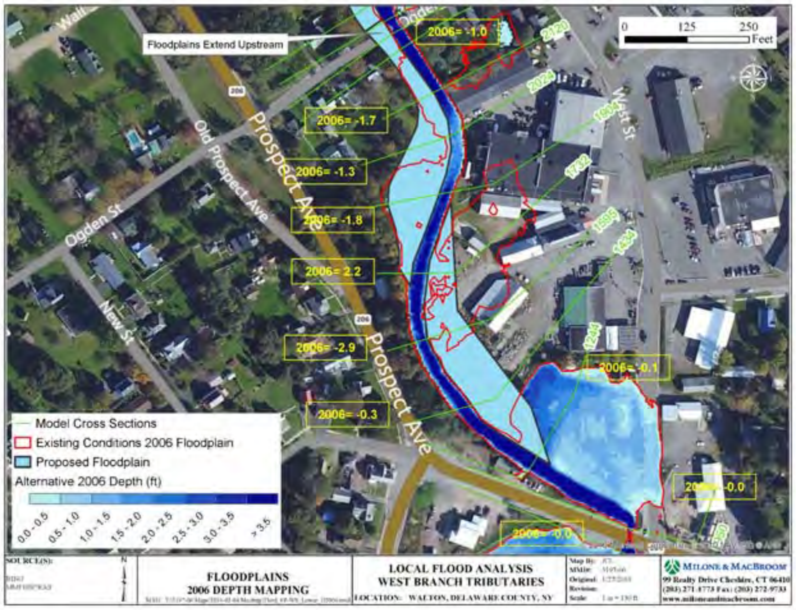
Lower Third Brook Depth Map (2006)



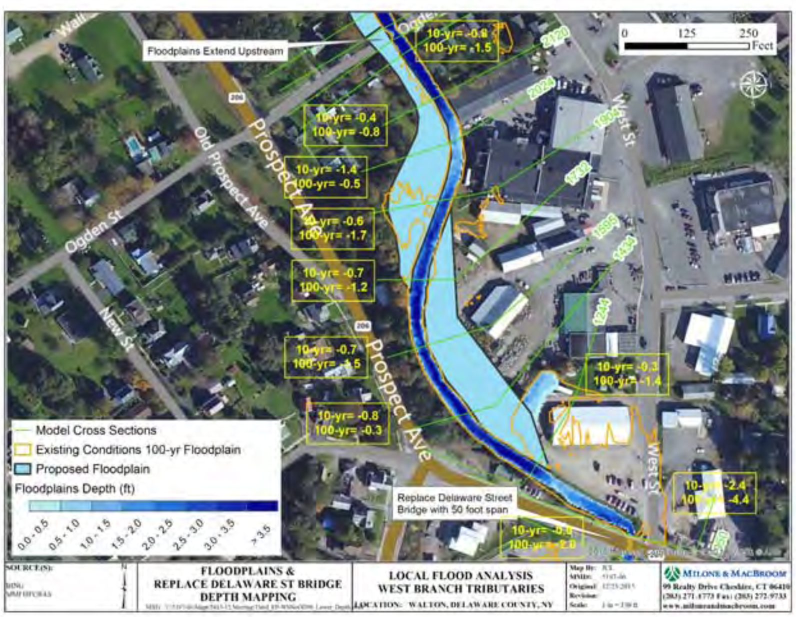
Lower Third Brook Floodplains (100-Yr)



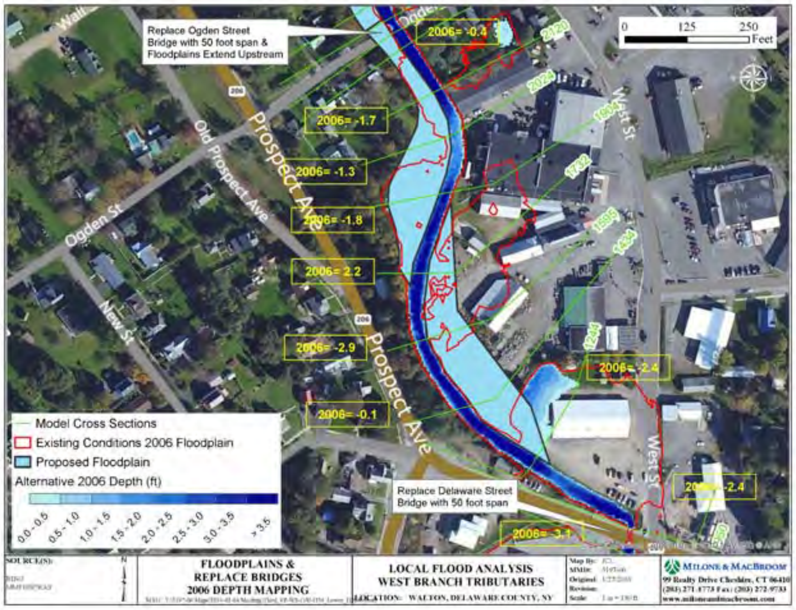
Lower Third Brook Floodplains (2006)



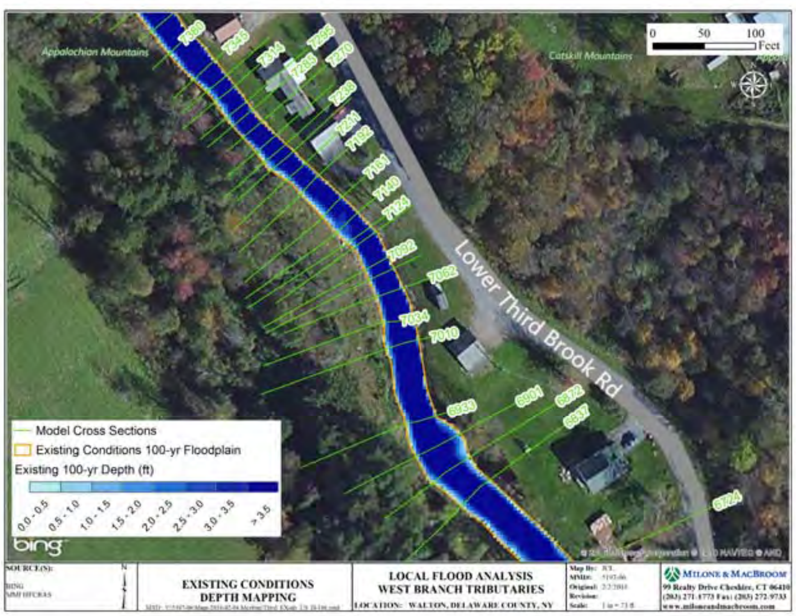
Floodplain + Replace Delaware St Bridge (100)



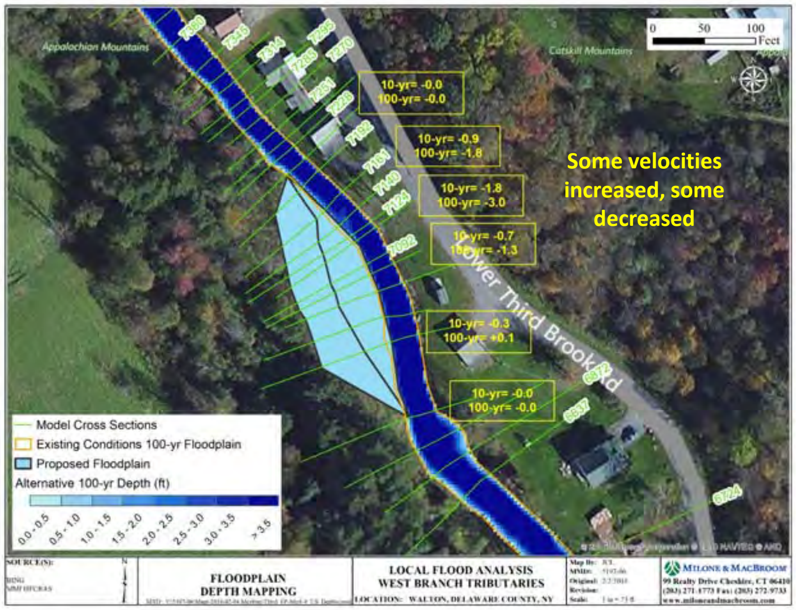
Floodplain + Replace Delaware St Bridge (2006)



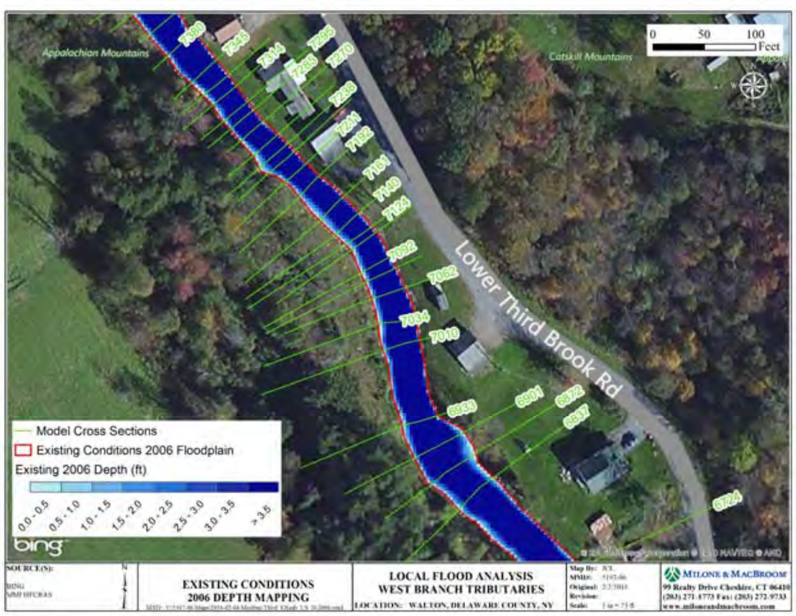
Upstream Area – Existing Depth Mapping



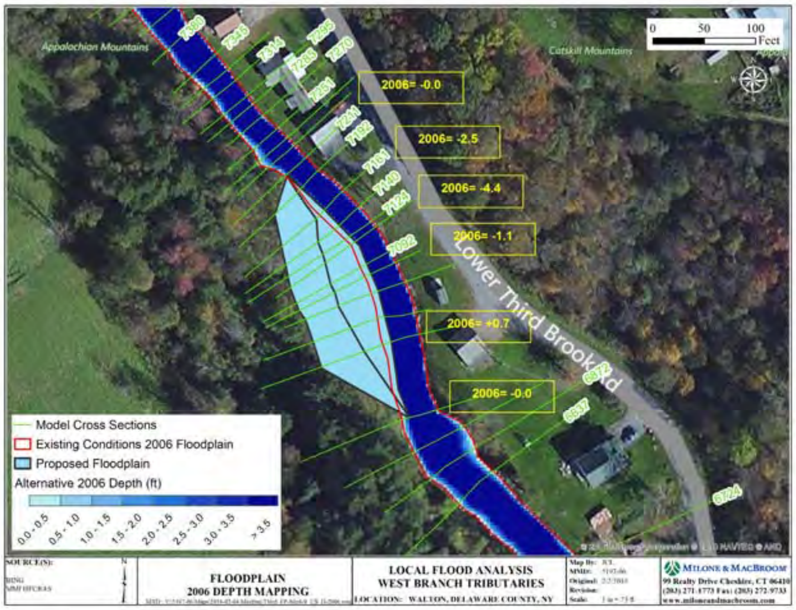
Floodplain- Upstream – Depth Mapping



Upstream Area – Existing Depth Mapping



Floodplain- Upstream – 2006 Storm



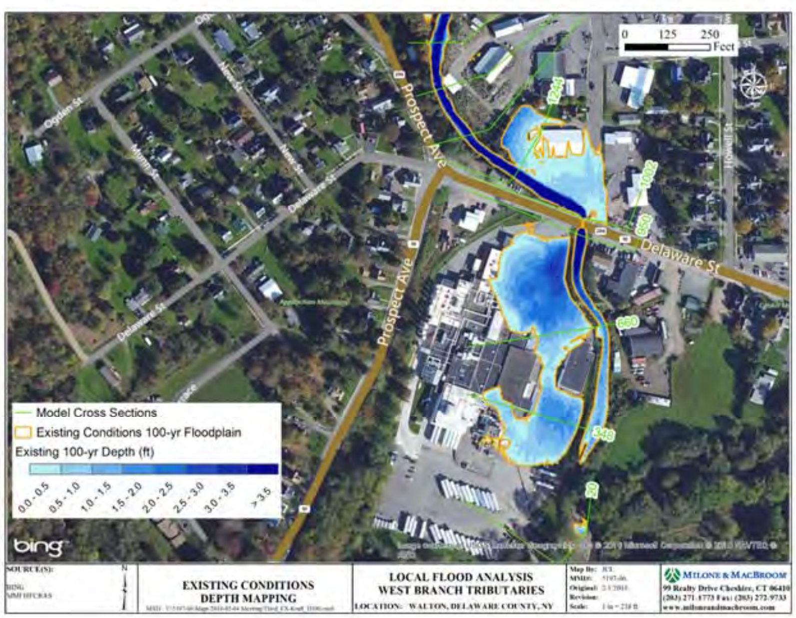
Kraft Bypass

- Modeled with a “lateral structure” as though the water goes out of the system
- No set design for the chute channel
- Using the culvert flow calculations, the flow is split after going through an iterative optimization
- Water going in the culvert is pulled out of Third Brook and therefore not going through the downstream sections of Third Brook
- If we set the bypass at the 50-yr WSE, almost no flow exits the channel.
- If we set the bypass at the 2-yr WSE, it works without taking all the water from Third Brook

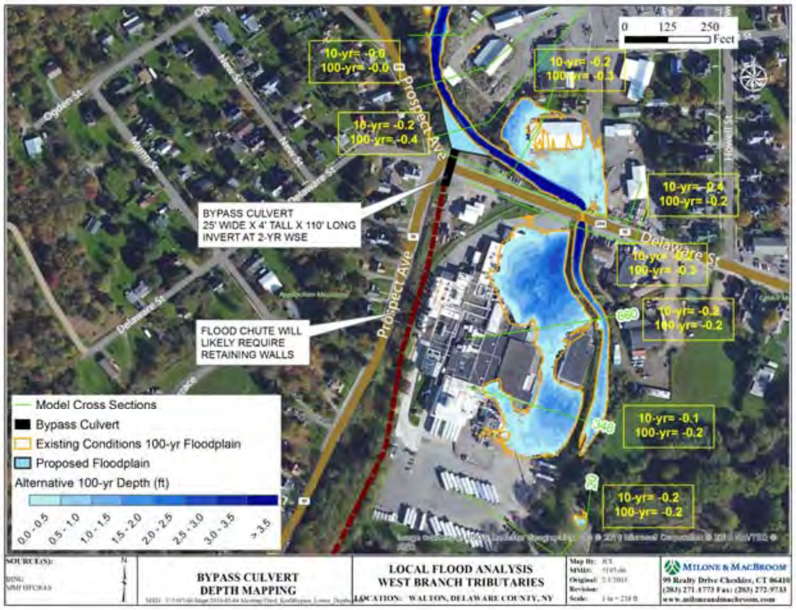
Kraft Bypass

- Results:
  - 100-yr flood causes ~100 cfs to leave the channel, or ~10% of the flood discharge
  - 2006 flood causes ~190 cfs to leave the channel, or ~11% of the flood discharge
- Note there is not much space behind the Kraft building and the bypass would likely require retaining walls along the road in order to fit

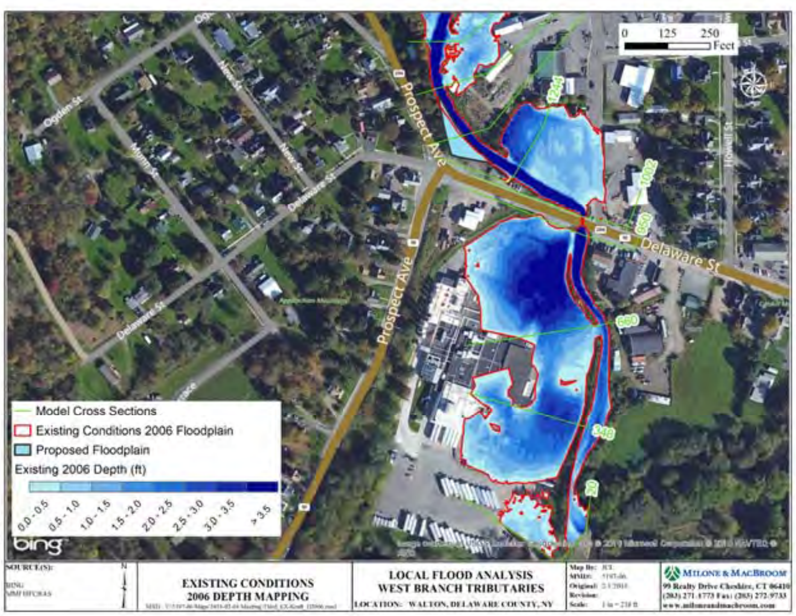
Existing Conditions at Kraft



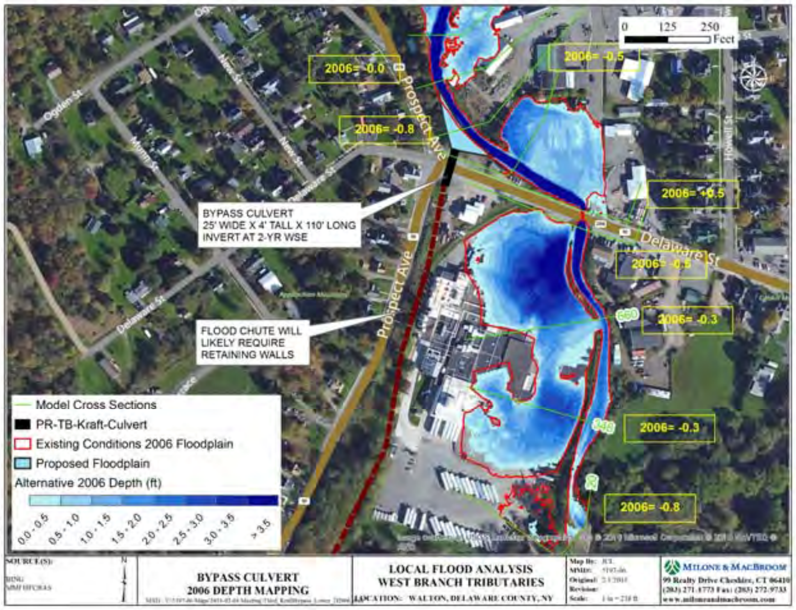
Bypass Culvert at Kraft



Existing Conditions at Kraft – 2006 Flood



Bypass Culvert at Kraft – 2006 Flood



East Brook Benefit Cost Analysis (BCA)

- The BCA Flood Module was used to generate benefits from buildings
- The BCA Damage Frequency Module was used to generate benefits from bridge and road damage figures
- Estimated costs are substantial:
  - Delaware Street over East Brook (New Span 110') – $2.55M
  - Benton Avenue over East Brook (New Span 90') – $1.45M
    Benton Avenue over East Brook (New Span 120') – $1.85M
  - Griswold Avenue over East Brook (New Span 120') – $2.75M
- Floodplain enhancements will add to costs
- Property acquisitions will add to costs
- Therefore we need to stack up the benefits!

East Brook Benefits from Flood Module

Project	Benefits
Delaware Street bridge replacement	$576,607
Delaware Street bridge replacement and floodplain bench (FP4)	$897,182
Benton Ave bridge replacement (90') and remove 2 homes	$160,917
Benton Ave bridge replacement (90') and remove 2 homes + floodplain at school (FP1)	$165,575
Benton Ave bridge replacement (120') and remove 4 homes	$204,762
Benton Ave bridge replacement (120') and remove 4 homes + floodplain at school (FP1)	$210,678
Benton Ave bridge removal and no replacement	$210,801
Benton Ave bridge removal and no replacement + floodplain at school (FP1)	$199,613
Griswold Street bridge replacement (includes 2 homes removed)	$71,150
Griswold Street bridge replacement and upstream floodplain (FP3)	$168,855

East Brook Benefits from Damage Frequency

- Received bridge and road damage costs for many sites, however only three sites have damage costs for multiple events

Stream	Location	1996	6/2006	11/2006	4/2011	Irene/Lee 8/2011	# of events with data
West Brook	Austin Lincoln Park		X			X	2
East Brook	Benton Avenue		X				1
Third Brook	Delaware Street - Third Brook		X				1
East Brook	Delaware Street Bridge - East Brook			X			1
West Brook	East Street Bridge over West Brook	X	X	X			3
East Brook	East Street Extension - East Brook		X				1
East Brook	Elm / Brook Street		X				1
WBDR?	Gardiner Place		X				1
East Brook	Griswold Street Bridge - East Brook		X			X	2
WBDR?	Liberty Street		X				1
Third Brook	Lower Third Brook Road Bridge		X				1
West Brook	Between Mead Street and East Street		X				1
West Brook	Mead Street Bridge - West Brook		X				1
WBDR?	North Street		X				1
Third Brook	Ogden Street		X				1
East Brook	Park Street retaining wall				X		1
East Brook	Union Street		X				1
East Brook	Upper and Lower Bassett Park		X				1
WBDR	Water Street		X				1
West Brook	West Brook Currie Well Field Embankment			X			1
Third Brook	West Street - Third Brook		X				1

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East Brook Benefits from Damage Frequency

- Because the damage figures are from significant events, the historic costs exceed projected benefits
- For higher benefits, we need to document more frequent damage

Site	Damage Events	Historic Costs	Preliminary Benefits
Austin Lincoln Park	June 2006 Flood, Irene/Lee 2011	$57,106	$13,815
East Street Bridge over West Brook	1996 Flood, June 2006 Flood, November 2006 Flood	$43,840	$20,577
Griswold Street Bridge	June 2006 Flood, Irene/Lee 2011	$118,727	$22,964

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Additional Information Needed

- In other words, we need additional damage figures for TWO REASONS:
  - To enable generation of benefits at additional bridge/road pairs
  - To increase the benefits overall
- The following information is needed to improve and complete the damage frequency analysis:
  - Damage figures at <u>each bridge/road pair for at least two past events (three is better)</u>
  - Damage figures from <u>less-severe, more frequent floods</u>
  - Think about placing barriers, inspections, repairs, cleanup
  - Think about parts, equipment, labor, and volunteers

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Additional Information Needed

- The following information might also help increase benefits, although our initial estimates demonstrate low likelihood of significant help:
  - Year bridges were built (best guess)
  - Days of road closure for past events (best guess)
  - Traffic counts (someone likely has this)
  - Water and sewer utility failure

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Summary of Next Steps

- Obtain FEMA model for upper Third Brook
- Provide additional bridge and road damage figures, road closure counts, and traffic counts to consultant by **February 12, 2016**
- Set public meeting date for East Brook
- Possible agenda for Walton Flood Commission meeting of March 3, 2016:
  - Public meeting logistics
  - East Brook BCA (complete)
  - West Brook BCA (preliminary)

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Minutes of Meeting

DATE: April 7, 2016
MMI #: 5197-06
PROJECT: Walton WBDR Tributaries LFA

SUBJECT: Notes from Walton Flood Commission Meeting
LOCATION: DCSWCD, Walton, NY

ATTENDEES:

David Murphy, P.E., CFM, MMI
Members of the Walton Flood Commission (sign-in sheet available from DCSWCD)

The Walton Flood Commission held its regular meeting on April 7, 2016 at 10:00 AM at the DCSWCD office. David Murphy presented a slide show that focused on the East Brook BCA and West Brook BCA. Following the presentation, a general discussion was held.

- The Flood Commission needs a clear path forward for the East Brook projects. What should be done first, second, third, etc.? For example, could a floodplain project be completed at the school now, and later tied into other projects?
- The Flood Commission would like to consider pursuing floodplain projects along East Brook without bridge replacements, but needs to understand the benefits and the costs. This is especially critical near Benton Avenue.
- A lengthy discussion about home acquisitions was undertaken, including a discussion about how the process is going in Sidney. The cost of relocating the residents can be significant. However, attendees recognize that the number of homes to be acquired for East Brook and West Brook projects is small relative to the number of housing units in the village, and therefore finding a new home may not be difficult.
- What would be the benefits of acquiring the house on Benton Avenue in foreclosure plus one floodplain project?
- Walt reminded the Flood Commission that the LFA report should include everything that reduced flooding.
- Nate said that CWC can fund updates to Comp Plans to identify places to relocate to.
- Garydon would like to understand what is really causing flooding at Big M. Are floodwaters breaking out near Mead Street or backing up at Delaware Street, or both?

Graydon explained that the next step is to schedule a joint Village/Town Board meeting to ensure that the sensitive issues are understood.

Other agenda items from the meeting included a discussion of flood and erosion mitigation projects that have been funded to date, and the nature of the CWC's open enrollment for grant applications. The Fair Board may apply for a planning study.

