# Village of Margaretville

## Local Flood Analysis

### Delaware County S&WCD

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Making Sustainability Happen

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# Acronyms and Abbreviations

| | |
|---|---|
| AEP | Annual Exceedance Probability |
| BCA | Benefit-Cost Analysis |
| BCR | Benefit-Cost Ratio |
| BFE | Base Flood Elevation |
| BRIC | Building Resilient Infrastructure and Communities |
| CFS | Cubic Feet per Second |
| CRS | Community Rating System |
| CSC | Climate Smart Communities |
| CWC | Catskill Watershed Corporation |
| DCSWCD | Delaware County Soil and Water Conservation District |
| DHSES | Division of Homeland Security and Emergency Services |
| DOH | Department of Health |
| EBDR | East Branch Delaware River |
| EFC | Environmental Facilities Corporation |
| EWP | Emergency Watershed Protection |
| FEMA | Federal Emergency Management Agency |
| FHWA | Federal Highway Administration |
| FIRM | Flood Insurance Rate Map |
| FIS | Flood Insurance Study |
| FMA | Flood Mitigation Assistance |
| FPMS | Floodplain Management Services Program |
| GIGP | Green Innovation Grant Program |
| GIS | Geographic Information System |
| HEC-RAS | Hydrologic Engineering Center – *River Analysis System* |
| HMA | Hazard Mitigation Assistance |