Local Flood Analysis
6th Project Discussion
West Branch Tributaries

Walton Flood Commission Meeting
Village and Town of Walton

David Murphy, P.E., CFM

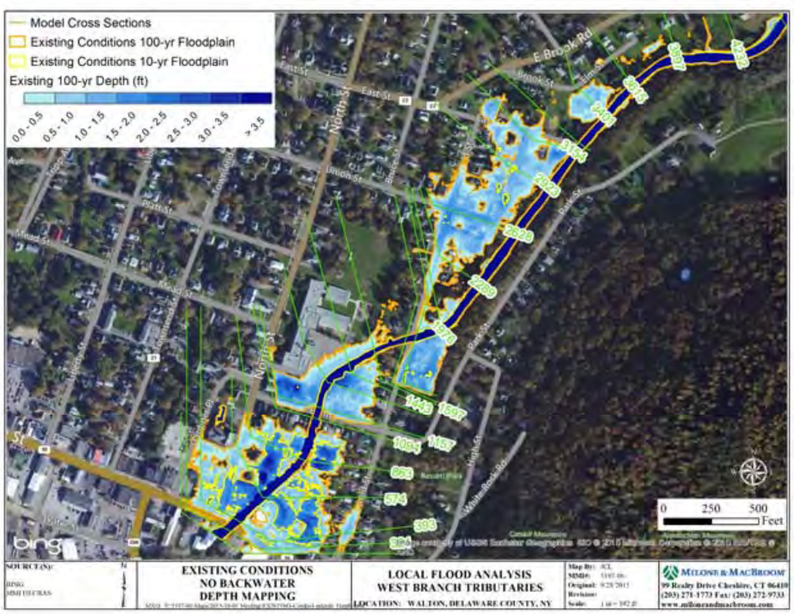
Delaware County Soil & Water Conservation District | April 7, 2016

Agenda

- East Brook BCA
- West Brook Focus Area – East Street
- West Brook BCA
- Next Steps

East Brook

Existing Conditions along East Brook



Combination of Options along East Brook

East Brook BCA

- The Flood Module was used to generate benefits from buildings
- The Damage Frequency Module was used to generate benefits from bridge and road damage figures, plus Townsend School
- Estimated costs are substantial:
  - Delaware Street over East Brook (New Span 110') – $2.55M
  - Benton Avenue over East Brook (New Span 90') – $1.45M
    Benton Avenue over East Brook (New Span 120') – $1.85M
  - Griswold Avenue over East Brook (New Span 120') – $2.75M
- Floodplain enhancements will add to costs
- Property acquisitions will add to costs

Townsend School

- Flood module used to attach benefits to **downstream** projects that reduce flooding from backwater conditions
- Damage frequency module used to attach benefits to **upstream** projects that reduce out-of-channel flooding
- We were provided $2.8M repair cost from 2006 flood (500 yr event)
- School website says $6M in repairs between 1996 and 2006 floods
  - 1996 damages therefore estimated at $3.2M
- 2013-2014 school budget / 3 = $6,694,839 annual budget estimate
- If 1996 event is 50 yr, benefits are $1,169,061
- If 1996 event is 100 yr, benefits are $532,502
- Need to know how many days the schools were closed following each event – at this time we are guessing
- The benefits are being added to the Griswold Street alternatives

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East Brook BCA Benefits

Project	Building Benefits	Acquisition Benefits	Infrastructure Benefits	Total Benefits
Delaware Street bridge replacement	$737,687	---	$100,773	$838,460
Delaware Street bridge replacement and floodplain bench (FP4)	$846,363	$289,733	$100,773	$1,236,869
Benton Ave bridge replacement (90') and remove 2 homes	$371,539	$294,686	$23,033	$689,258
Benton Ave bridge replacement (90') and remove 2 homes + floodplain at school (FP1)	$399,888	$294,686	$23,033	$717,607
Benton Ave bridge replacement (120') and remove 4 homes	$445,405	$590,908	$23,033	$1,059,346
Benton Ave bridge replacement (120') and remove 4 homes + floodplain at school (FP1)	$451,332	$590,908	$23,033	$1,065,273
Benton Ave bridge removal and no replacement	$465,031	---	$23,875	$488,906
Benton Ave bridge removal and no replacement + floodplain at school (FP1)	$435,770	---	$23,875	$459,645
Griswold Street bridge replacement (includes 2 homes removed)	$1,237,799	$377,918	$72,040	$1,687,757
Griswold Street bridge replacement and upstream floodplain (FP3) (includes four homes removed)	$1,336,239	$1,064,441	$72,040	$2,472,720

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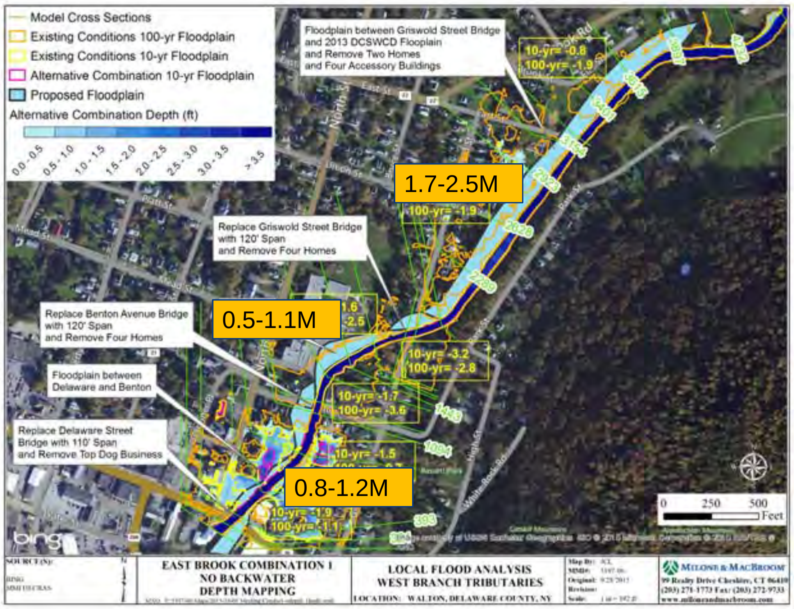
Total Benefits (Ranges) along East Brook



West Brook

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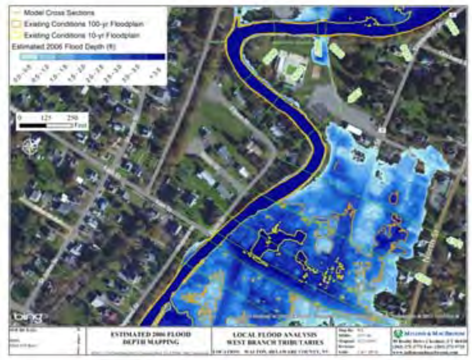
West Brook – Floodplain Bench DS of Park

- A comparison of the 100-year and 2006 flood depth shows that water may be able to break out of this area
- The goal would be to reduce this potential



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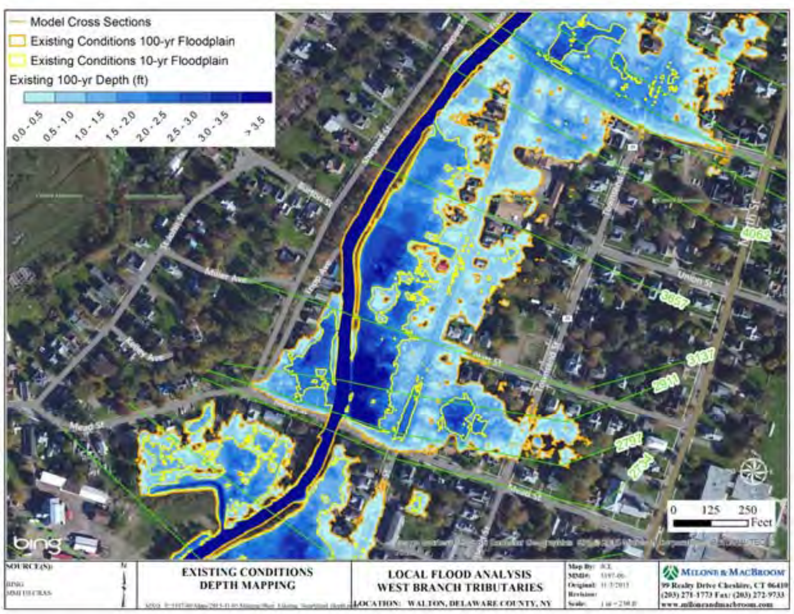
West Brook – Floodplain Bench DS of Park

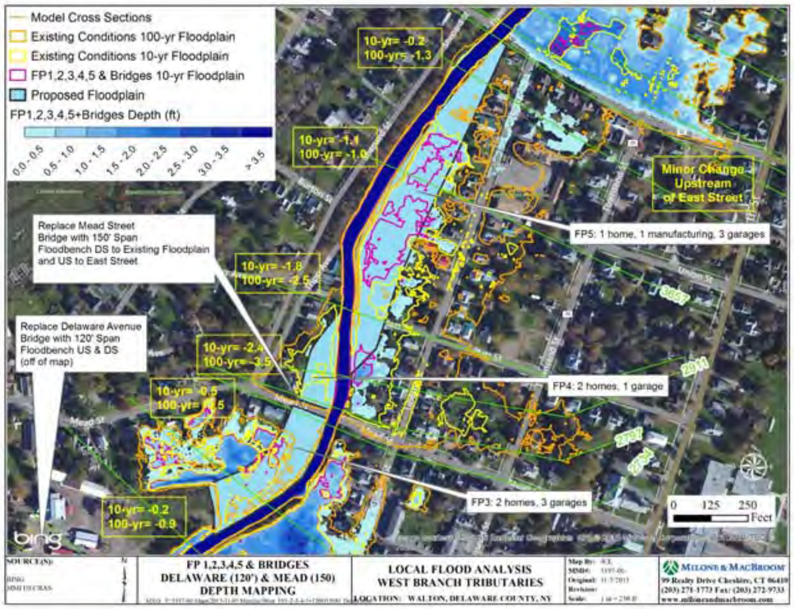
West Brook – Floodplain Bench DS of Park

- The floodplain bench downstream of the park creates water surface elevation increases in the 100-year and 50-year flood
- The East Street Bridge replacement also creates some increases in water surface elevation in the 500-year flood
- When the bridge replacement and floodplain bench are modeled together, none of the flood events show slight increases
- ***These alternatives work best together***

Existing Conditions along West Brook



Combination of Options along West Brook



West Brook BCA

- The Flood Module was used to generate benefits from buildings
- The Damage Frequency Module was used to generate benefits from bridge and road damage figures
- Estimated costs are substantial:
  - Delaware Street over West Brook (New Span 120') – 2.75M
  - Mead Street over West Brook (New Span 150') – 2.30M
  - East Street over West Brook (New Span 60') – 1.10M
- Floodplain enhancements will add to costs
- Property acquisitions will add to costs

West Brook BCA Benefits

Project	Building Benefits	Acquisition Benefits	Infrastructure Benefits	Total Benefits
Floodplain Downstream of Delaware St (FP1)	$3,142,179	--	--	$3,142,179
Floodplains Downstream and Upstream of Delaware St, (FP 1+2) and Replace Delaware St Bridge	$3,404,750	--	$706,515	$4,111,265
Floodplains Upstream and Downstream of Mead St (FP 3 + 4) and Replace Mead St Bridge	$181,075	$1,095,234	$195,971	$1,472,280
Mead St Floodplains and Floodplain Between East St and Mead St (FP 3 + 4 + 5) and Replace Mead Street Bridge	$317,338	$1,586,670	$195,971	$2,099,979
Replace East Street Bridge	$262,782	--	$385,565	$648,347
Floodplain between East Street and Park, and replace East Street Bridge	TBD	TBD	TBD	TBD

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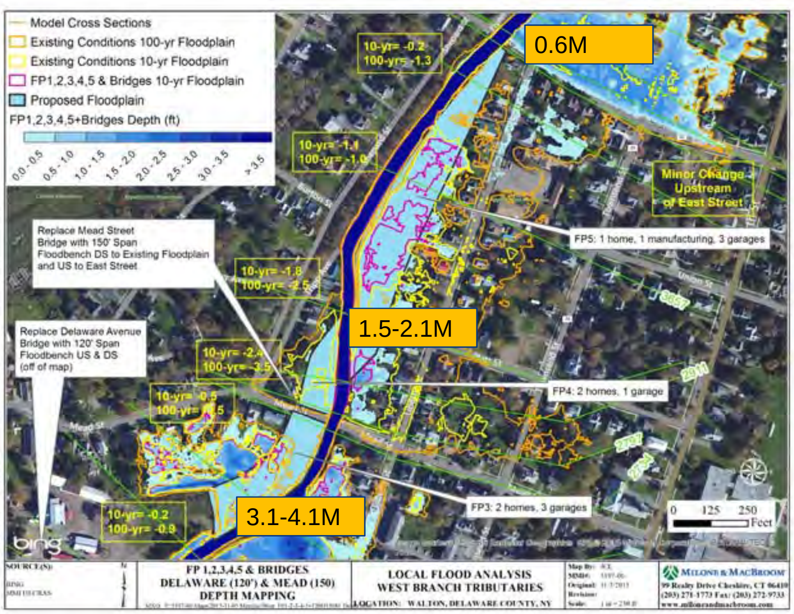
Total Benefits (Ranges) along West Brook



Next Steps

- The following <u>might</u> help increase benefits, although there is <u>low</u> likelihood of significant change:
  - ✓ Population served by water for each bridge crossing
  - ✓ Population served by sewer for each bridge crossing
  - ✓ Population served by gas for each bridge crossing
- Set public meeting dates for East Brook and/or West Brook
- Set agenda for Walton Flood Commission meeting of May 5, 2016 (I will not be present; someone else will cover me)

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Public Information Meeting

Walton Tributaries LFA
June 29, 2016
Meeting Minutes

A public meeting was held on June 29, 2016 at 6:00 PM at the Walton Fire Department regarding the West Branch Delaware River Tributaries LFA. Mr. Graydon Dutcher from Delaware County Soil and Water Conservation District provided introductory statements and described the LFA process. Mr. David Murphy, P.E., CFM from Milone & MacBroom, Inc. presented a power point slide show which provided an overview of river systems and described potential alternatives for flood reduction along East Brook, West Brook, and Third Brook. Following the presentation, Mr. Murphy turned over the meeting for a general discussion. Discussion points included the following:

- A resident of Elm Street asked how removing a retaining wall along the stream bank would protect homes if it meant that floodwaters might be closer to homes. Mr. Murphy explained that removing a retaining wall would create a larger river corridor which would lower water surface elevations and velocities. The resident noted that the upstream floodplain reclamation project has seemed to help reduce flooding.
- An attendee asked if it mattered which of the proposed alternatives are implemented first. Mr. Murphy explained that each alternative is somewhat modular and has independent benefits and therefore, there is flexibility regarding the sequence that they can be implemented.
- An attendee asked what would happen to the tax base if homes were removed and residents are relocated. Mr. Dutcher explained that homes will be relocated to an area within the village and there would hopefully be no negative impact to the tax base.
- An attendee asked what timeframe the BCA considers, since this will influence whether short term or long term projects are pursued. Mr. Murphy explained that the BCA considers the individual life span of the proposed alternative. For bridge replacements and floodplain projects, the life span is considered to be 50 years.
- An attendee asked why a floodplain bench was proposed for West Brook when a bench was already constructed through EWP funds. Mr. Dutcher explained that the proposed floodplain bench would be larger and configured differently than the one previously constructed and would provide greater flood mitigation benefits because fewer floods would leave the channel here.
- An attendee asked how much higher new bridges would need to be. Mr. Murphy explained that this would vary.
- A resident expressed frustration with the number of people present and noted that getting people to attend can be difficult. Mr. Phil Eskeli of NYCDEP suggested that residents may be interested in limited field reconnaissance to observe the nature of potential projects.
- An attendee asked how many homes are proposed for relocation and is there a place designated for relocation. Mr. Murphy explained that there is a list that can be reviewed after the meeting, and Mr. Dutcher explained that there is not currently a location set for relocation.
- An attendee asked if the alternative of retaining flood water in upstream locations has been considered. Mr. Dutcher explained that it has been considered and that it would take a large retention area to make a significant impact in large watersheds such as East Brook and West Brook. However, this option is not off the table.
- A resident asked if we knew offhand the recurrence interval of the 2006 flood.

- Bruce Dolph took a moment to explain to the audience that benefits of the flood mitigation projects would combine with those proposed for the main stem of the West Branch Delaware River. Mr. Dutcher described the return channels that will lead from Delaware Street across Water Street.
- A short discussion proceeded about how the area is very unique, and Mr. Dolph noted that many people have studied the West Branch and its tributaries.

At the conclusion of the general discussion (7:45 PM), Mr. Murphy laid out maps of each brook and had attendees make notes on the maps showing areas that have been impacted by flooding and discuss specific alternatives for each brook. Mr. Dutcher, Mr. Murphy, and Ms. Cole (MMI) each stayed with a set of maps to facilitate discussions.

Local Flood Analysis Public Meeting West Branch Tributaries

Walton Flood Commission and Village and Town of Walton

David Murphy, P.E., CFM
Jillian Cole, E.I.T.

Delaware County Soil & Water Conservation District | June 29, 2016

Agenda

- Water Cycle, Rivers, and Floodplains
- Local Flood Analysis (LFA) Goals, Outcomes, and Advisory Structure
- Review Public Comments from Summer 2015
- East Brook Flood Mitigation Options
- West Brook Flood Mitigation Options
- Third Brook Flood Mitigation Options
- Next Steps

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How Do We Study the Water Cycle?

Ecology - The study of plants, animals, and their environment, with emphasis on aquatic systems, wetlands, and riparian forests..

Hydrology - The study of precipitation, infiltration, surface runoff, streamflow rates, water storage in wetlands, detention basins, and reservoirs, plus water use and diversions.

Hydraulics - The study of the stream's water velocity, flow depth, flood elevations, channel erosion, storm drains, culverts, bridges, and dams.

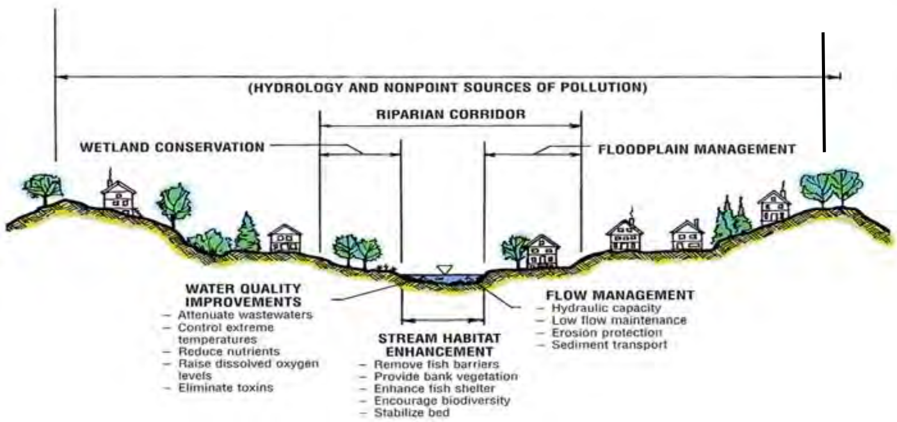
Water Quality - The study of the physical, biological, and chemical characteristics of surface waters and groundwaters.

Engineering/Construction – The application of science and mathematics in analysis design, permitting, and construction.

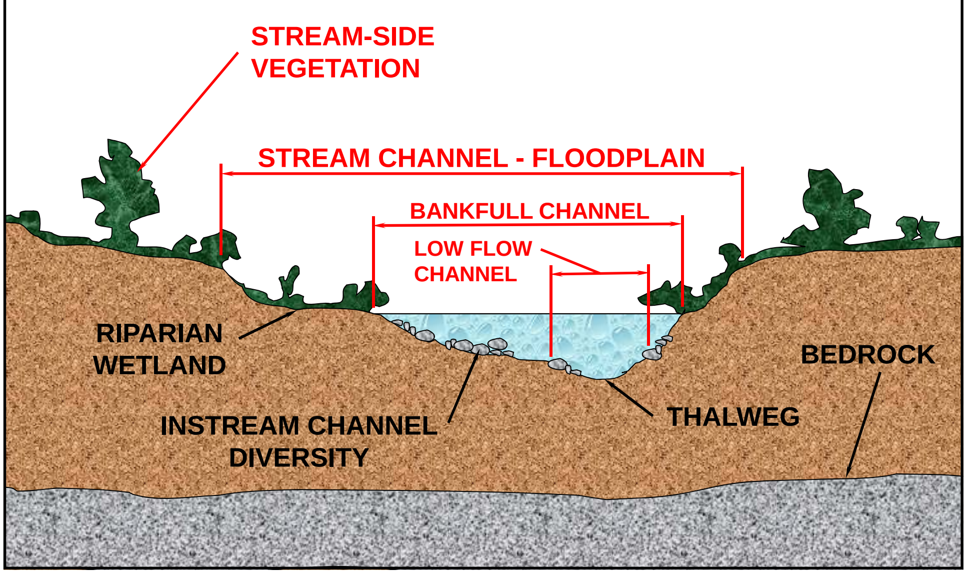
Fluvial Morphology - The study of the channel's geologic origin, alignment, slope, shape, size, sediments, and floodplains.

Socioeconomic - The study of the sociology, social relationships, economic impacts, and their interconnections.

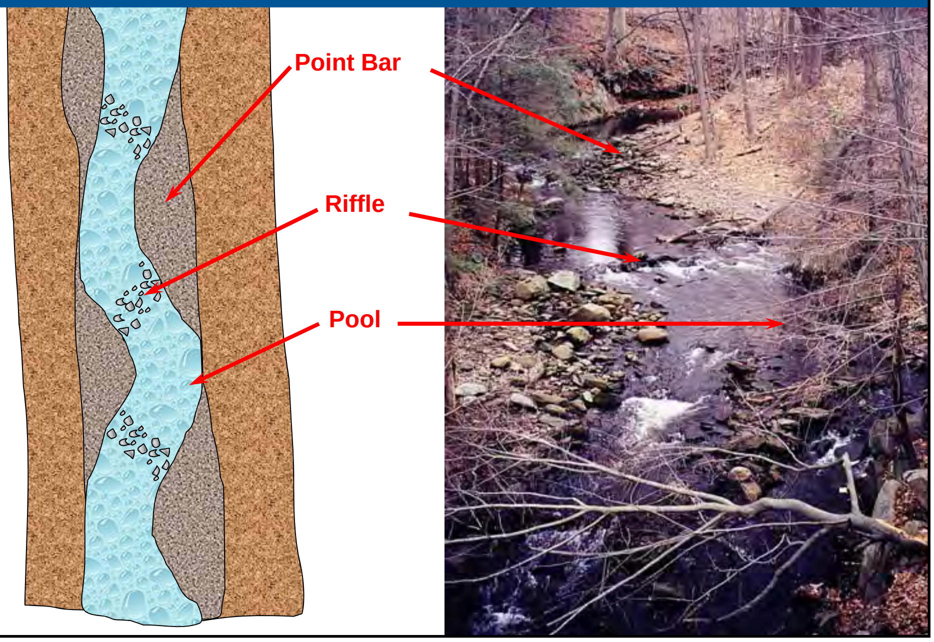
How Do We Manage Watersheds?



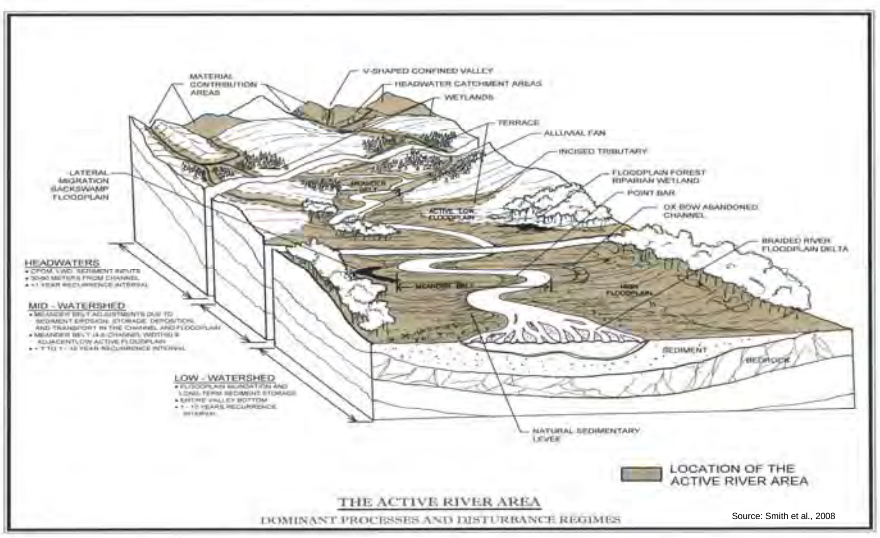
Features of a Natural Channel



Features of a Natural Channel

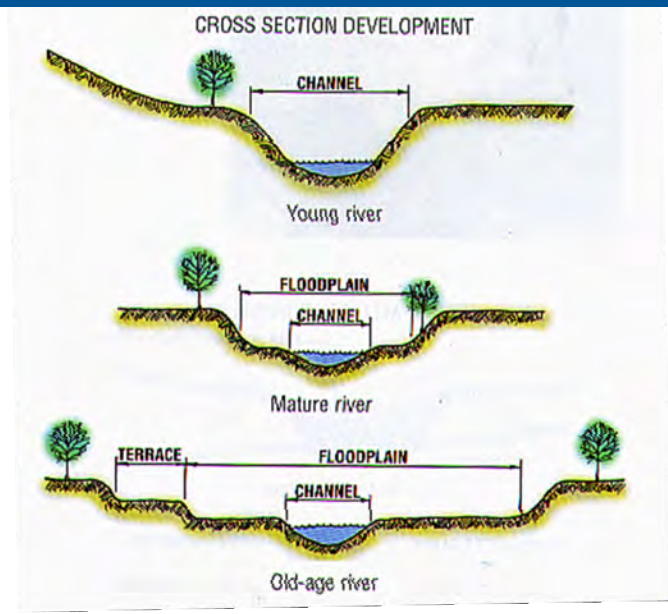


The Active River Area Is Much Larger

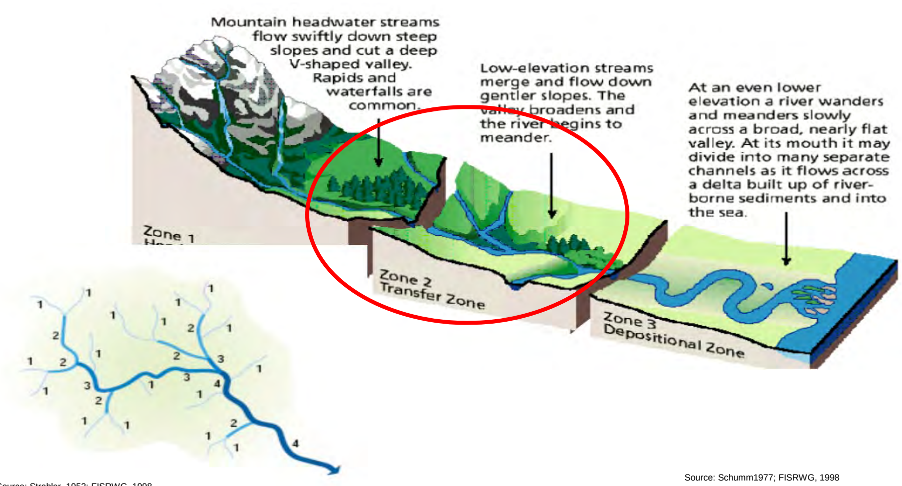


Source: Smith et al., 2008

Rivers Can Change Over Time



Where Do the Tribs Fit Into the River Profile?

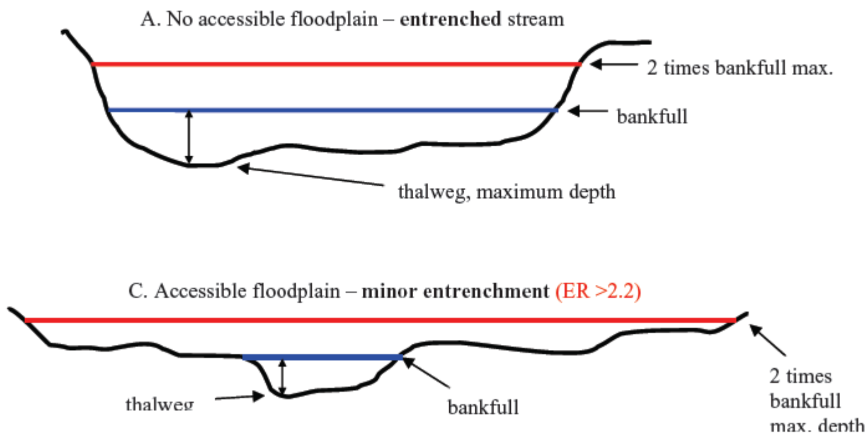


Source: Strahler, 1952; FISRWG, 1998

Source: Schumm1977; FISRWG, 1998

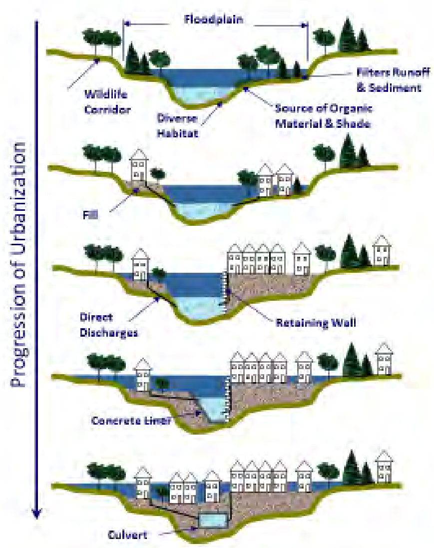
Where Do the Tribs Fit Within Floodplains?

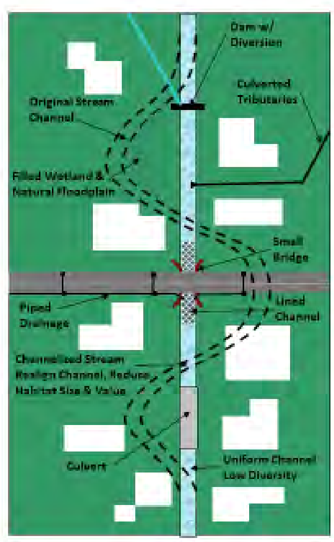
Is the Channel Connected to its Floodplain?



Source: VTANR 2010

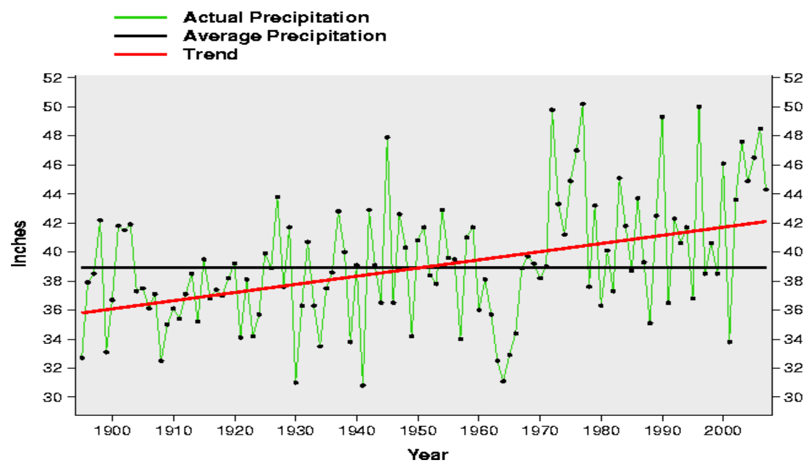
What Have We Done to the Tributaries?





What Are We Experiencing?

New York Annual Precipitation



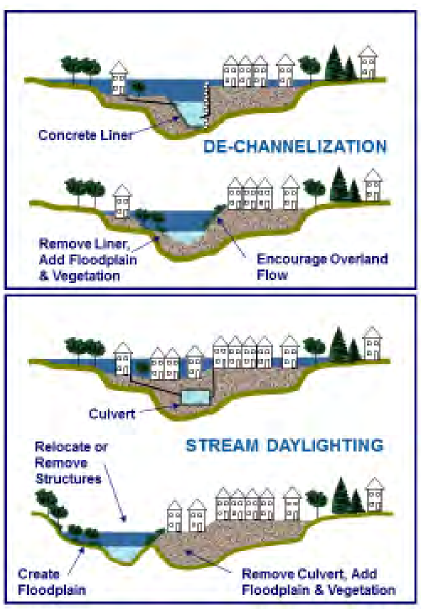
Flood Responses Can Differ

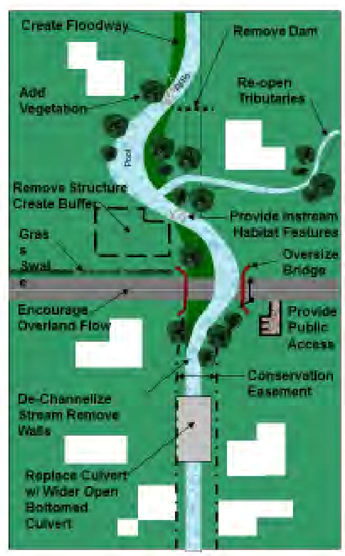
<u>Steep Slopes</u>	<u>Medium Slopes</u>	<u>Low Slopes</u>
Channel Deepening	Deepens or Widens	Shallows
High Velocity	Modified Sinuosity	Overbank Floods
Bank Failures	Floodplain Scour	Avulsions
Coarser Bed	Debris Jams	Wetland Damage

Floods Can Impair Water Quality

- Mobilization of sediment
- Mobilization of pollutants
  - Basements and basement utilities
  - Gasoline service stations
  - Fuel oil
  - Swimming pools
  - Waste storage sites
  - Septic Systems
  - Vehicles
  - Materials stored at commercial and industrial sites

What Can We Do to the Tributaries to Help?





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What is an LFA?

What is an LFA?

A **Local Flood Analysis**, or LFA, is a New York City funded program developed at the request of West of Hudson New York City Watershed communities following flooding caused by Tropical Storms Irene and Lee in 2011. The program funds a two-step process to:

(1) conduct engineering analysis to determine the causes of flooding and evaluate mitigation options; and

(2) undertake project design and implementation.

What is the end product of an LFA?

An engineering analysis of existing flooding conditions and feasible options to mitigate flooding moving forward, including sketches of the mitigation options, cost estimates, benefit-cost analyses, and funding sources available.

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The LFA Process

- Uniform across communities yet able to be customized
- Collect input about flooding and flood damage from property owners, municipal officials, and others
- Build upon FEMA flood modeling efforts and the county hazard mitigation plan
- Identify and evaluate potential flood mitigation measures that protect water quality
- Assess potential magnitude of flood relief alternatives through hydraulic modeling
- Refine alternatives through vetting of cost, feasibility, and public support

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Why Walton?

- Walton has been devastated by flooding, resulting in extensive damage
- Critical infrastructure, businesses, and homes remain vulnerable
- Located within the New York City public water supply watershed
- LFA funding provides a unique opportunity to assess the watershed under current conditions and plan for the future

Walton Flood Commission

- Village of Walton
- Town of Walton
- Other Community Representatives such as School Officials and the County Fair Board
- Delaware County Soil & Water Conservation District
- Delaware County Watershed Affairs
- Delaware County Planning Department
- Delaware County Public Works Department
- Catskill Watershed Corporation
- New York City Department of Environmental Protection

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LFA Goals in Walton

- Reduce flood risk to homes and businesses
- Reduce flood risk to roads
- Become more resilient over the long-term
- Maintain sense of community
- Attract and maintain businesses and services
- Obtain appropriate funding for flood mitigation projects

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LFA Outcomes

- Scientifically Based Analysis
- Sketches of Mitigation Options
- Planning-Level Cost Estimates
- Benefit Cost Analysis to Understand Project Viability
- Identification of Potential Funding Sources
- A Blueprint for Near-Term and Long-Term Flood Mitigation
- A Better Understanding of What is Feasible, What is Cost Effective, and What is Desired by Citizens

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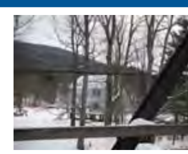
Flood Mitigation Strategies

Flood Mitigation



Structural Projects

- Replace Bridges and Culverts
- Remove In-Stream Dams
- Remove Obstructions
- Upstream Detention
- Install Stormwater Systems
- Create Floodways
- Enlarge Channels
- Reduce Flow Resistance
- Install Levees
- Install Flood Walls

Property Protection

- Wet Floodproofing
- Dry Floodproofing
- Elevate Buildings
- Relocate Buildings
- Secure Utilities
- Anchor Floatables
- Remove Hazardous Materials
- Re-Grade Properties
- Purchase Flood Insurance
- Join the Community Rating System (CRS)

Prevention

- Modify Zoning
- Modify Comp Plan
- Stormwater Management Regulations
- Increase Flood Damage Prevention Standards
- Freeboard
- Low Impact Development
- Minimize Impervious Cover

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Flood Mitigation Strategies

Flood Mitigation

Natural Resources

- Acquire or Preserve Floodplain Land
- Acquire and Remove Structures from Floodplains and Convert to Open Space
- Acquire or Preserve Other Lands
- Increase Wetland Storage
- Re-Connect Streams to Floodplains

Emergency Services

- Build Local Capacities to Respond
- Move Critical Facilities from Flood Risk Areas
- Establish Emergency Shelters
- Elevate Roads or Bridges to Ensure Egress
- Develop Community Evacuation Plans
- Develop Site-Specific Evacuation Plans
- Establish Satellite Facilities in Areas Subject to Isolation

Public Education

- Newsletters
- Community Meetings
- Information Kiosks
- Web Site with Flood Risk Maps
- Education of Municipal Staff
- Leverage State and FEMA Education Programs
- Establish a Standing Committee or Board to Oversee Outreach

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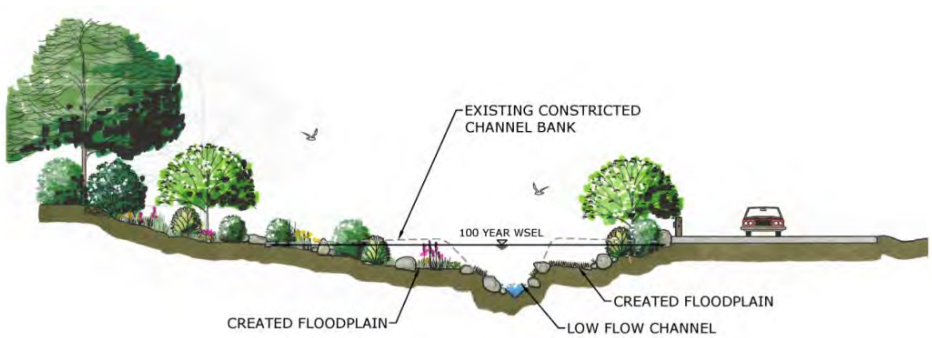
Flood Mitigation Strategies

- Channel Alteration – Widening or realignment, creation of compound channel or bypass channel
- Floodplain – Reclamation, creation, enhancement
- Bridges – Removal or replacement



TYPICAL COMPOUND CHANNEL

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Flood Mitigation Strategies

- Sediment Management
  Sediment removal, stabilization of sources
- Individual Structures
  Floodproofing, elevation of structures, voluntary buy-outs, relocations

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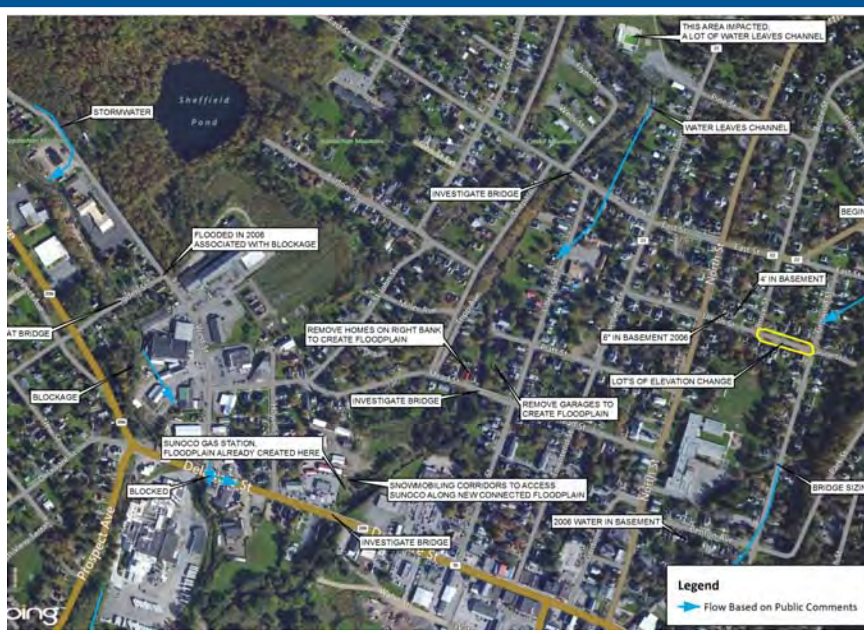
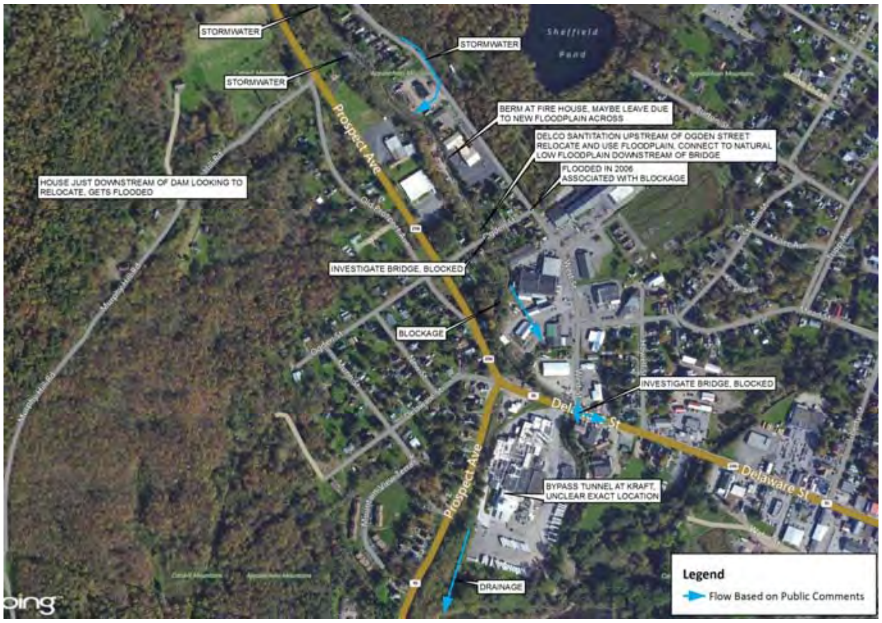
Review Public Comments – East Brook

Review Public Comments – West Brook



Review Public Comments – Third Brook



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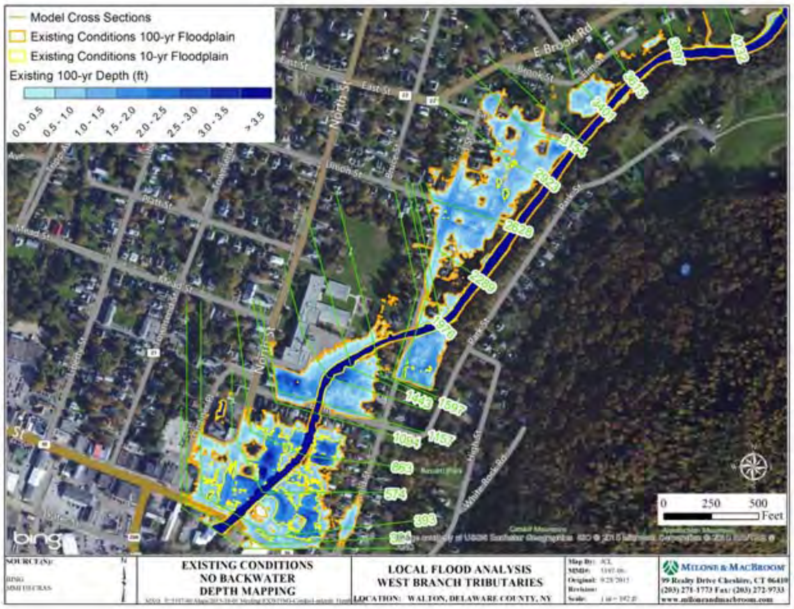
Existing Conditions along East Brook



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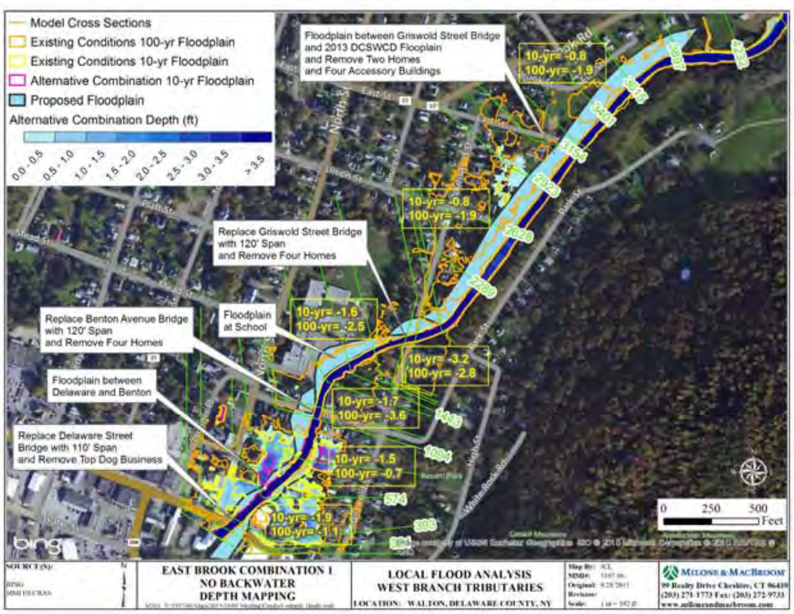

East Brook Project Costs and Benefits

Project	Total Benefits	Total Costs
Delaware Street bridge replacement	$838,460	$2,550,000
Delaware Street bridge replacement and floodplain bench (FP4)	$1,287,060	$3,317,000
Benton Ave bridge replacement (90') and remove 2 homes	$689,258	$2,165,000
Benton Ave bridge replacement (90') and remove 2 homes + floodplain at school (FP1)	$717,607	$2,347,000
Benton Ave bridge replacement (120') and remove 4 homes	$1,059,346	$2,476,000
Benton Ave bridge replacement (120') and remove 4 homes + floodplain at school (FP1)	$1,065,273	$2,306,000
Benton Ave bridge removal and no replacement	$488,906	$500,000
Benton Ave bridge removal and no replacement + floodplain at school (FP1)	$459,645	$682,131
Griswold Street bridge replacement (includes 2 homes removed)	$1,687,757	$3,275,000
Griswold Street bridge replacement and upstream floodplain (FP3) (includes four homes removed)	$2,472,720	$4,421,000

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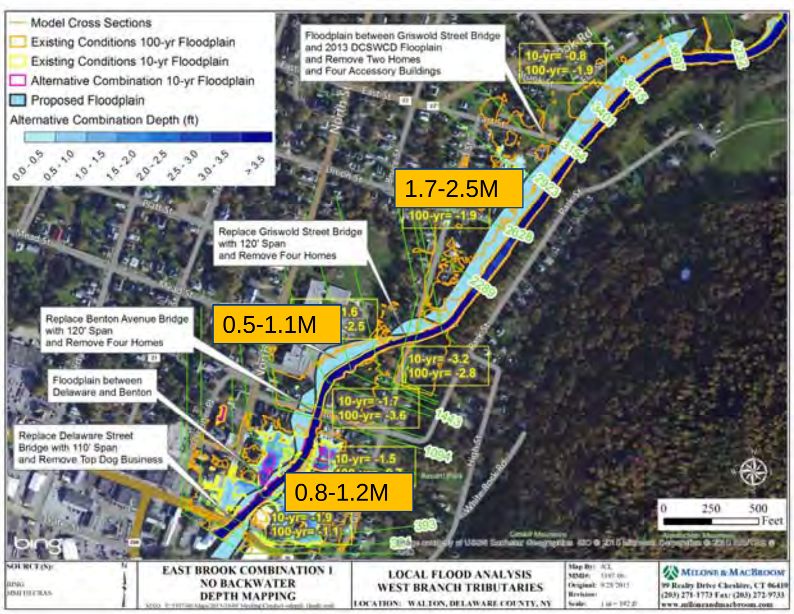
Total Benefits (Ranges) along East Brook



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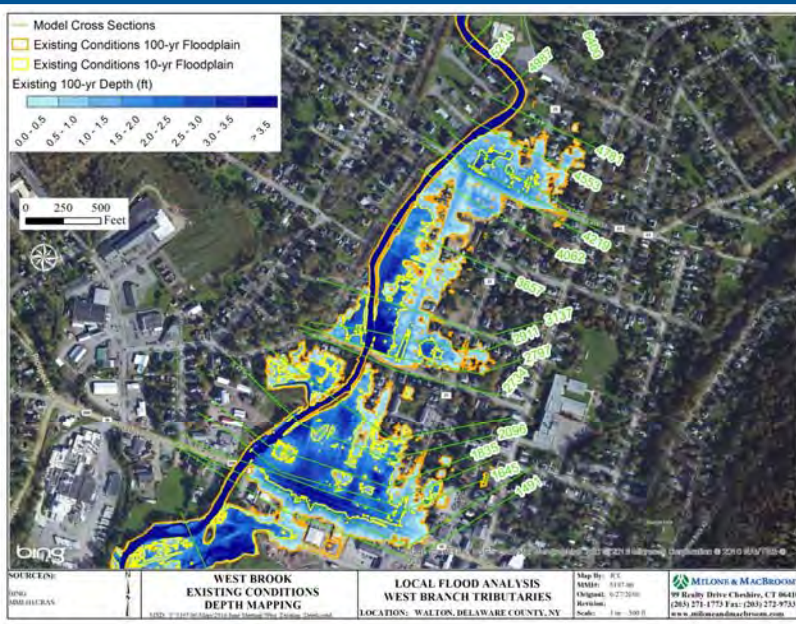
Existing Conditions along West Brook



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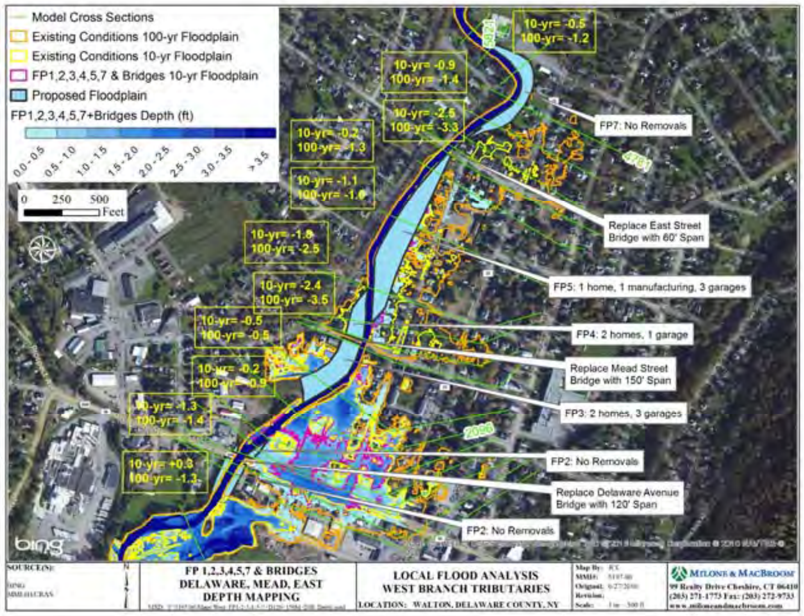

West Brook Project Costs and Benefits

Project	Total Benefits	Total Costs
Floodplain Downstream of Delaware St (FP1)	$3,142,179	$102,000
Floodplains Downstream and Upstream of Delaware St, (FP 1+2) and Replace Delaware St Bridge	$4,111,265	$2,882,000
Floodplains Upstream and Downstream of Mead St (FP 3 + 4) and Replace Mead St Bridge	$1,472,280	$3,156,000
Mead St Floodplains and Floodplain Between East St and Mead St (FP 3 + 4 + 5) and Replace Mead Street Bridge	$2,099,979	$4,009,000
Replace East Street Bridge	$648,347	$1,100,000
Floodplain between East Street and Park, and replace East Street Bridge	$657,894	$1,207,000

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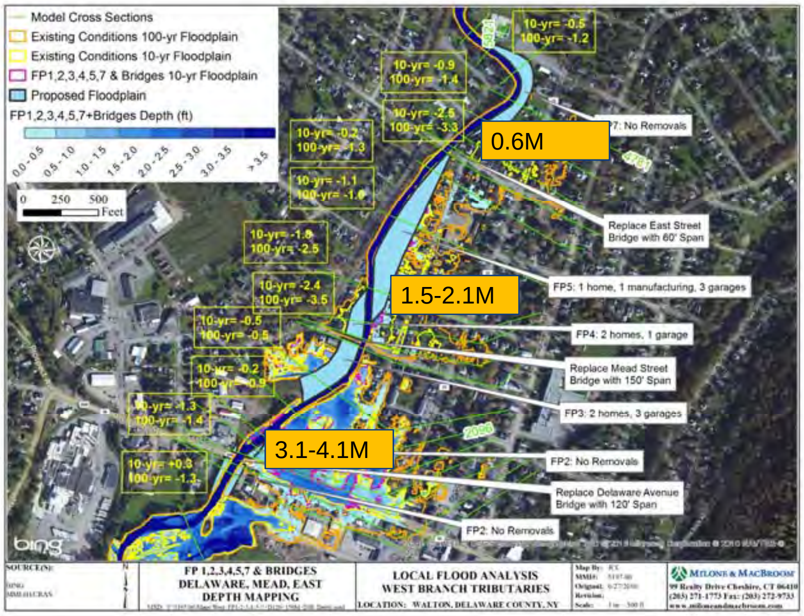
Total Benefits (Ranges) along West Brook



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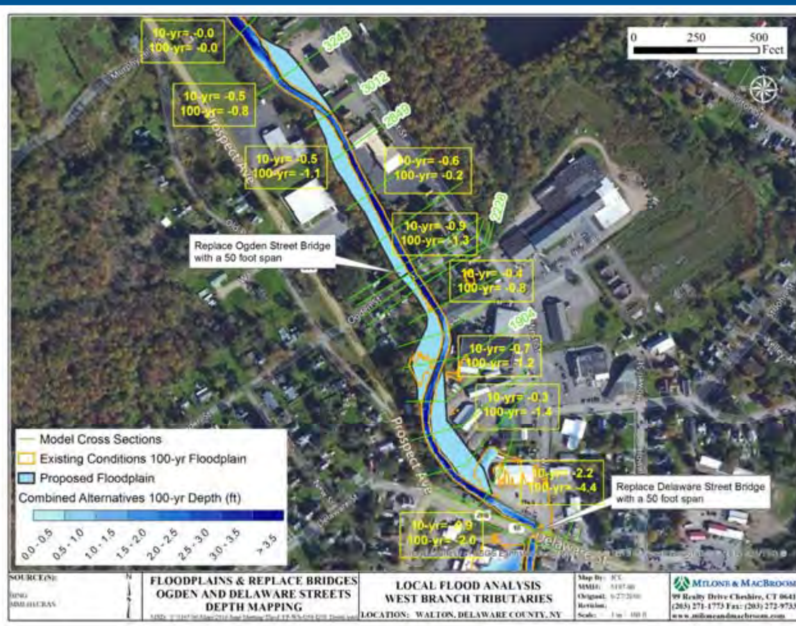
Third Brook Existing Depth Map

Third Brook- Floodplain Alternative



Third Brook Project Costs and Benefits

Project	Total Benefits	Total Costs
Lower floodplain project (behind Klinger)	?	$231,000
Middle floodplain project (along Del-Ton)		$322,000
Upper floodplain project (behind Neale)		$109,000
All floodplains plus both bridges		$2,862,000
Delaware Street bridge replacement		$1,100,000
Ogden Street bridge replacement		$1,100,000

Benefits are difficult to calculate because damage is caused by only the most severe floods

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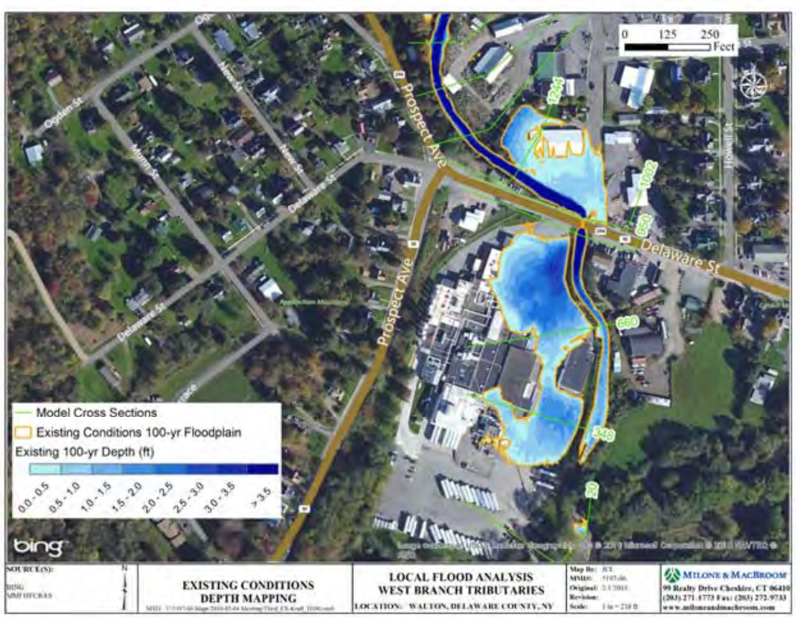
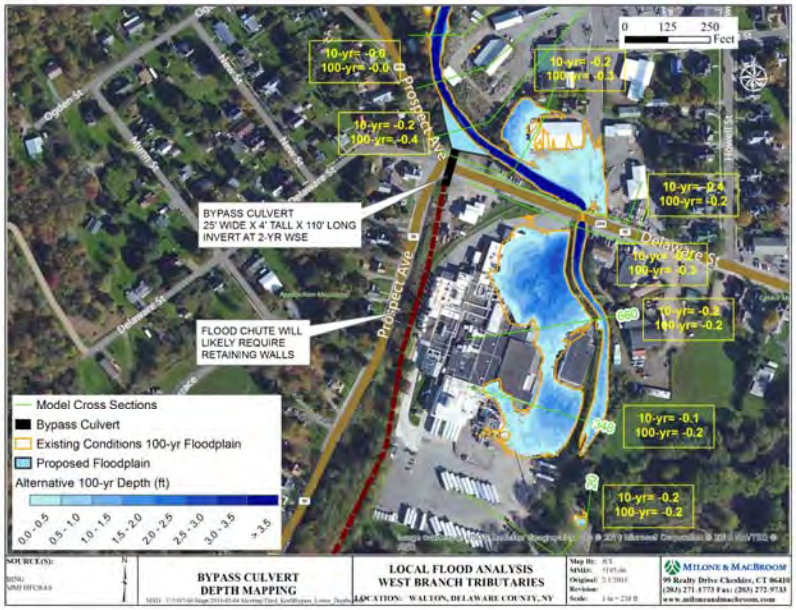
Existing Conditions at Kraft



Bypass Culvert at Kraft



Kraft Bypass

- Results:
  - 100-yr flood causes ~100 cfs to leave the channel, or ~10% of the flood discharge
  - 2006 flood causes ~190 cfs to leave the channel, or ~11% of the flood discharge
- Note there is not much space behind the Kraft building and the bypass would likely require retaining walls along the road in order to fit

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Next Steps

- Repeat Public Meeting on July 11, 2016
- Incorporate Feedback
- Complete Draft LFA Report
- Present the LFA Report
- Apply for Project Design and Construction Funds

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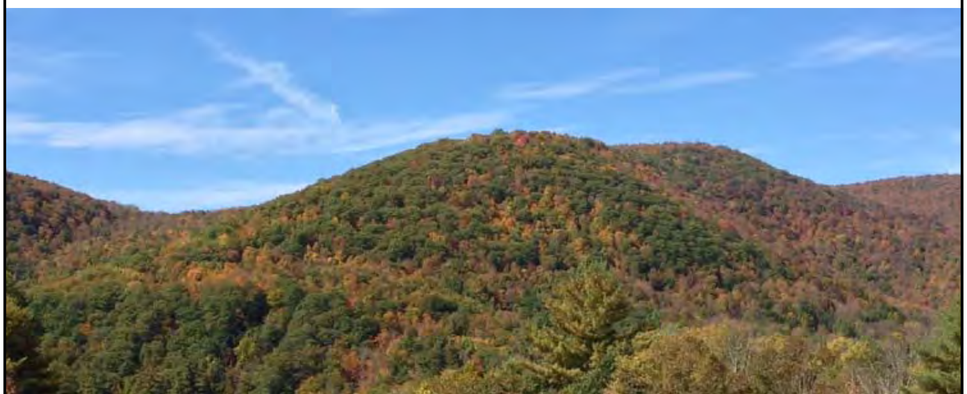
Questions, Comments, or Thoughts?



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Boneyard slides

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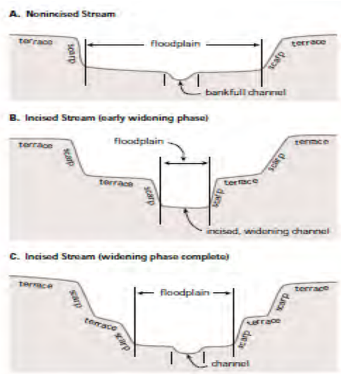
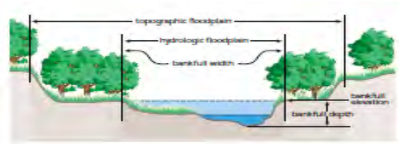
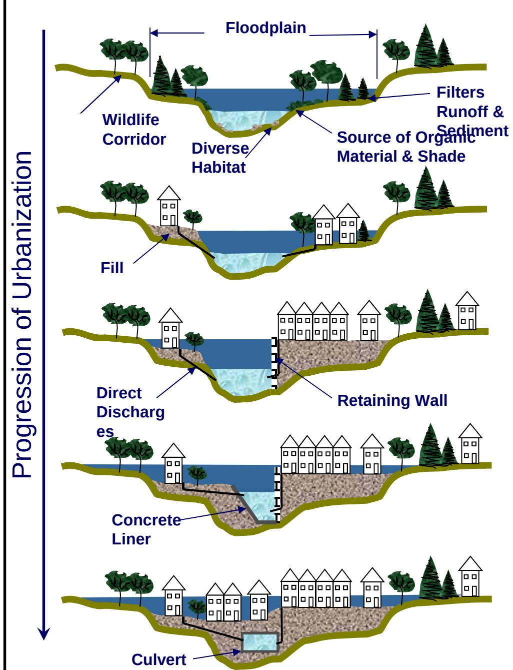
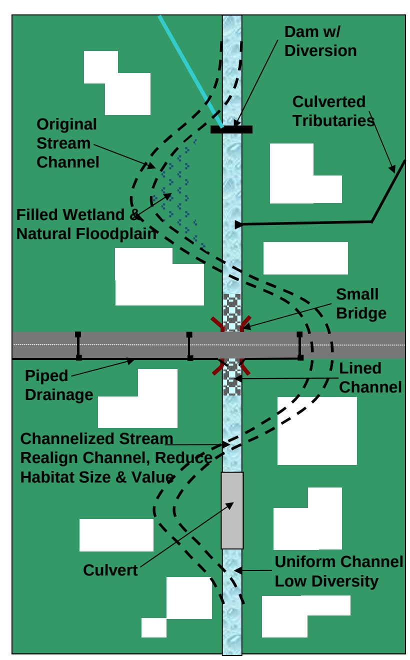
Rivers and Streams

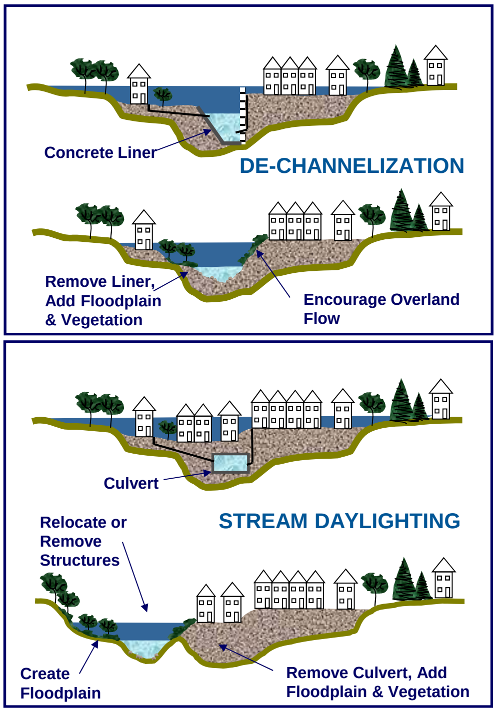


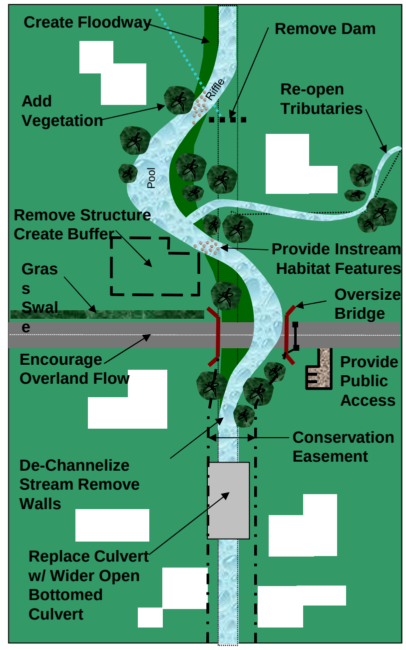
Cross Section Geometry











Flood Reduction Options

- Channel Alteration
- Floodplain Alteration:
  - **Reclaim** through excavation/removals
  - **Create** through new excavation
  - **Enhance** through additional excavation

- Bridge Replacement
- Sediment Management
- Floodproofing Structures

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East Brook BCA Benefits

Project	Building Benefits	Acquisition Benefits	Infrastructure Benefits	Total Benefits
Delaware Street bridge replacement	$737,687	---	$100,773	$838,460
Delaware Street bridge replacement and floodplain bench (FP4)	$724,309	$461,978	$100,773	$1,287,060
Benton Ave bridge replacement (90') and remove 2 homes	$371,539	$294,686	$23,033	$689,258
Benton Ave bridge replacement (90') and remove 2 homes + floodplain at school (FP1)	$399,888	$294,686	$23,033	$717,607
Benton Ave bridge replacement (120') and remove 4 homes	$445,405	$590,908	$23,033	$1,059,346
Benton Ave bridge replacement (120') and remove 4 homes + floodplain at school (FP1)	$451,332	$590,908	$23,033	$1,065,273
Benton Ave bridge removal and no replacement	$465,031	---	$23,875	$488,906
Benton Ave bridge removal and no replacement + floodplain at school (FP1)	$435,770	---	$23,875	$459,645
Griswold Street bridge replacement (includes 2 homes removed)	$1,237,799	$377,918	$72,040	$1,687,757
Griswold Street bridge replacement and upstream floodplain (FP3) (includes four homes removed)	$1,336,239	$1,064,441	$72,040	$2,472,720

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West Brook – Floodplain Bench DS of Park

- The floodplain bench downstream of the park creates water surface elevation increases in the 100-year and 50-year flood
- The East Street Bridge replacement also creates some increases in water surface elevation in the 500-year flood
- When the bridge replacement and floodplain bench are modeled together, none of the flood events show slight increases
- ***These alternatives work best together***

West Brook BCA Benefits

Project	Building Benefits	Acquisition Benefits	Infrastructure Benefits	Total Benefits
Floodplain Downstream of Delaware St (FP1)	$3,142,179	--	--	$3,142,179
Floodplains Downstream and Upstream of Delaware St, (FP 1+2) and Replace Delaware St Bridge	$3,404,750	--	$706,515	$4,111,265
Floodplains Upstream and Downstream of Mead St (FP 3 + 4) and Replace Mead St Bridge	$181,075	$1,095,234	$195,971	$1,472,280
Mead St Floodplains and Floodplain Between East St and Mead St (FP 3 + 4 + 5) and Replace Mead Street Bridge	$317,338	$1,586,670	$195,971	$2,099,979
Replace East Street Bridge	$262,782	--	$385,565	$648,347
Floodplain between East Street and Park, and replace East Street Bridge	$272,329	--	$385,565	$657,894

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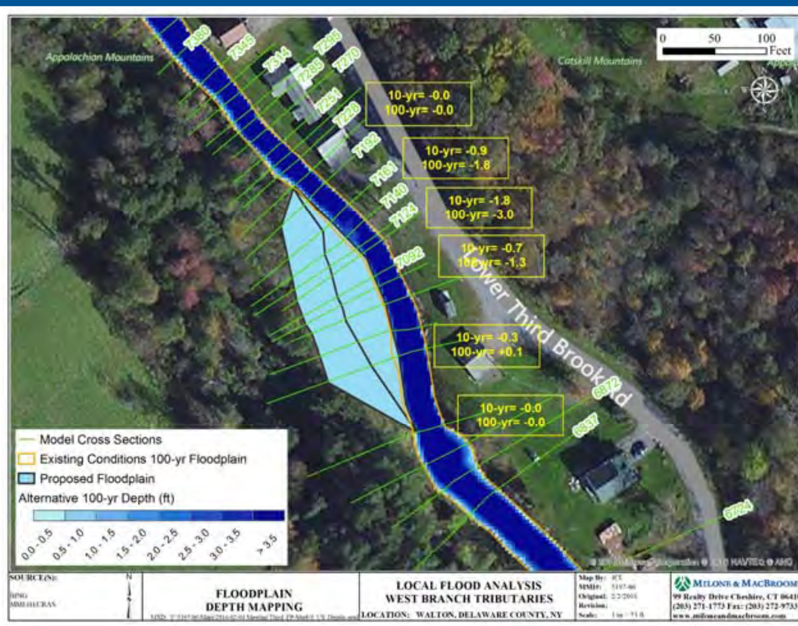
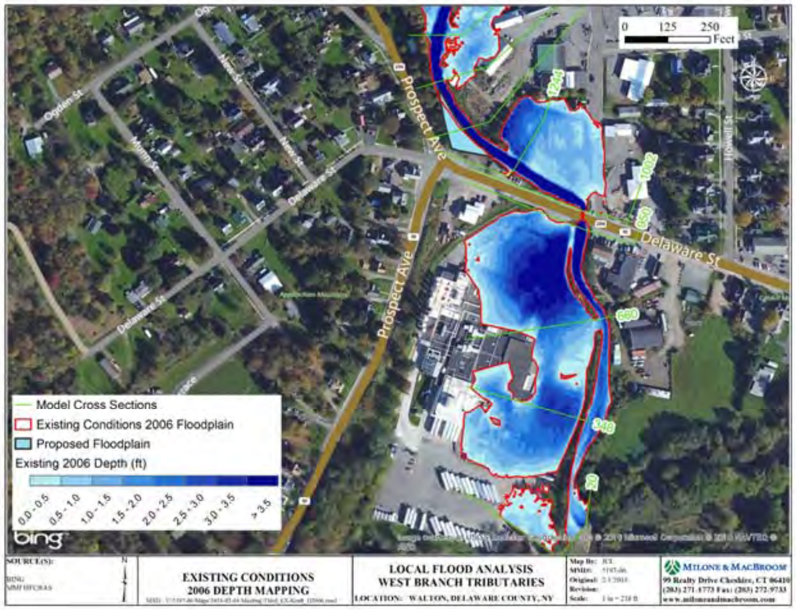
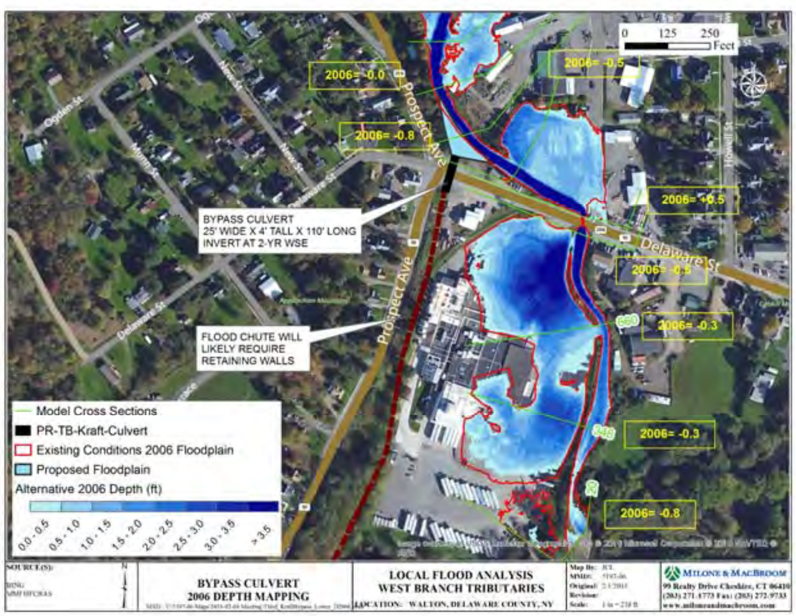
EWP 8-9 Depth Map



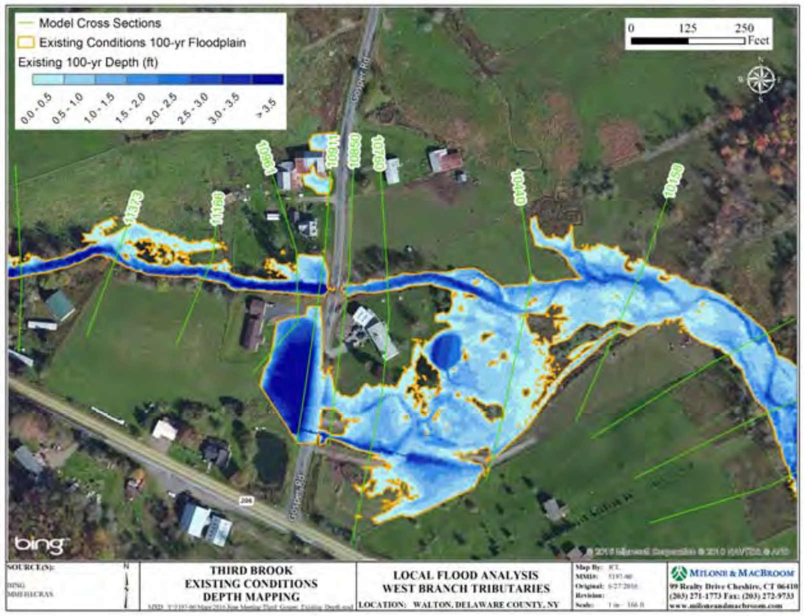
Existing Conditions at Kraft – 2006 Flood



Bypass Culvert at Kraft – 2006 Flood



Gosper Road Existing Depth Map



East Brook BCA

- The Flood Module was used to generate benefits from buildings
- The Damage Frequency Module was used to generate benefits from bridge and road damage figures, plus Townsend School
- Estimated costs are substantial:
  - Delaware Street over East Brook (New Span 110') – $2.55M
  - Benton Avenue over East Brook (New Span 90') – $1.45M
    Benton Avenue over East Brook (New Span 120') – $1.85M
  - Griswold Avenue over East Brook (New Span 120') – $2.75M
- Floodplain enhancements will add to costs
- Property acquisitions will add to costs

Townsend School

- Flood module used to attach benefits to **downstream** projects that reduce flooding from backwater conditions
- Damage frequency module used to attach benefits to **upstream** projects that reduce out-of-channel flooding
- We were provided $2.8M repair cost from 2006 flood (500 yr event)
- School website says $6M in repairs between 1996 and 2006 floods
  - 1996 damages therefore estimated at $3.2M
- 2013-2014 school budget / 3 = $6,694,839 annual budget estimate
- If 1996 event is 50 yr, benefits are $1,169,061
- If 1996 event is 100 yr, benefits are $532,502
- Need to know how many days the schools were closed following each event – at this time we are guessing
- The benefits are being added to the Griswold Street alternatives

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West Brook BCA

- The Flood Module was used to generate benefits from buildings
- The Damage Frequency Module was used to generate benefits from bridge and road damage figures
- Estimated costs are substantial:
  - Delaware Street over West Brook (New Span 120') – 2.75M
  - Mead Street over West Brook (New Span 150') – 2.30M
  - East Street over West Brook (New Span 60') – 1.10M
- Floodplain enhancements will add to costs
- Property acquisitions will add to costs

Public Information Meeting

Walton Tributaries LFA
July 19, 2016
Meeting Minutes

A public meeting was held on July 19, 2016 at 6:00 PM at the Walton Fire Department regarding the West Branch Delaware River Tributaries LFA. Mr. Graydon Dutcher from Delaware County Soil and Water Conservation District provided introductory statements and described the LFA process. Mr. David Murphy, P.E., CFM from Milone & MacBroom, Inc. presented a power point slide show which provided an overview of river systems and described potential alternatives for flood reduction along East Brook, West Brook, and Third Brook. During the East Brook portion of the presentation, the following questions from the audience were fielded:

- The owner of Breakey Motors believes that floodplain bench and floodplain enhancement projects may be too far-reaching and that the same results can be accomplished by replacing rock walls with bulkheads that are further back, creating a wider channel. Mr. Murphy explained that modeling has demonstrated that making floodplain benches has better results for reducing water surface elevations and making space for flooding.
- A resident who lives along a tributary believes that the water is already too close, and making a floodplain bench will allow floodwaters to be unacceptably close thereby increasing risk. Mr. Murphy explained that the project would lower water surface elevations, reducing risk.
- The same resident asked what the timeframe for projects might be, and asked what the next steps would be. She had heard from a neighbor that a 20+ year timeframe was being evaluated. She is concerned that there is a timetable in the near future for approaching residents about selling their homes. Mr. Dutcher explained that the process is not top-down; the community must support these projects and they would be pursued as funding and consensus would allow.
- The resident also asked for a clarification of the terms floodway and floodplain. Mr. Dutcher explained the difference.

During the West Brook portion of the presentation, the following questions from the audience were fielded:

- A resident from the area of the park stated that the EWP project at the bend on West Brook has not been maintained. A woman on the other side of the audience added to this sentiment. Mr. Dutcher explained how the EWP project was funded and implemented, and how there is not a provision for continuous monitoring in perpetuity. He urged attendees to contact his office is there is a problem.
- The owner of Breakey Motors asked about the gravel bar beneath Bridge Street in the West Branch Delaware River. Mr. Murphy explained that this was addressed in the river's LFA report, and asked to revisit the question after the meeting.

Following the presentation, Mr. Murphy turned over the meeting for a general discussion. Discussion points included the following:

- The owner of Breakey Motors explained that the bridge replacements needed to happen first because they are the cause of most of the flooding. Mr. Murphy said that there was general agreement that the bridges are causing much of the flooding. Mr. Dutcher added that his office understands this, but some of the floodplain projects can be pursued in early phases and then would add to the bridge replacement benefits later. He also explained that getting everything into the LFA report can help advance timeframes and gave the example from Prattsville's bridge which is being replaced sooner than originally planned.

- The resident who asked about the timing of projects earlier urged community officials to let people know the timeframe for when residents would be approached about projects that involve their properties.
- Residents asked who should be called when questions come up. Mr. Dutcher said that his office can be contacted.
- A resident asked if replacement trees would be planted in areas that floodplains are enhanced, if trees need to be removed for these projects. Mr. Dutcher said this would be done.

At the conclusion of the general discussion (7:45 PM), Mr. Murphy laid out maps of each brook and had attendees make notes on the maps showing areas that have been impacted by flooding and discuss specific alternatives for each brook. Mr. Dutcher and Mr. Murphy each stayed with a set of maps to facilitate discussions.

Local Flood Analysis
Public Meeting
West Branch Tributaries

Walton Flood Commission and Village and Town of Walton

David Murphy, P.E., CFM



Delaware County Soil & Water Conservation District | July 19, 2016

Agenda

- Water Cycle, Rivers, and Floodplains
- Local Flood Analysis (LFA) Goals, Outcomes, and Advisory Structure
- Review Public Comments from Summer 2015
- East Brook Flood Mitigation Options
- West Brook Flood Mitigation Options
- Third Brook Flood Mitigation Options
- Next Steps

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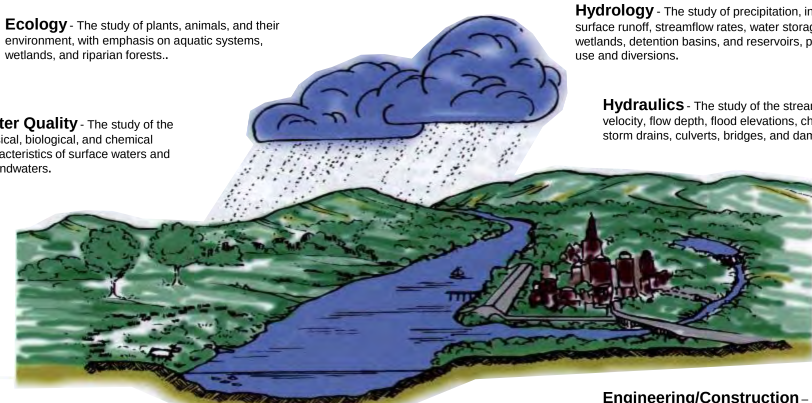
How Do We Study the Water Cycle?

Ecology - The study of plants, animals, and their environment, with emphasis on aquatic systems, wetlands, and riparian forests..

Hydrology - The study of precipitation, infiltration, surface runoff, streamflow rates, water storage in wetlands, detention basins, and reservoirs, plus water use and diversions.

Water Quality - The study of the physical, biological, and chemical characteristics of surface waters and groundwaters.

Hydraulics - The study of the stream's water velocity, flow depth, flood elevations, channel erosion, storm drains, culverts, bridges, and dams.

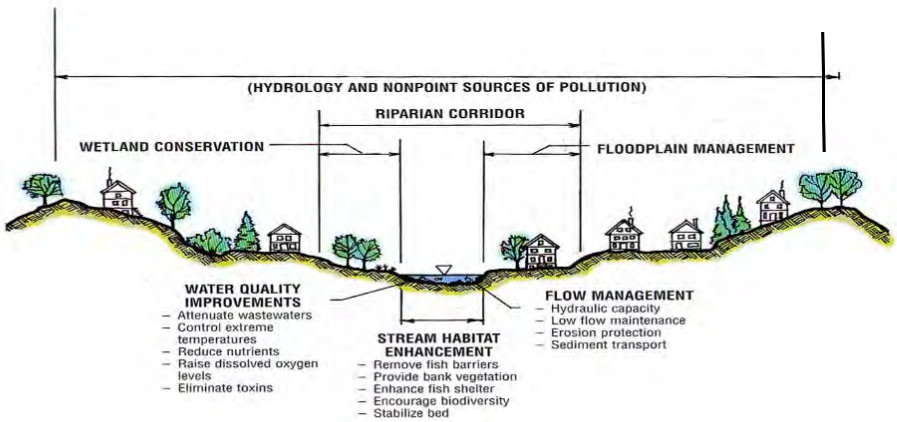


Engineering/Construction – The application of science and mathematics in analysis design, permitting, and construction.

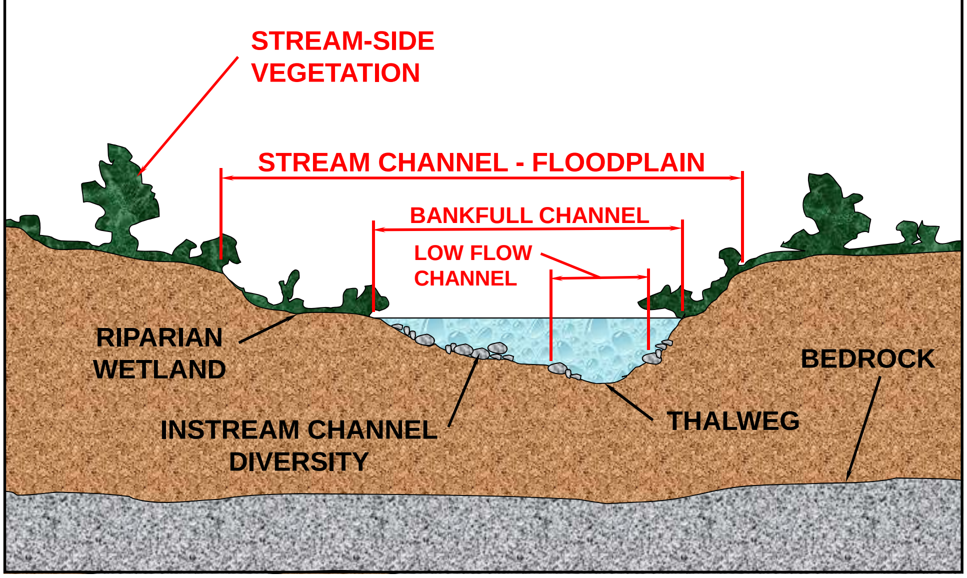
Fluvial Morphology - The study of the channel's geologic origin, alignment, slope, shape, size, sediments, and floodplains.

Socioeconomic - The study of the sociology, social relationships, economic impacts, and their interconnections.

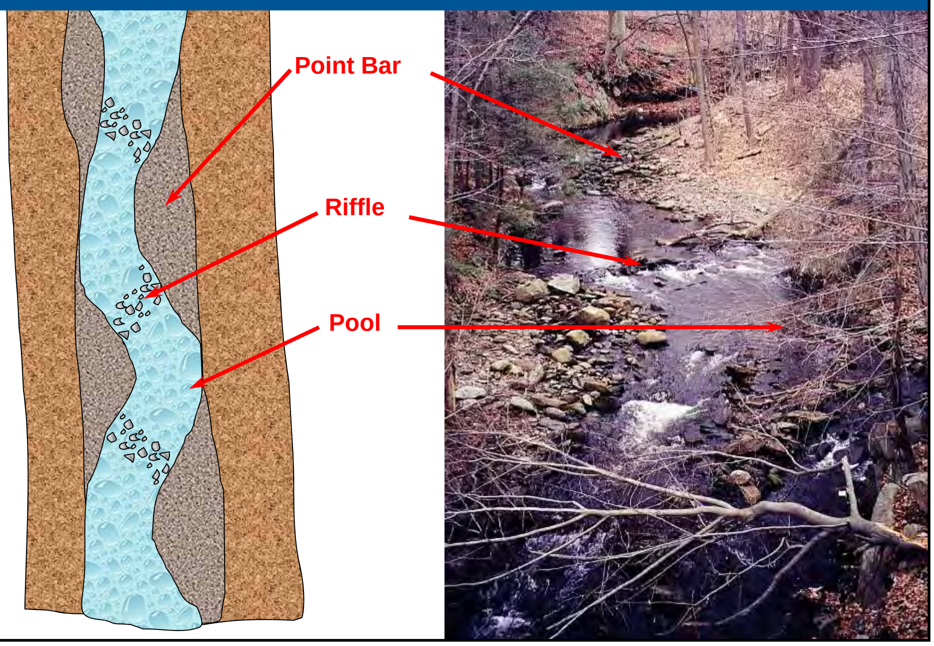
How Do We Manage Watersheds?



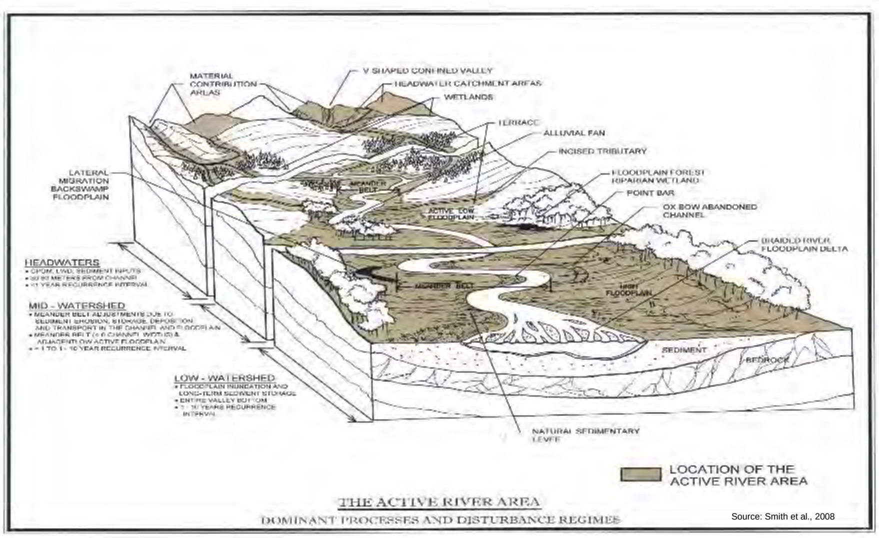
Features of a Natural Channel



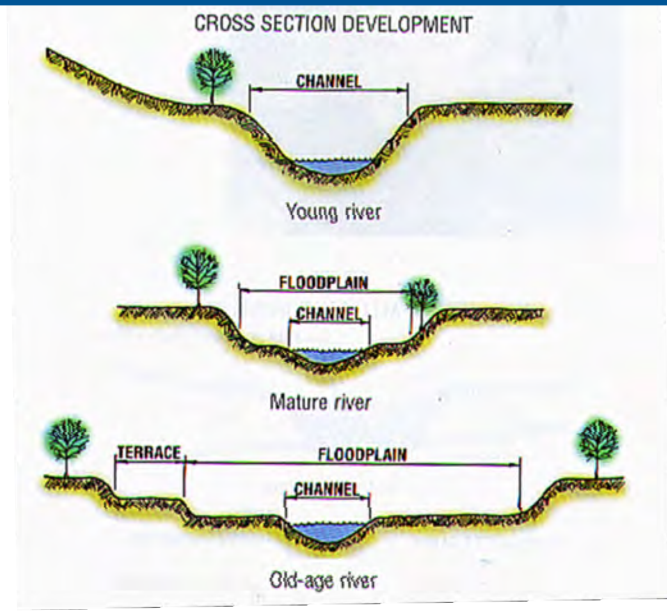
Features of a Natural Channel



The Active River Area Is Much Larger

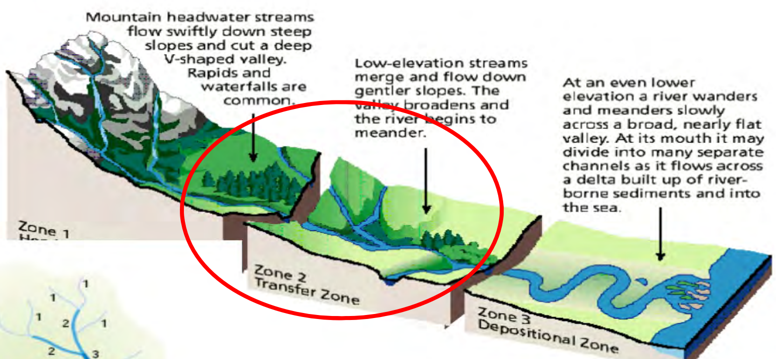


Rivers Can Change Over Time



Where Do the Tribs Fit Into the River Profile?

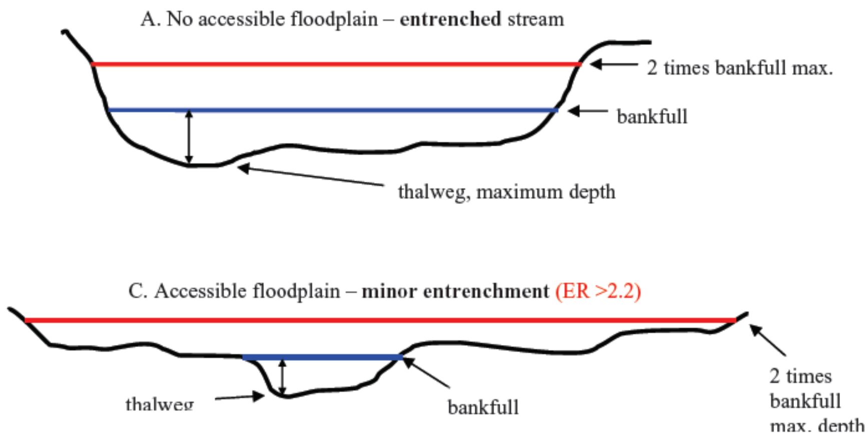
Source: Strahler, 1952; FISRWG, 1998



Source: Schumm1977; FISRWG, 1998

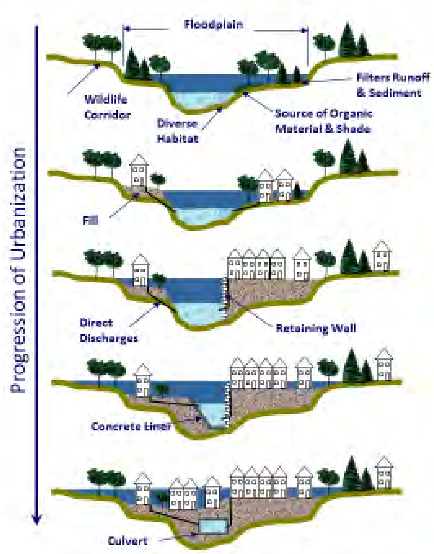
Where Do the Tribs Fit Within Floodplains?

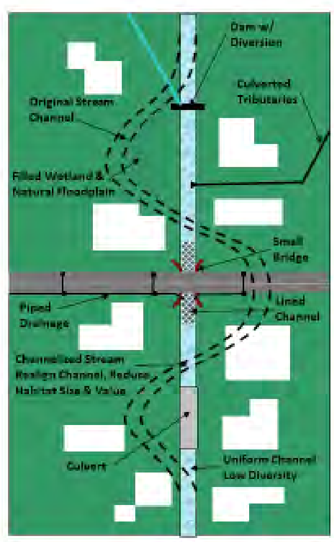
Is the Channel Connected to its Floodplain?



Source: VTANR 2010

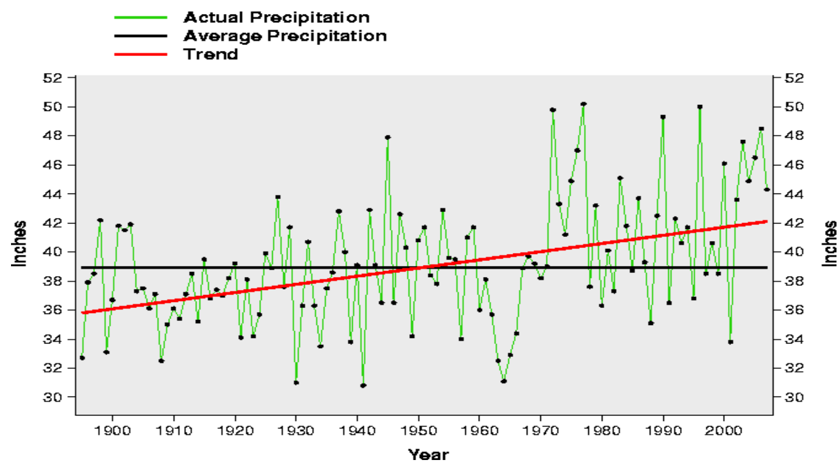
What Have We Done to the Tributaries?





What Are We Experiencing?

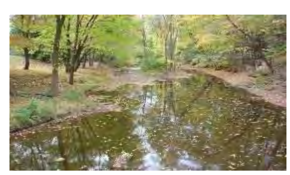
New York Annual Precipitation



Flood Responses Can Differ

Steep Slopes	Medium Slopes	Low Slopes
Channel Deepening	Deepens or Widens	Shallows
High Velocity	Modified Sinuosity	Overbank Floods
Bank Failures	Floodplain Scour	Avulsions
Coarser Bed	Debris Jams	Wetland Damage

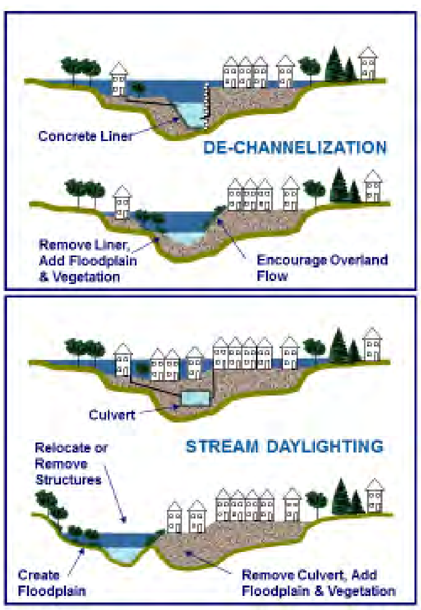


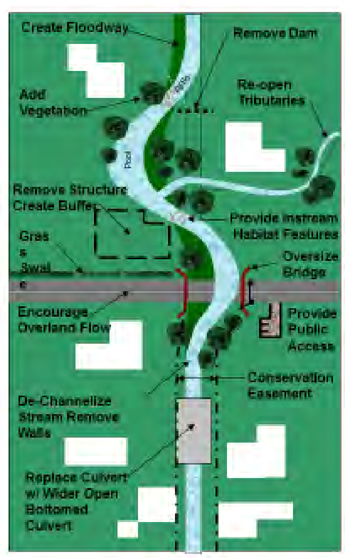


Floods Can Impair Water Quality

- Mobilization of sediment
- Mobilization of pollutants
  - Basements and basement utilities
  - Gasoline service stations
  - Fuel oil
  - Swimming pools
  - Waste storage sites
  - Septic Systems
  - Vehicles
  - Materials stored at commercial and industrial sites

What Can We Do to the Tributaries to Help?





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What is an LFA?

What is an LFA?

A **Local Flood Analysis**, or LFA, is a New York City funded program developed at the request of West of Hudson New York City Watershed communities following flooding caused by Tropical Storms Irene and Lee in 2011. The program funds a two-step process to:

(1) conduct engineering analysis to determine the causes of flooding and evaluate mitigation options; and

(2) undertake project design and implementation.

What is the end product of an LFA?

An engineering analysis of existing flooding conditions and feasible options to mitigate flooding moving forward, including sketches of the mitigation options, cost estimates, benefit-cost analyses, and funding sources available.

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The LFA Process

- Uniform across communities yet able to be customized
- Collect input about flooding and flood damage from property owners, municipal officials, and others
- Build upon FEMA flood modeling efforts and the county hazard mitigation plan
- Identify and evaluate potential flood mitigation measures that protect water quality
- Assess potential magnitude of flood relief alternatives through hydraulic modeling
- Refine alternatives through vetting of cost, feasibility, and public support

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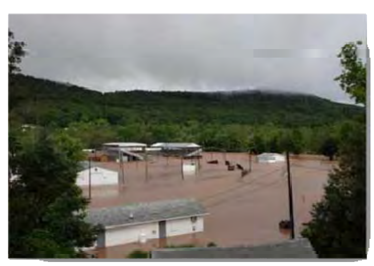
Why Walton?

- Walton has been devastated by flooding, resulting in extensive damage
- Critical infrastructure, businesses, and homes remain vulnerable
- Located within the New York City public water supply watershed
- LFA funding provides a unique opportunity to assess the watershed under current conditions and plan for the future



Walton Flood Commission

- Village of Walton
- Town of Walton
- Other Community Representatives such as School Officials and the County Fair Board
- Delaware County Soil & Water Conservation District
- Delaware County Watershed Affairs
- Delaware County Planning Department
- Delaware County Public Works Department
- Catskill Watershed Corporation
- New York City Department of Environmental Protection

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LFA Goals in Walton

- Reduce flood risk to homes and businesses
- Reduce flood risk to roads
- Become more resilient over the long-term
- Maintain sense of community
- Attract and maintain businesses and services
- Obtain appropriate funding for flood mitigation projects

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LFA Outcomes

- Scientifically Based Analysis
- Sketches of Mitigation Options
- Planning-Level Cost Estimates
- Benefit Cost Analysis to Understand Project Viability
- Identification of Potential Funding Sources
- A Blueprint for Near-Term and Long-Term Flood Mitigation
- A Better Understanding of What is Feasible, What is Cost Effective, and What is Desired by Citizens

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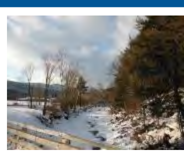
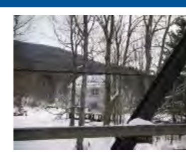
Flood Mitigation Strategies



Flood Mitigation



Structural Projects

- Replace Bridges and Culverts
- Remove In-Stream Dams
- Remove Obstructions
- Upstream Detention
- Install Stormwater Systems
- Create Floodways
- Enlarge Channels
- Reduce Flow Resistance
- Install Levees
- Install Flood Walls

Property Protection

- Wet Floodproofing
- Dry Floodproofing
- Elevate Buildings
- Relocate Buildings
- Secure Utilities
- Anchor Floatables
- Remove Hazardous Materials
- Re-Grade Properties
- Purchase Flood Insurance
- Join the Community Rating System (CRS)

Prevention

- Modify Zoning
- Modify Comp Plan
- Stormwater Management Regulations
- Increase Flood Damage Prevention Standards
- Freeboard
- Low Impact Development
- Minimize Impervious Cover

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Flood Mitigation Strategies

Flood Mitigation

Natural Resources

- Acquire or Preserve Floodplain Land
- Acquire and Remove Structures from Floodplains and Convert to Open Space
- Acquire or Preserve Other Lands
- Increase Wetland Storage
- Re-Connect Streams to Floodplains

Emergency Services

- Build Local Capacities to Respond
- Move Critical Facilities from Flood Risk Areas
- Establish Emergency Shelters
- Elevate Roads or Bridges to Ensure Egress
- Develop Community Evacuation Plans
- Develop Site-Specific Evacuation Plans
- Establish Satellite Facilities in Areas Subject to Isolation

Public Education

- Newsletters
- Community Meetings
- Information Kiosks
- Web Site with Flood Risk Maps
- Education of Municipal Staff
- Leverage State and FEMA Education Programs
- Establish a Standing Committee or Board to Oversee Outreach

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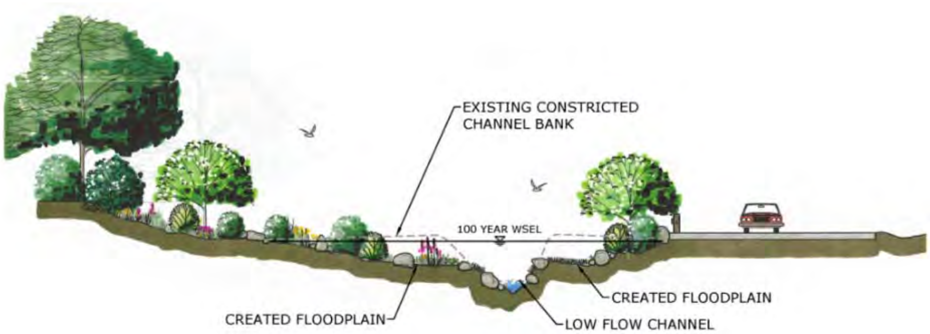
Flood Mitigation Strategies

- Channel Alteration – Widening or realignment, creation of compound channel or bypass channel
- Floodplain – Reclamation, creation, enhancement
- Bridges – Removal or replacement



TYPICAL COMPOUND CHANNEL

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Flood Mitigation Strategies

- Sediment Management
  Sediment removal, stabilization of sources
- Individual Structures
  Floodproofing, elevation of structures, voluntary buy-outs, relocations

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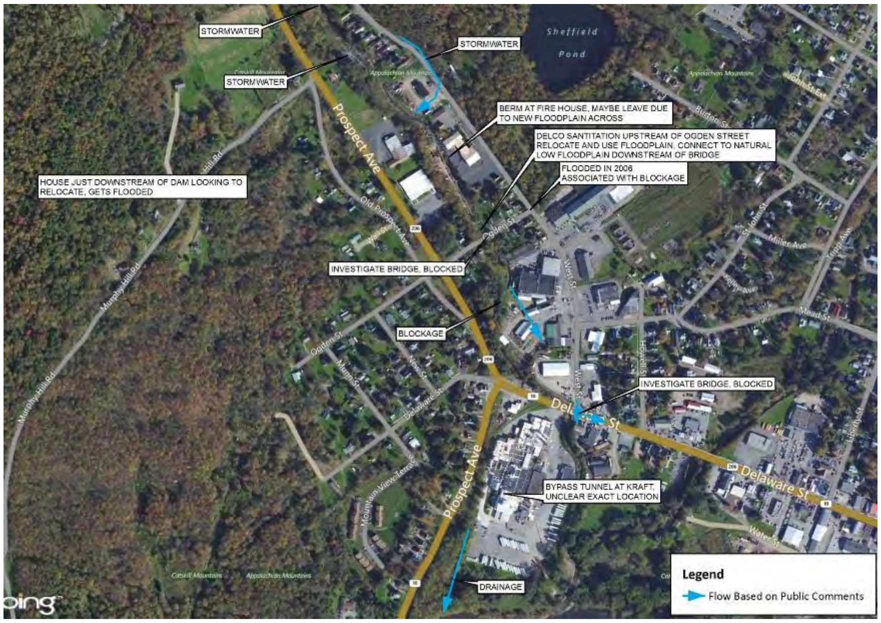
Review Public Comments – East Brook

Review Public Comments – West Brook

Review Public Comments – Third Brook



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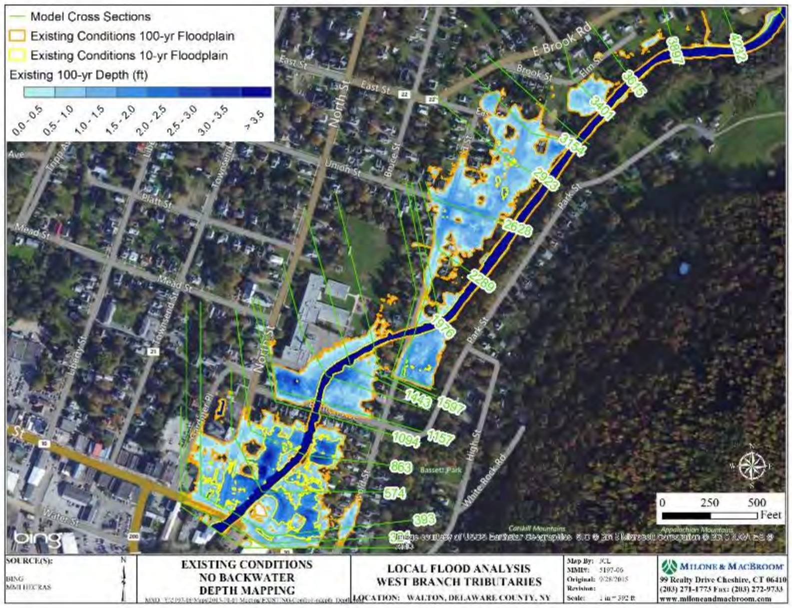
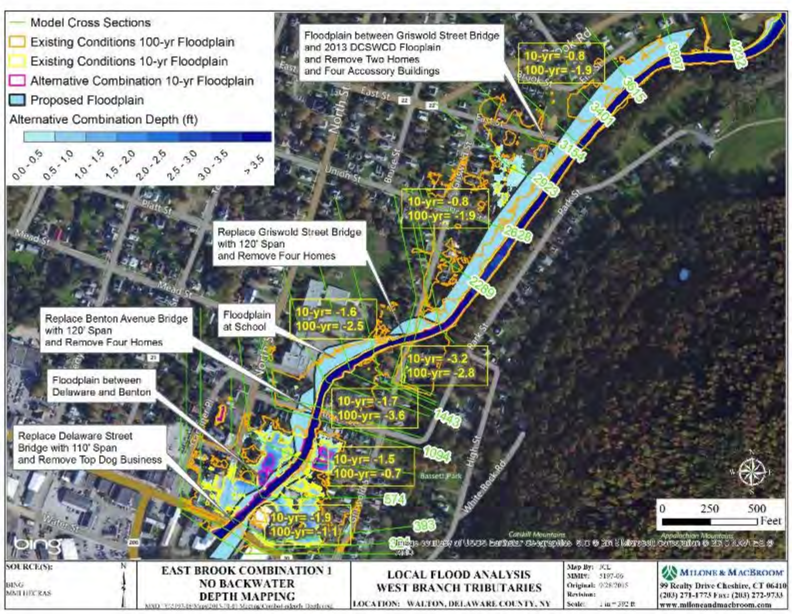
Existing Conditions along East Brook



Combination of Options along East Brook



East Brook Project Costs and Benefits

Project	Total Benefits	Total Costs
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Benton Ave bridge replacement (90') and remove 2 homes + floodplain at school (FP1)	$717,607	$2,347,000
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Benton Ave bridge replacement (120') and remove 4 homes + floodplain at school (FP1)	$1,065,273	$2,306,000
Benton Ave bridge removal and no replacement	$488,906	$500,000
Benton Ave bridge removal and no replacement + floodplain at school (FP1)	$459,645	$682,131
Griswold Street bridge replacement (includes 2 homes removed)	$1,687,757	$3,275,000
Griswold Street bridge replacement and upstream floodplain (FP3) (includes four homes removed)	$2,472,720	$4,421,000

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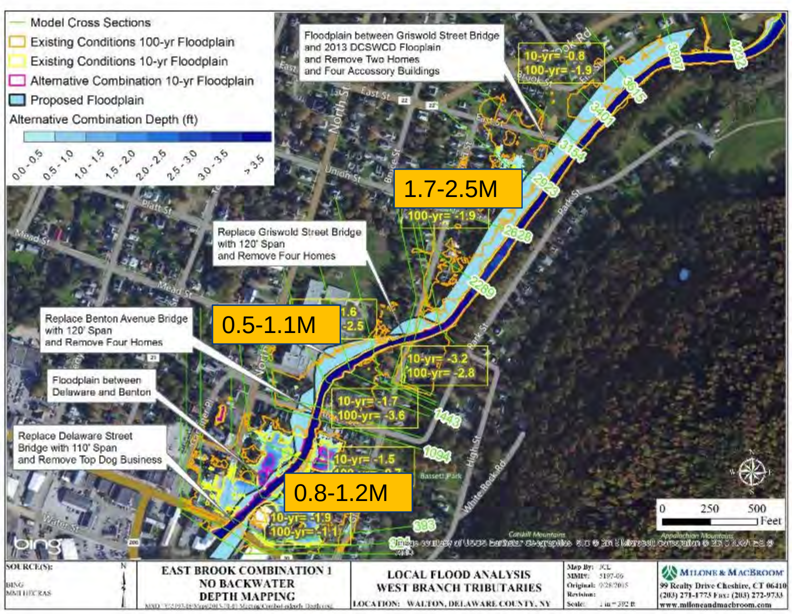
Total Benefits (Ranges) along East Brook



Agenda

- Water Cycle, Rivers, and Floodplains
- Local Flood Analysis (LFA) Goals, Outcomes, and Advisory Structure
- Review Public Comments from Summer 2015
- East Brook Flood Mitigation Options
- West Brook Flood Mitigation Options
- Third Brook Flood Mitigation Options
- Next Steps

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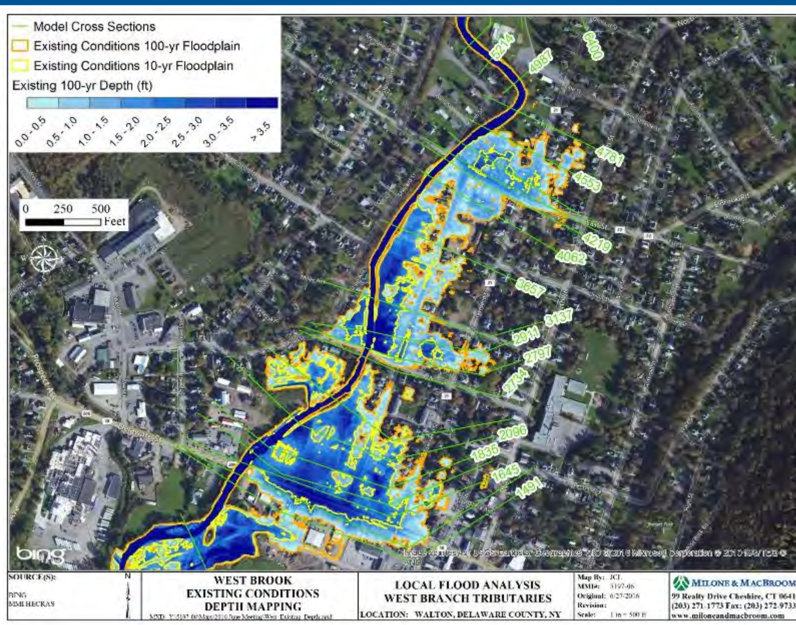
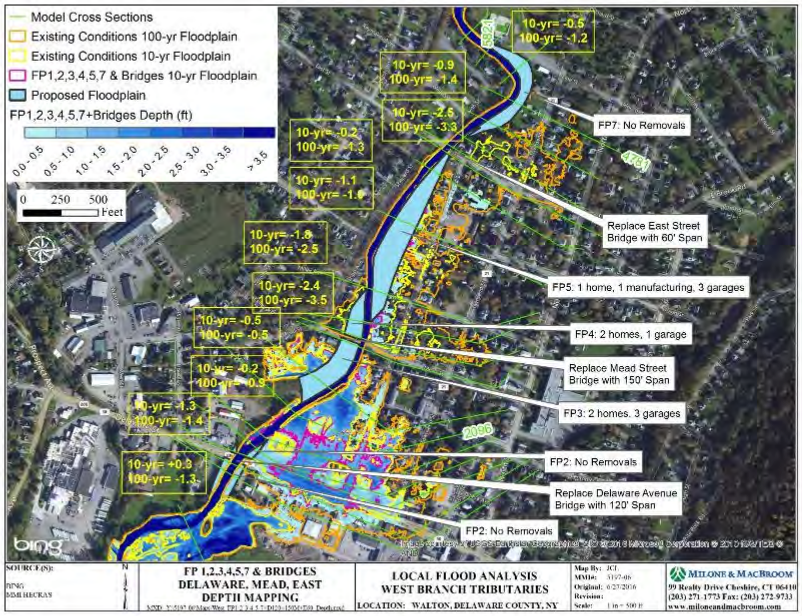
Existing Conditions along West Brook



Combination of Options along West Brook



West Brook Project Costs and Benefits

Project	Total Benefits	Total Costs
Floodplain Downstream of Delaware St (FP1)	$3,142,179	$102,000
Floodplains Downstream and Upstream of Delaware St, (FP 1+2) and Replace Delaware St Bridge	$4,111,265	$2,882,000
Floodplains Upstream and Downstream of Mead St (FP 3 + 4) and Replace Mead St Bridge	$1,472,280	$3,156,000
Mead St Floodplains and Floodplain Between East St and Mead St (FP 3 + 4 + 5) and Replace Mead Street Bridge	$2,099,979	$4,009,000
Replace East Street Bridge	$648,347	$1,100,000
Floodplain between East Street and Park, and replace East Street Bridge	$657,894	$1,207,000

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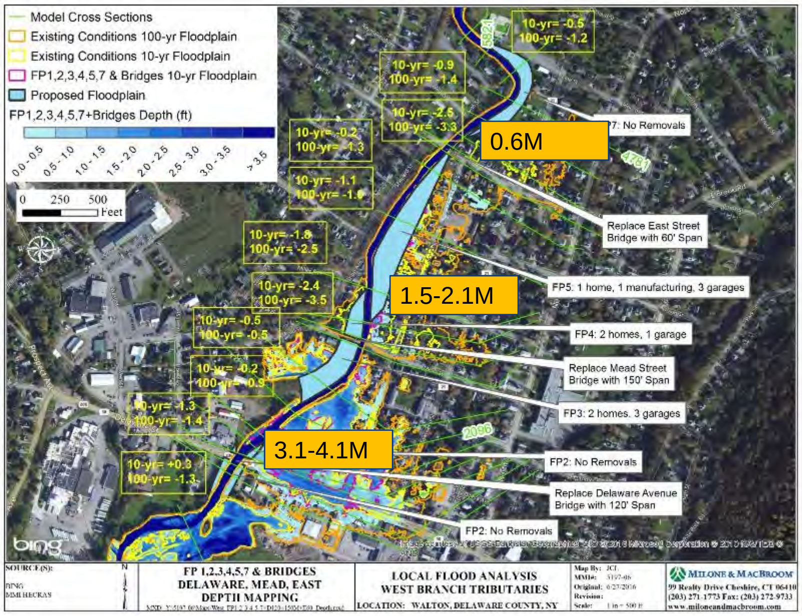
Total Benefits (Ranges) along West Brook



Agenda

- Water Cycle, Rivers, and Floodplains
- Local Flood Analysis (LFA) Goals, Outcomes, and Advisory Structure
- Review Public Comments from Summer 2015
- East Brook Flood Mitigation Options
- West Brook Flood Mitigation Options
- Third Brook Flood Mitigation Options
- Next Steps

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Third Brook Existing Depth Map

Third Brook- Floodplain Alternative

Third Brook Project Costs and Benefits

Project	Total Benefits	Total Costs
Lower floodplain project (behind Klinger)	?	$231,000
Middle floodplain project (along Del-Ton)		$322,000
Upper floodplain project (behind Neale)		$109,000
All floodplains plus both bridges		$2,862,000
Delaware Street bridge replacement		$1,100,000
Ogden Street bridge replacement		$1,100,000

Benefits are difficult to calculate because damage is caused by only the most severe floods

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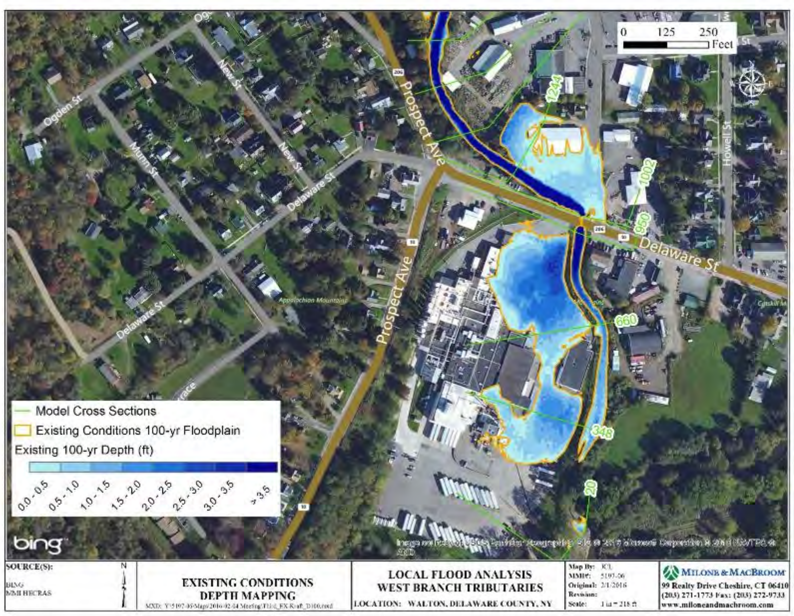
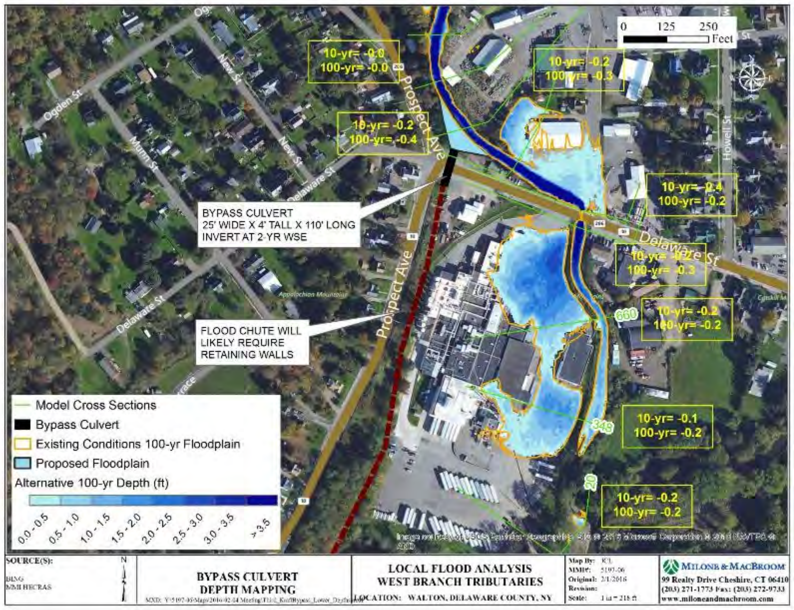
Existing Conditions at Kraft



Bypass Culvert at Kraft



Kraft Bypass

- Results:
  - 100-yr flood causes ~100 cfs to leave the channel, or ~10% of the flood discharge
  - 2006 flood causes ~190 cfs to leave the channel, or ~11% of the flood discharge
- Note there is not much space behind the Kraft building and the bypass would likely require retaining walls along the road in order to fit

Agenda

- Water Cycle, Rivers, and Floodplains
- Local Flood Analysis (LFA) Goals, Outcomes, and Advisory Structure
- Review Public Comments from Summer 2015
- East Brook Flood Mitigation Options
- West Brook Flood Mitigation Options
- Third Brook Flood Mitigation Options
- Next Steps

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Next Steps

- Incorporate Feedback
- Complete Draft LFA Report
- Present the LFA Report
- Apply for Project Design and Construction Funds

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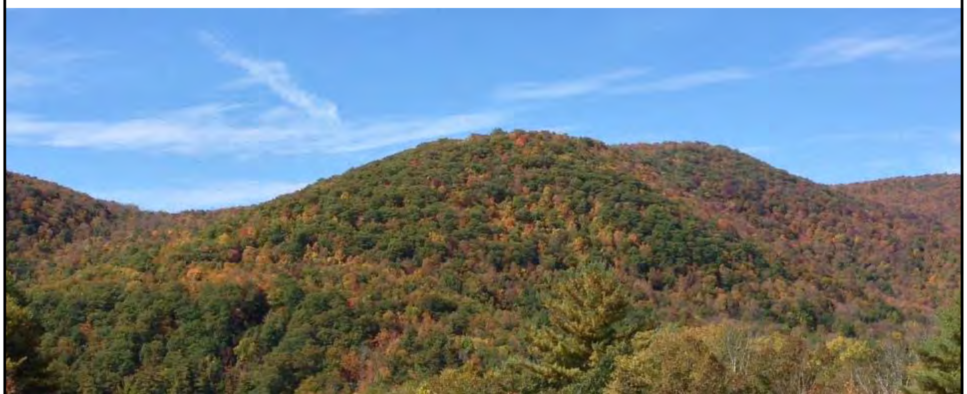
Questions, Comments, or Thoughts?



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Local Flood Analysis
Public Meeting
West Branch Tributaries

Walton Flood Commission and Village and Town of Walton

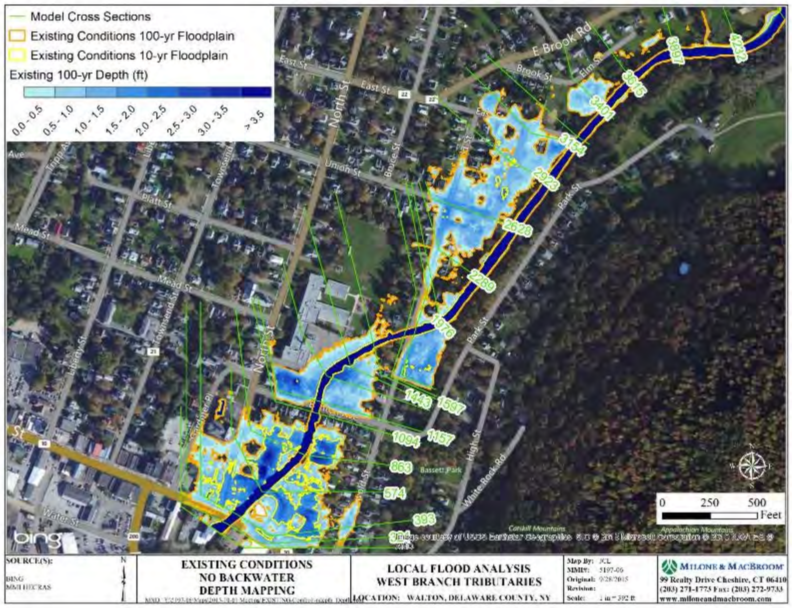
David Murphy, P.E., CFM

Delaware County Soil & Water Conservation District | October 5, 2017

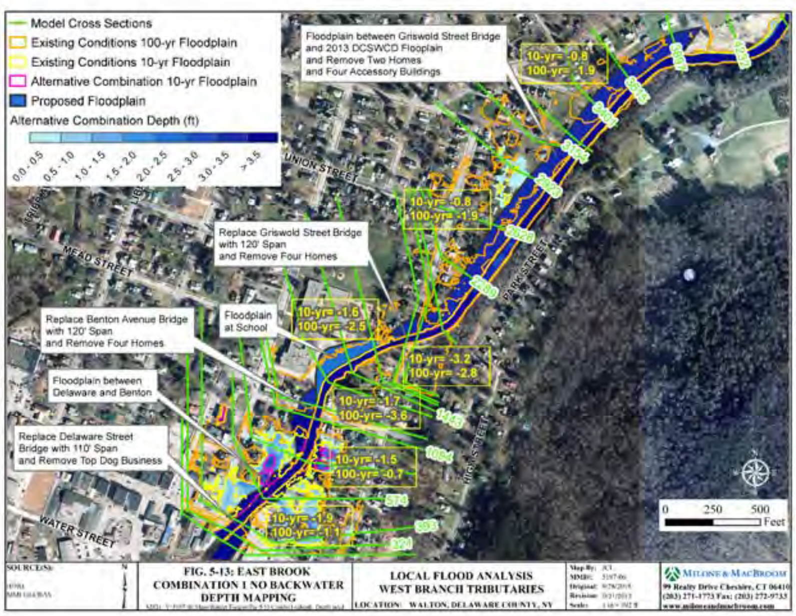
Agenda

- East Brook Alternatives and BCA
- West Brook Alternatives and BCA
- Third Brook Alternatives and BCA
- Recommendations

Existing Conditions along East Brook



Combination of Options along East Brook



East Brook Acquisitions/Relocations

Alt.	Description	Potential Property Acquisitions / Relocations	Individual Property Acquisition Benefits	Total Building Acquisition Benefits
1	Delaware Street bridge replacement and remove one business	2 North Street	$172,245	$172,245
2	Delaware Street bridge replacement and floodplain bench (FP4)	10-12 Benton Avenue	$146,077	$461,978
		14 Benton Avenue	$143,656	
		2 North Street	$172,245	
3	Benton Ave bridge replacement (90') and remove 2 homes	13 Benton Avenue	$151,030	$294,686
		14 Benton Avenue	$143,656	
4	Benton Ave bridge replacement (90') and remove 2 homes + floodplain at school (FP1)	13 Benton Avenue	$151,030	$294,686
		14 Benton Avenue	$143,656	
5	Benton Ave bridge replacement (120') and remove 4 homes	10-12 Benton Avenue	$146,077	$590,908
		11 Benton Avenue	$150,145	
		13 Benton Avenue	$151,030	
		14 Benton Avenue	$143,656	
6	Benton Ave bridge replacement (120') and remove 4 homes + floodplain at school (FP1)	10-12 Benton Avenue	$146,077	$590,908
		11 Benton Avenue	$150,145	
		13 Benton Avenue	$151,030	
		14 Benton Avenue	$143,656	
7	Benton Ave bridge removal and no replacement	None	None	None
8	Benton Ave bridge removal and no replacement + floodplain at school (FP1)	None	None	None
9	Griswold Street bridge replacement (includes 2 homes removed)	53 Griswold Street	$229,371	$377,918
		60 Griswold Street	$148,547	
10	Griswold Street bridge replacement and upstream floodplain (FP3) (includes four homes removed)	53 Griswold Street	$229,371	$1,064,441
		60 Griswold Street	$148,547	
		8 Elm Street	$544,811	
		14 East Street	$141,712	

East Brook Infrastructure Benefits

- Damage Frequency Analysis (DFA) was used to calculate infrastructure benefits using historical damages
- Calculates benefits due to reduction in damaged utilities, reduced repair costs, and reduced detour trips
- DFA was used at:
  - Griswold Street
  - Benton Avenue
  - Delaware Street

East Brook Revenue Figures

- Revenue losses were included for the businesses below
- Daily revenue figures were determined by dividing the revenue lost after the 2006 flood by the number of days each business was shut down
- Closure of seven days was assumed, except for businesses that provided longer durations of shut-downs

Business	Number of Days of Closure	2006 Lost Revenue	Business	Number of Days of Closure	2006 Lost Revenue
Napa Auto	7	$25,000	**Magic Car Wash (Top Dog)**	30	$8,000
McAdams Lawnmower	120	$100,000	**Karate (Yarnover)**	60	$5,000
Jewelry and Frame Shop	60	$4,000	**Walton Liquor**	21	$50,000

East Brook Summary of Benefits

Alt.	Description	Building Acquisition Benefits	Benefits from Water Surface Reductions at Buildings that Remain	Infrastructure Benefits	Total Benefits
1	Delaware Street bridge replacement and remove one business	$172,245	$737,687	$100,773	$1,011,000
2	Delaware Street bridge replacement and floodplain bench (FP4)	$461,978	$724,309	$100,773	$1,287,000
3	Benton Ave bridge replacement (90') and remove 2 homes	$294,686	$371,539	$23,033	$689,000
4	Benton Ave bridge replacement (90') and remove 2 homes + floodplain at school (FP1)	$294,686	$399,888	$23,033	$718,000
5	Benton Ave bridge replacement (120') and remove 4 homes	$590,908	$445,405	$23,033	$1,059,000
6	Benton Ave bridge replacement (120') and remove 4 homes + floodplain at school (FP1)	$590,908	$451,332	$23,033	$1,065,000
7	Benton Ave bridge removal and no replacement	None	$465,031	$23,875	$489,000
8	Benton Ave bridge removal and no replacement + floodplain at school (FP1)	None	$435,770	$23,875	$460,000
9	Griswold Street bridge replacement (includes 2 homes removed)	$377,918	$1,237,799	$72,040	$1,688,000
10	Griswold Street bridge replacement and upstream floodplain (FP3) (includes four homes removed)	$1,064,441	$1,336,239	$72,040	$2,473,000

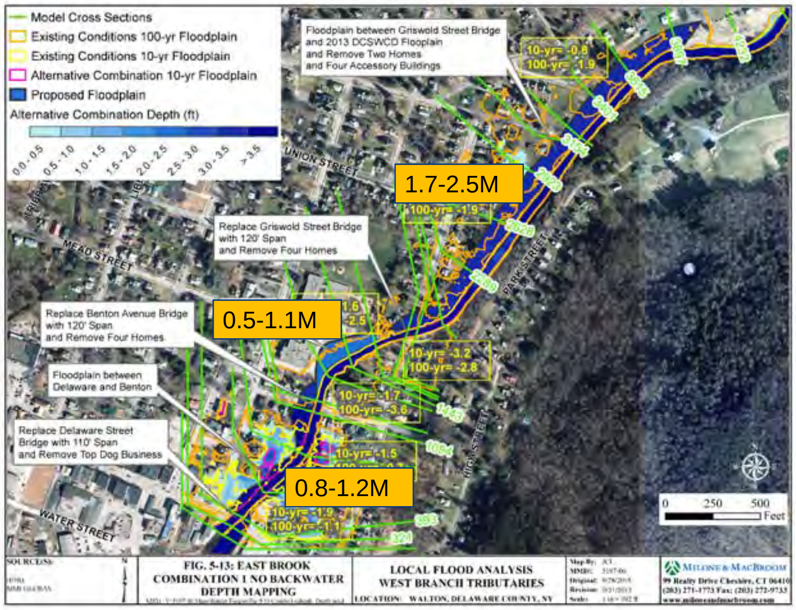
East Brook Summary of Costs

	Alternative	Partial Cost Estimate
1	Delaware Street bridge replacement	$2,550,000
	Excavation	$94,000
	Remove Top Dog business	$204,000
2	Delaware Street bridge replacement	$2,550,000
	Floodplain bench (FP4)	$311,000
	Remove 3 homes	$456,000
3	Benton Ave bridge replacement (90')	$1,850,000
	Remove 2 homes	$239,000
	Excavation	$76,000
4	Benton Ave bridge replacement (90')	$1,850,000
	Remove 2 homes	$239,000
	Floodplain bench at school (FP1)	$258,000
5	Benton Ave bridge replacement (120')	$1,850,000
	Remove 4 homes	$479,000
	Excavation	$147,000
6	Benton Ave bridge replacement (120')	$1,850,000
	Remove 4 homes	$479,000
	Floodplain at school (FP1)	$329,000
7	Benton Ave bridge removal and no replacement	$500,000
8	Benton Ave bridge removal and no replacement	$500,000
	Floodplain at school (FP1)	$182,000
9	Griswold Street bridge replacement	$2,750,000
	Remove 2 homes	$385,000
	Excavation	$140,000
10	Griswold Street bridge replacement	$2,750,000
	Remove 4 homes	$656,000
	Upstream floodplain (FP3)	$1,015,000

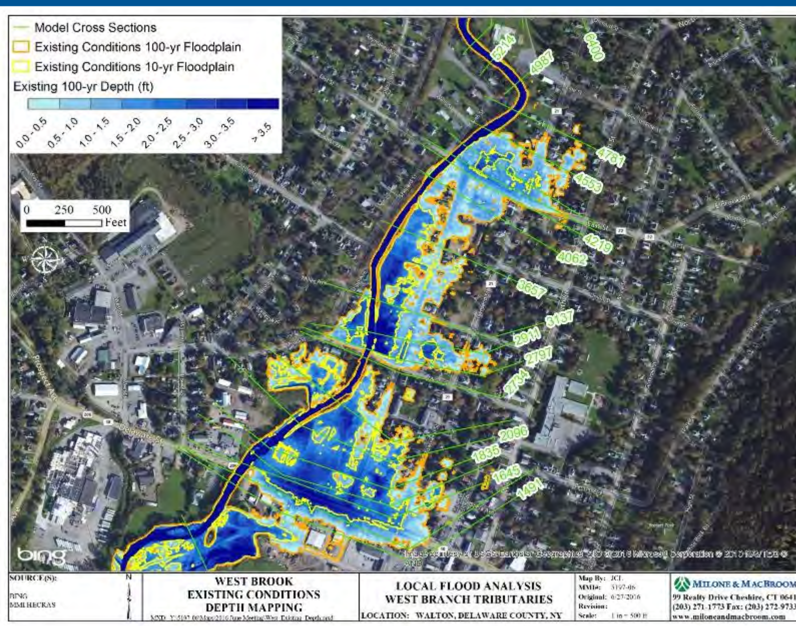
East Brook Project Costs and Benefits

Alt.	Description	Total Benefits	Total Cost	BCR
1	Delaware Street bridge replacement and removal of one business	$1,011,000	$2,848,000	0.35
2	Delaware Street bridge replacement and floodplain bench (FP4)	$1,287,000	$3,317,000	0.39
3	Benton Ave bridge replacement (90') and remove 2 homes	$689,000	$2,165,000	0.32
4	Benton Ave bridge replacement (90') and remove 2 homes + floodplain at school (FP1)	$718,000	$2,347,000	0.31
5	Benton Ave bridge replacement (120') and remove 4 homes	$1,059,000	$2,476,000	0.43
6	Benton Ave bridge replacement (120') and remove 4 homes + floodplain at school (FP1)	$1,065,000	$2,658,000	0.40
7	Benton Ave bridge removal and no replacement	$489,000	$500,000	0.98
8	Benton Ave bridge removal and no replacement + floodplain at school (FP1)	$460,000	$682,000	0.67
9	Griswold Street bridge replacement (includes 2 homes removed)	$1,688,000	$3,275,000	0.52
10	Griswold Street bridge replacement and upstream floodplain (FP3) (includes four homes removed)	$2,473,000	$4,421,000	0.56

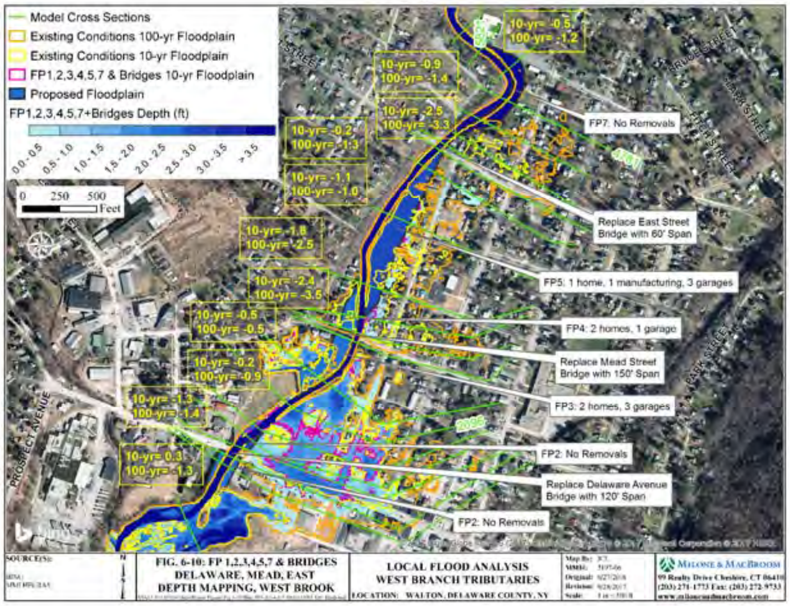
Total Benefits (Ranges) along East Brook



Existing Conditions along West Brook



Combination of Options along West Brook



West Brook Acquisitions/Relocations

Alt.	Description	Potential Property Acquisitions / Relocations	Individual Property Acquisition Benefits	Total Building Acquisition Benefits
1	Floodplain Downstream of Delaware Street (FP1)	None	None	None
2	Floodplains Downstream and Upstream of Delaware Street, (FP 1+2) and Replace Delaware Street Bridge	None	None	None
3	Floodplains Upstream and Downstream of Mead Street (FP 3+4) and Replace Mead Street Bridge	48 Mead Street	$276,804	$1,095,234
		46 Mead Street	$219,105	
		49 Mead Street	$388,912	
		45 Mead Street	$210,413	
4	Mead Street Floodplains and Floodplain Between East Street and Mead Street (FP 3+4+5) and Replace Mead Street Bridge	48 Mead Street	$276,804	$1,586,670
		46 Mead Street	$219,105	
		49 Mead Street	$388,912	
		45 Mead Street	$210,413	
		53 Liberty Street	$491,436	
5	Replace East Street Bridge	None	None	None
7	Floodplain between East Street and park, and Replace East Street Bridge	None	None	None

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West Brook Infrastructure Benefits

- Damage Frequency Analysis (DFA) was used to calculate infrastructure benefits due to reduction in damaged utilities, reduced repair costs, and reduced detour trips
- DFA was used at:
  - East Street
  - Mead Street
  - Delaware Street

West Brook Revenue Figures

- On West Brook, only Big M provided annual revenue figures
- Big M Supermarket reported annual budget of $14,407,895
- The annual budget was used in the benefit calculations for Big M

West Brook Summary of Benefits

Alt.	Description	Building Acquisition Benefits	Benefits from Water Surface Reductions at Buildings that Remain	Infrastructure Benefits	Total Benefits
1	Floodplain Downstream of Delaware Street (FP1)	None	$3,142,179	None	$3,142,000
2	Floodplains Downstream and Upstream of Delaware Street, (FP 1+2) and Replace Delaware Street Bridge	None	$3,404,750	$706,515	$4,111,000
3	Floodplains Upstream and Downstream of Mead Street (FP 3+4) and Replace Mead Street Bridge	$1,095,234	$181,075	$195,971	$1,472,000
4	Mead Street Floodplains and Floodplain Between East Street and Mead Street (FP 3+4+5) and Replace Mead Street Bridge	$1,586,670	$317,338	$195,971	$2,100,000
5	Replace East Street Bridge	None	$262,782	$385,565	$648,000
7	Floodplain between East Street and park, and Replace East Street Bridge	None	$272,329	$385,565	$658,000

West Brook Summary of Costs

Alternative		Partial Cost Estimate
1	Floodplain Downstream of Delaware Street (FP1)	$102,000
2	Replace Delaware Street Bridge	$2,750,000
	Floodplains downstream of Delaware Street (FP 1+2)	$132,000
3	Replace Mead Street Bridge	$2,300,000
	Floodplains Upstream and Downstream of Mead Street (FP 3+4)	$334,000
	Remove 4 homes	$522,000
4	Replace Mead Street Bridge	$2,300,000
	Mead Street Floodplains and Floodplain between East Street and Mead Street (FP 3+4+5)	$761,000
	Remove 5 homes and 3 garages	$948,000
5	Replace East Street Bridge	$1,100,000
7	Replace East Street Bridge	$1,100,000
	Floodplain between East Street and park (FP 7)	$107,000

West Brook Project Costs and Benefits

Alt.	Description	Total Benefits	Total Cost	BCR
1	Floodplain Downstream of Delaware Street (FP1)	$3,142,000	$102,000	30.80
2	Floodplains Downstream and Upstream of Delaware Street, (FP 1+2) and Replace Delaware Street Bridge	$4,111,000	$2,882,000	1.43
3	Floodplains Upstream and Downstream of Mead Street (FP 3+4) and Replace Mead Street Bridge	$1,472,000	$3,156,000	0.47
4	Mead Street Floodplains and Floodplain Between East Street and Mead Street (FP 3+4+5) and Replace Mead Street Bridge	$2,100,000	$4,009,000	0.52
5	Replace East Street Bridge	$648,000	$1,100,000	0.59
7	Floodplain between East Street and park, and Replace East Street Bridge	$658,000	$1,207,000	0.55

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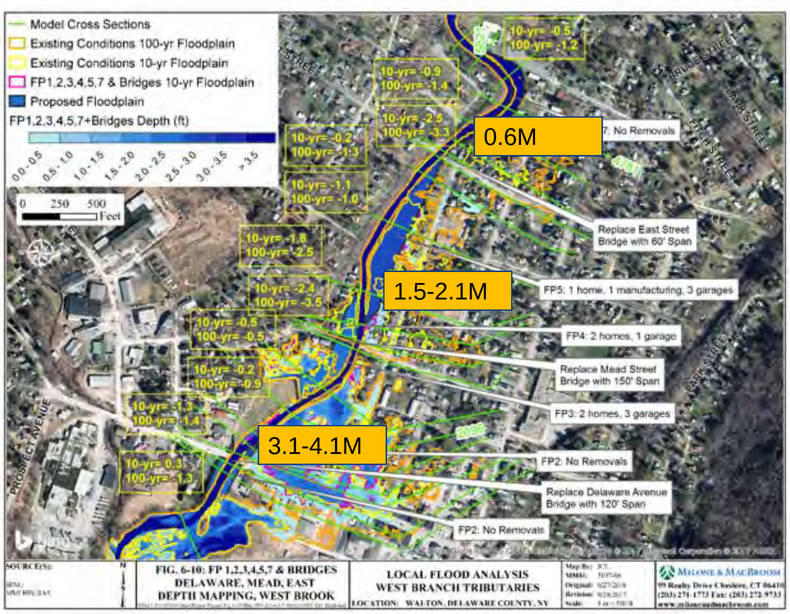
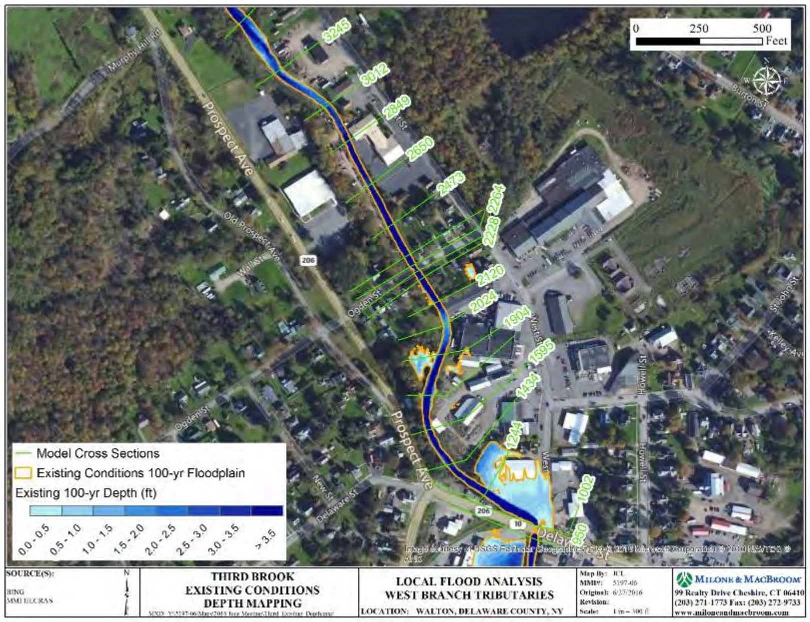
Total Benefits (Ranges) along West Brook



Third Brook Existing Depth Map



Third Brook- Floodplain Alternative

Third Brook Project Costs and Benefits

Alternative		Partial Cost Estimate	Total Cost
1	Lower floodplain behind Klinger	$221,000	$662,000
	Remove garages	$10,000	
	Middle floodplain along Del-Ton	$312,000	
	Remove garages	$10,000	
	Upper floodplain project behind Neale	$99,000	
	Remove garages	$10,000	
2	Delaware Street bridge replacement	$1,100,000	$2,862,000
	Ogden Street bridge replacement	$1,100,000	
	Upper, middle and lower floodplains	$632,000	
	Remove garages	$30,000	

Benefits are difficult to calculate because damage is caused by only the most severe floods

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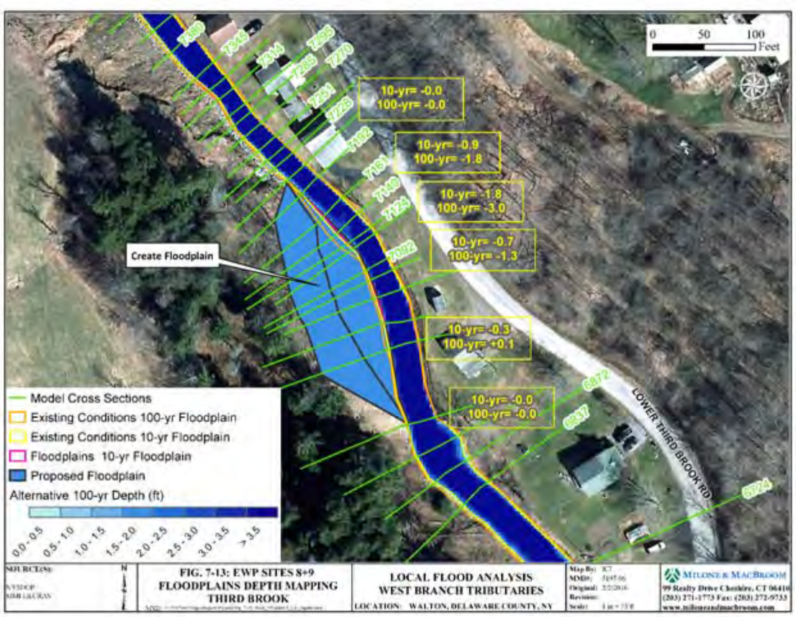
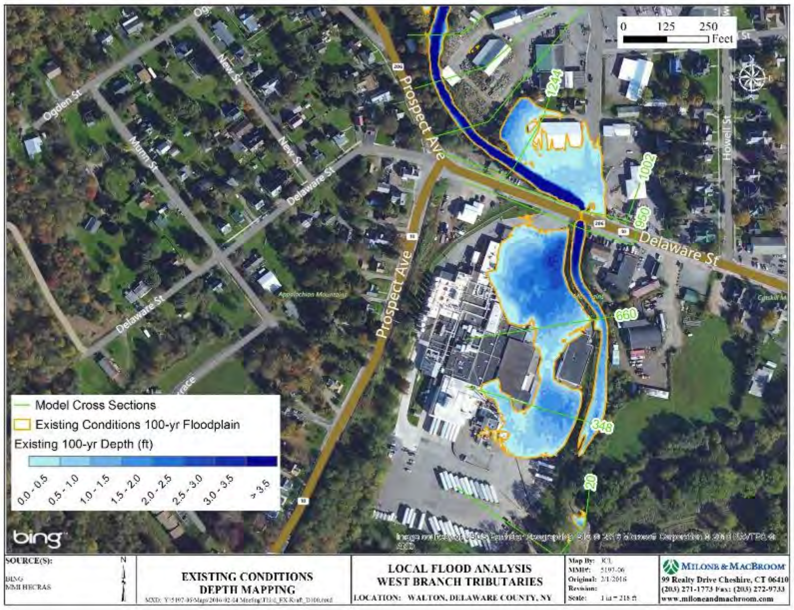
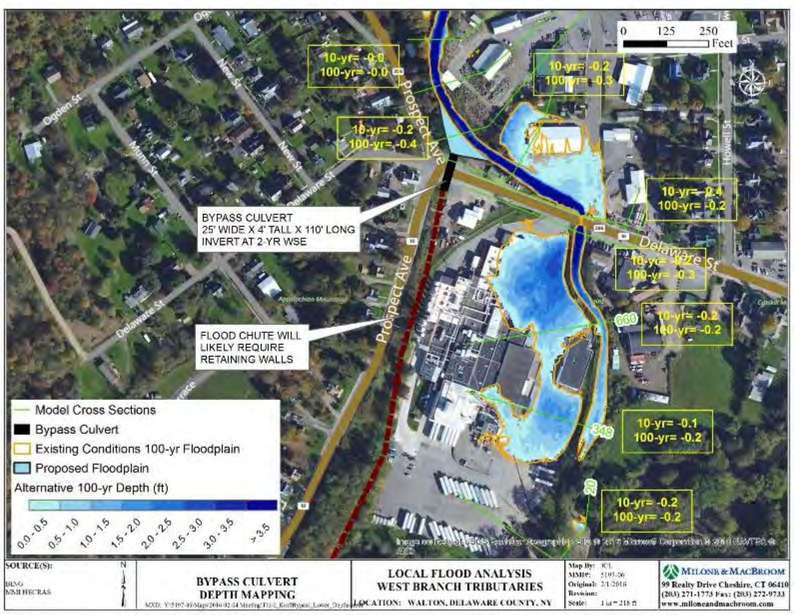
EWP 8-9 Depth Map



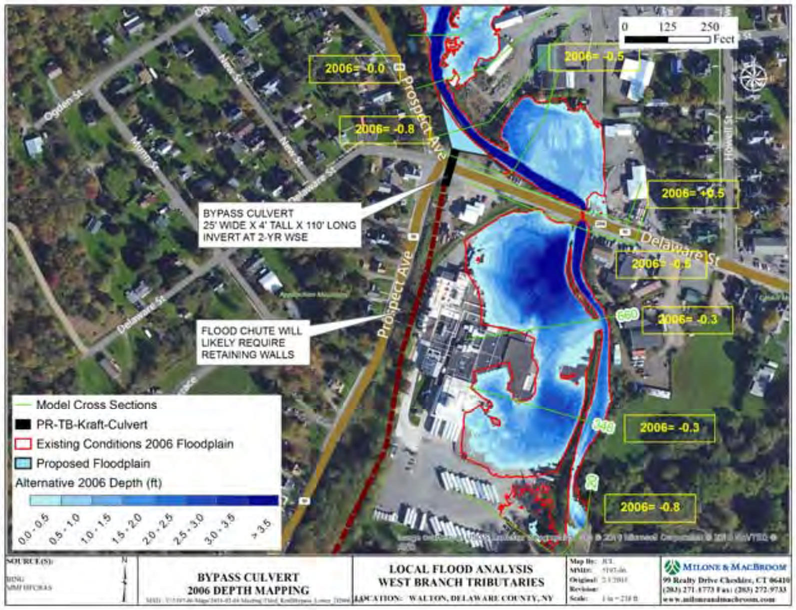
Existing Conditions at Kraft



Bypass Culvert at Kraft



Bypass Culvert at Kraft – 2006 Flood



Kraft Bypass

- Results:
  - 100-yr flood causes ~100 cfs to leave the channel, or ~10% of the flood discharge
  - 2006 flood causes ~190 cfs to leave the channel, or ~11% of the flood discharge
- Note there is not much space behind the Kraft building and the bypass would likely require retaining walls along the road in order to fit

Recommendations

- Proceed with implementation of West Brook Alternatives 1 or 2 as funding allows
- Study the feasibility of East Brook Alternative 7 including the viability of not maintaining a crossing of the brook at Benton Avenue
- Re-instate the gauging station on East Brook
- Consider establishing some type of gauging station on West Brook
- Pursue floodproofing of commercial buildings in Walton
- Pursue elevation of homes on a case-by-case basis as property owners approach the Walton Flood Commission and/or the Village
- When opportunities arise for acquisitions where floodplain projects may be effective in the future, support these acquisitions
- Ensure that future bridge replacements incorporate larger openings to reduce flooding

APPENDIX B

COST ESTIMATES

EAST BROOK

COST ESTIMATES

Alt. 1: Delaware Street bridge replacement

Properties to be purchased

Address	**Value**	**Demolition costs**
2 North Street	$154,412	$50,000
Total:	$154,412	$50,000

Cost of bridge $2,550,000

Restoration (Floodplains)

Area to restore (SF)	19835
Topsoil cost ($25/CY), assume 0.5 ft topsoil	$9,183
Seedmix cost ($0.75/SF)	$14,876

Volume Calculations

XS	XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
Start of FP	0	57	8863.50
393	311	72	24984.00
321	383	62	23343.00
259	370	113	20905.00
End of FP	0		
		Total CF:	78095.50

Excavation costs ($4/CY)	$11,570
Export costs ($20/CY)	$57,849

Total Costs: $2,847,889

Alt. 2: FP4+Delaware Street bridge replacement

Properties to be purchased

Address		**Value**	**Demolition costs**
10-12 Benton Ave		$76,471	$50,000
14 Benton Ave		$75,118	$50,000
2 North Street		$154,412	$50,000
	Total:	$306,001	$150,000

Cost of bridge $2,550,000

Restoration (Floodplains)

Area to restore (SF)	72464
Topsoil cost ($25/CY), assume 0.5 ft topsoil	$33,548
Seedmix cost ($0.75/SF)	$54,348

Volume Calculations

XS	XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
1094.197	510	231	91438.30
863.2922	282	289	64788.04
574.0599	166	181	45473.82
392.8893	336	72	25827.56
320.5432	378	62	23163.80
258.6079	370		
		Total CF:	250691.52

Excavation costs ($4/CY)	$37,139
Export costs ($20/CY)	$185,697

Total Costs: $3,316,734

Alt. 3: 90' Benton Ave Bridge Replacement

Properties to be purchased

Address		**Value**	**Demolition costs**
13 Benton Ave		$63,603	$50,000
14 Benton Ave		$75,118	$50,000
	Total:	$138,721	$100,000

Cost of bridge	$1,850,000

Restoration (Floodplains)

Area to restore (SF)	16355
Topsoil cost ($25/CY), assume 0.5 ft topsoil	$7,572
Seedmix cost ($0.75/SF)	$12,266

Volume Calculations

XS	XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
1302.314	0	145	19430.13
1157.313	268	63	15999.91
1094.197	239	231	27593.12
863.2922	0		
		Total CF:	63023.16

Excavation costs ($4/CY)	$9,337
Export costs ($20/CY)	$46,684
Total Costs:	$2,164,580

Alt. 4: FP 1 +90' Benton Ave Bridge Replacement

Properties to be purchased

Address		**Value**	**Demolition costs**
13 Benton Ave		$63,603	$50,000
14 Benton Ave		$75,118	$50,000
	Total:	$138,721	$100,000

Cost of bridge $1,850,000

Restoration

Area to restore (SF)	56267
Topsoil cost ($25/CY), assume 0.5 ft topsoil	$26,050
Seedmix cost ($0.75/SF)	$42,200

Volume Calculations

XS	XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
1764.867	0	168	17423.224
1597.336	208	154	50523.48
1443.301	448	141	56676.774
1302.314	356	145	45240.31
1157.313	268	63	15999.91
1094.197	239	231	27593.12
863.2922	0		
		Total CF:	213456.8196

Excavation costs ($4/CY)	$31,623
Export costs ($20/CY)	$158,116
Total Costs:	$2,346,710

Alt. 5: 120' Benton Ave Bridge Replacement

Properties to be purchased

Address	**Value**		**Demolition costs**
13 Benton Ave		$63,603	$50,000
14 Benton Ave		$75,118	$50,000
11 Benton Ave		$63,603	$50,000
10-12 Benton Ave		$76,471	$50,000
	Total:	$278,795	$200,000

Cost of bridge	$1,850,000

Restoration

Area to restore (SF)	27288
Topsoil cost ($25/CY), assume 0.5 ft topsoil	$12,633
Seedmix cost ($0.75/SF)	$20,466

Volume Calculations

XS	XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
1302.314	0	145	36757.75
1157.313	507	63	32189.16
1094.197	513	231	59227.08
863.2922	0		
		Total CF:	128173.9947

Excavation costs ($4/CY)	$18,989
Export costs ($20/CY)	$94,944
Total Costs:	$2,475,827

Alt. 6: FP1+120' Benton Ave Bridge Replacement

Properties to be purchased

Address	**Value**	**Demolition costs**
13 Benton Ave	$63,603	$50,000
14 Benton Ave	$75,118	$50,000
11 Benton Ave	$63,603	$50,000
10-12 Benton Ave	$76,471	$50,000
Total:	$278,795	$200,000

Cost of bridge	$1,850,000

Restoration

Area to restore (SF)	67200
Topsoil cost ($25/CY), assume 0.5 ft topsoil	$31,111
Seedmix cost ($0.75/SF)	$50,400

Volume Calculations

XS	XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
1764.867	0	168	17423.22
1597.336	208	154	50523.48
1443.301	448	141	56676.77
1302.314	356	145	62567.93
1157.313	507	63	32189.16
1094.197	513	231	59227.08
863.2922	0		
		Total CF:	278607.7

Excavation costs ($4/CY)	$41,275
Export costs ($20/CY)	$206,376
Total Costs:	$2,657,957

Alt. 7: Benton Ave Bridge Removal

Cost of bridge removal	$500,000
Total Costs:	$500,000

Alt. 8: FP1+Benton Ave Bridge Removal

Properties to be purchased

Address	**Value**	**Demolition costs**
None		
Total:	$0	$0

Cost of bridge removal	$500,000

Restoration

Area to restore (SF)	39912
Topsoil cost ($25/CY), assume 0.5 ft topsoil	$18,478
Seedmix cost ($0.75/SF)	$29,934

Volume Calculations

XS	XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
1764.867	0	168	17423.22
1597.336	208	154	50523.48
1443.301	448	141	56676.77
1302.314	356	145	25810.18
1157.313	0		
		Total CF:	150433.7

Excavation costs ($4/CY)	$22,286
Export costs ($20/CY)	$111,432
Total Costs:	$682,131

Alt. 9: Griswold Street Bridge Replacement

Properties to be purchased

Address	Value	Demolition costs
53 Griswold Street	$147,452	$50,000
60 Griswold Street	$137,426	$50,000
Total:	$284,878	$100,000

Cost of bridge	$2,750,000

Restoration

Area to restore (SF)	18680
Topsoil cost ($25/CY), assume 0.5 ft topsoil	$8,648
Seedmix cost ($0.75/SF)	$14,010

Volume Calculations

XS	XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
1975.495	0	159	48872.65
1816.041	613	51	31548.77
1764.867	620	168	51934.61
1597.336	0		
		Total CF:	132356

Excavation costs ($4/CY)	$19,608
Export costs ($20/CY)	$98,042
Total Costs:	$3,275,186

Alt. 10: FP3 + Griswold Street Bridge Replacement

Properties to be purchased

Address	**Value**	**Demolition costs**
60 Griswold Street	$137,426	$50,000
14 East Street	$85,088	$50,000
8 Elm Street	$86,441	$50,000
53 Griswold Street	$147,452	$50,000
Total:	$456,407	$200,000

Cost of bridge	$2,750,000

Restoration

Area to restore (SF)	229200
Topsoil cost ($25/CY), assume 0.5 ft topsoil	$106,111
Seedmix cost ($0.75/SF)	$171,900

Volume Calculations

XS	XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
3896.515	215	282	63819.093
3614.753	238	214	54630.18
3400.517	272	198	74089.875
3202.944	478	49	24792.154
3153.508	525	230	81288.06275
2923.067	180.5	296	93164.5715
2627.541	450	338	144006.744
2289.497	402	314	127798.814
1975.495	412	159	81640.448
1816.041	612	51	31523.184
1764.867	620	168	51934.61
1597.336	0		
		Total CF:	828687.7363

Excavation costs ($4/CY)	$122,769
Export costs ($20/CY)	$613,843
Total Costs:	$4,421,029

WEST BROOK

COST ESTIMATES

Alt. 1: FP-1

Properties to be purchased

Address	**Value**	**Demolition costs**
None		
Total:	$0	$0

Restoration (Floodplains)

Area to restore (SF)	23748
Topsoil cost ($25/CY), assume 0.5 ft topsoil	$10,994
Seedmix cost ($0.75/SF)	$17,811

Volume Calculations

XS	XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
1559.124	339	68	20706
1490.963	270	230	62100
End of floodplain	270	0	
		Total CF:	82806

Excavation costs ($4/CY)	$12,268
Export costs ($20/CY)	$61,338
Total Costs:	$102,411

Alt. 2: FP-1 + 2 + Delaware Street Bridge Replacement

Properties to be purchased

Address	**Value**	**Demolition costs**
None		
Total:	$0	$0

Cost of bridge	$2,750,000

Restoration (Floodplains)

Area to restore (SF)	30165
Topsoil cost ($25/CY), assume 0.5 ft topsoil	$13,965
Seedmix cost ($0.75/SF)	$22,624

Volume Calculations

FP-1

XS	XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
1559.124	339	68	20706
1490.963	270	230	62100
	270	0	

FP-2

XS	XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
1835.467	0	94	3290
1741.981	70	97	20806.5
1644.658	359		
		Total CF:	106902.5

Excavation costs ($4/CY)	$15,837
Export costs ($20/CY)	$79,187
Total Costs:	$2,881,613

Alt 3: FP 3 + 4 + Mead St Bridge Replacement

Properties to be purchased

Address	**Value**		**Demolition costs**
48 Mead Street		$87,985	$50,000
46 Mead Street		$69,779	$50,000
49 Mead Street		$71,669	$50,000
45 Mead Street		$92,941	$50,000
	Total:	$322,374	$200,000

Cost of bridge	$2,300,000

Restoration

Area to restore (SF)	97078
Topsoil cost ($25/CY), assume 0.5 ft topsoil	$44,944
Seedmix cost ($0.75/SF)	$72,809

Volume Calculations
FP-3+4

XS		XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
	3136.622	0	226	45087
	2910.536	399	113	51415
	2797.185	511	63	32161.5
	2733.917	510	350	107100
	2384.009	102	140	7140
End of floodplain		0		
			Total CF:	242903.5

Excavation costs ($4/CY)	$35,986
Export costs ($20/CY)	$179,929
Total Costs:	$3,156,040

Alt 4: FP 3 + 4 + 5 + Mead St Bridge Replacement

Properties to be purchased

Address	**Value**	**Demolition costs**
48 Mead Street	$87,985	$50,000
46 Mead Street	$69,779	$50,000
49 Mead Street	$71,669	$50,000
45 Mead Street	$92,941	$50,000
53 Liberty Street	$255,147	$50,000
85 Liberty Street (Garage)	$30,000	$10,000
81 Liberty Street (Garage)	$30,000	$10,000
69 Liberty Street (Garage)	$30,000	$10,000
Total:	$667,521	$280,000

Cost of bridge	$2,300,000

Restoration

Area to restore (SF)	244178
Topsoil cost ($25/CY), assume 0.5 ft topsoil	$113,045
Seedmix cost ($0.75/SF)	$183,134

Volume Calculations

XS	XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
4218.838	0	157	17898
4061.811	228	408	89760
3656.573	212	517	136746.5
3136.622	317	226	80908
2910.536	399	113	51415
2797.185	511	63	32161.5
2733.917	510	350	107100
2384.009	102	140	7140
End of floodplain	0		
		Total CF:	523129

Excavation costs ($4/CY)	$77,501
Export costs ($20/CY)	$387,503
Total Costs:	$4,008,703

Alt. 5: East Street Bridge Replacement

Properties to be purchased

Address		**Value**	**Demolition costs**
None			
	Total:	$0	$0

Cost of bridge	$1,100,000
Total Costs:	$1,100,000

Alt 7: FP-7 + East Street Bridge Replacement

Properties to be purchased

Address	**Value**	**Demolition costs**
None		
Total:	$0	$0

Cost of bridge	$1,100,000

Restoration

Area to restore (SF)	66934
Topsoil cost ($25/CY), assume 0.5 ft topsoil	$30,988
Seedmix cost ($0.75/SF)	$50,201

Volume Calculations

XS	XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
5213.537	0	227	73434.5
4986.937	647	206	106193
4780.62	384	227	101242
4553.368	508	183	60390
4370.657	152	100	17650
4270.313	201	51	11016
4219	231		
		Total CF:	28666

Excavation costs ($4/CY)	$4,247
Export costs ($20/CY)	$21,234
Total Costs:	$1,206,669

THIRD BROOK

COST ESTIMATES

Alt. 1: Third Brook Floodplains

Properties to be purchased

Address	**Value**	**Demolition costs**
Only garages acquired		$30,000
Total:	$0	$30,000

Restoration (Floodplains)

Area to restore (SF)	131099
Topsoil cost ($25/CY), assume 0.5 ft topsoil	$60,694
Seedmix cost ($0.75/SF)	$98,324

Volume Calculations

Upper FP

XS		XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
Start of FP		0	172	30186
	3245	351	233	49512.5
	3012	74		

Middle FP

XS		XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
Start of FP		0	48	2976
	3012	124	163	36919.5
	2849	329	199	50844.5
	2650	182	177	35842.5
	2473	223	137	30482.5
	2336	222	43	10083.5
	2293	247	29	6539.5
	2264	204	36	5274
	2228	89	108	9126
	2120	80	96	16368
	2024	261	120	28980
	1904	222	172	22188
	1732	36		

Lower FP

XS		XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
Start of FP		0	146	16133
	1732	221	137	40209.5
	1595	366	161	77843.5
	1434	601	190	62130
	1244	53		
			Total CF:	531638.50

Excavation costs ($4/CY)	$78,761
Export costs ($20/CY)	$393,806
Total Costs:	$661,586

Alt. 2: Third Brook Floodplains + Ogden Street Bridge Replacement (50') + Delaware Street Bridge Replacement (50')

Properties to be purchased

Address	**Value**	**Demolition costs**
Only garages acquired		$30,000
Total:	$0	$30,000
	Acquisition costs =	$30,000

Cost of Delaware Street Bridge Replacement	$1,100,000
Cost of Ogden Street Bridge Replacement	$1,100,000

Restoration (Floodplains)

Area to restore (SF)	131099
Topsoil cost ($25/CY), assume 0.5 ft topsoil	$60,694
Seedmix cost ($0.75/SF)	$98,324

Volume Calculations

Upper FP

XS	XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
Start of FP	0	172	30186
3245	351	233	49512.5
3012	74		

Middle FP

XS	XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
Start of FP	0	48	2976
3012	124	163	36919.5
2849	329	199	50844.5
2650	182	177	35842.5
2473	223	137	30482.5
2336	222	43	10083.5
2293	247	29	6539.5
2264	204	36	5274
2228	89	108	9126
2120	80	96	16368
2024	261	120	28980
1904	222	172	22188
1732	36		

Lower FP

XS	XS Area Removed (SF)	Dist to next XS (FT)	Volume (CF)
Start of FP	0	146	16133
1732	221	137	40209.5
1595	366	161	77843.5
1434	601	190	62130
1244	53		
		Total CF:	531638.50

Excavation costs ($4/CY)	$78,761
Export costs ($20/CY)	$393,806
Total Costs:	$2,861,586

APPENDIX C

STREAM WALKTHROUGH NOTES

Charlie's Notes from
West Brook Landowner Walkthrough
3 Jun3 2017

1. (Bill Rathmell) Why not lower the level of Austin Lincoln field so the water collects there?

2. (Bill Rathmell) "Sam (Swart) lost 30' of yard because they wouldn't put in a wall"

3. (Bill Rathmell) "They took good top soil and sole it to Earl Sines, and replaced it with clay"

4. (Bill Rathmell) The village was supposed to maintain the wall and adjacent areas, but they didn't.

5. (Sam Swart) They used the wrong type of rock in repairing the stream. They used what they call "pencil rock"

6. Bridges are a big part of the challenge but could take many years to replace since they are so expensive

7. (Bill Rathmell) The width of West Brook went from 28ft when they first repaired it to about 11ft now. They need to maintain the brook!

8. (Sam Swart) The rocks along the stream are secured with steel pins, but steel rusts

9. (Sam Swart) No inspections have been done on the wall

10. (Bill Rathmell) Originally, they wanted to make the wall 2ft lower than it is now

11. (Bill Rathmell) They didn't put down cloth under the rocks until he complained about it. that is why thee are so many trees & bushes growing up between them

12. (Bill Rathmell) Consider taking out the East Street bridge

West Brook Landowner Walkthrough
June 3, 2017 10:00Am

Attendance -= 16

<u>Comments:</u>

1) Why can't we dig the streams deeper?
2) William Rathmell – Can we do some mitigation project at the Austin Lincoln Park by the bridge? The bridge plugged up with debris which sent the water to Townsend Street. William witnessed the water coming in this direction during the 2006 flood.
3) William Rathmell – EWP project is not what was promised when they proposed the project. They said that our properties would be back to normal. The topsoil from the project was sold to Earl Sines and they placed clay material as fill instead. It took a lot of effort to get the grass to grow.
4) Sam Swart – The EWP project placed rock in the wall that was incorrect and is known as "Iron Rock". This rock can easily break down and is a failure point in the structure. Also there was no fabric placed under the rocks to prevent the trees and vegetation from growing through the rock and ruining the wall. The village is supposed to be maintaining the project for 10 years and they have not done anything.
5) William Rathmell – The brooks just need to be cleaned out. The EWP projects width was designed to be 28 feet wide and is now 11 feet wide. We have talked to Rick and he stated that there was nothing the we can do about it.
6) Can you patch the bridges? Since replacing the bridge structure to a wider span will take a long time to get into the construction schedule, can you put floodplain culverts in?
7) John Zammataro – I was promised at the last public meeting that the cross sections would be mailed to me. I have not received them yet.
8) Joan Stewart – You are not going to take any more land or any more trees.
9) Sam Stewart's property has trees growing through the rock that is plugging up the water channel that may be causing a constriction. The trees are moving rocks.
10) William Rathmell – They should try to retain the water up at the swamp and Austin Lincoln Park. I don't think the landowners will go along with the floodplain projects.
11) Talk to the Engineers to see if there are any additional storage capacity that could be done at the park.
12) East Brook bridge existing length 30 feet width with a proposed width of 60 feet. When measuring the bridge from guardrail near Flynn street the propose bridge would be in the private drive on the Robert Barnhart property. Some options were discussed on having the proposed bridge closer to Flynn Street side where there is already a "small" floodplain bench at the downstream end of the bridge. Flynn Street may have to move as part of this project within the right of way. The concern is putting the streambank so close to Mr. Barnhart's house.
13) John Tweedie – Who is going to clean the grass when it is all stone, mud and debris if these floodplain projects are installed.
14) John Tweedie – I have concerns about bringing the ground water closer to the houses and the potential of flooding the basements. If you lower the ground elevation the ground water is going to travel through the cobble layer and enter the houses. How will you address all the ground

water. Each of the houses on Liberty street already of sub pumps that they pump their basements out. There was discussions on the potential of installing drains or trenches on the back of the floodplains to re-direct the ground water back to the streams.

15) John Tweedie – There is a stormwater issue on Liberty street that retains all the water on the street during rainfall events. There are no stormwater drains to remove the water. The new Church building installed the storm drains and there is underground erosion and ground water piping occurring around the basin and the street at Liberty and Platt Street.
16) Mead Street Bridge project has willing landowners that would like to be bought out. The three houses that are located on the right streambank (2 houses upstream of bridge and 1 house downstream).

17) William Rathmell – Why can't we take out the East Street bridge since is causing a constriction and purchase the Barnhart property to continue the wall downstream? Some discussions about the bridge being a memorial bridge and the possible traffic problems.

Jenabay Sezen

From: Dave Murphy
Sent: Thursday, December 14, 2017 8:39 AM
To: Jenabay Sezen
Subject: FW: East Brook Walkover Notes

David Murphy, P.E., CFM
Manager of Water Resources Planning

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From: Jessica Rall [mailto:jessica-rall@dcswcd.org]
Sent: Monday, October 16, 2017 3:19 PM
To: Dave Murphy <davem@miloneandmacbroom.com>
Cc: Graydon Dutcher <graydon-dutcher@dcswcd.org>
Subject: East Brook Walkover Notes

Here are the notes of the East Brook Walk Through from the recording during the Walton Flood Commission meeting held on December 1, 2016. Graydon and Steve Dutcher gave the report:

Steve Dutcher: On October 29, 2016 there was a walkover on East Brook stream we met at Lower Bassett Park. All properties that were identified in the LFA that would effected by some sort of mitigation projects such as a flood bench in their back yard or moving their house. The fliers were placed on everybody's door to get them to attend the meeting. There were 24 fliers handed out to the landowners that and about half of those people attended the walkover.

Graydon: There was representation by landowners from MacAdams to the school as well as upstream of Griswold Street to the old East Street crossing. There was pretty good representation for behind everyone's house. We stretched tapes out showing the floodplain bench widths and showed pictures of what a floodplain bench would actually look like. The walkthrough was well received once the landowners saw the examples they were more engaged in the conversation. There was conservation about the 6 homes and business that are identified for removal that are in the flood hazard areas. There was discussion on the strategies of funding and the process to remove the buildings. There is a lot of information on CWC website and a list of funding source was reported to the landowners. These approaches will not be mandated because it is not a top down approach. Everett Farrell from the Delaware County Planning Department as the LFA planner and was given some tasks from the landowners. There was some new areas that were identified such as behind Gary Brook's house the floodplain drops down for a short distance that allows water to artificially come out in a location and there may want to be a terrace installed here. This walkthrough was a great effort and well received.

Steve Dutcher added that a couple of things that came out of the meeting is the trees along Benton Avenue Bridge are pushing on the wall. The landowner's are willing to remove the trees and was wondering how they can be removed. Do we want to wait until spring to do the West Brook walk through? I will need a couple of weeks to go door to door with the flier.

Please let me know if you need anything else.

Thank you,
Jessica

Jessica Patterson, CFM
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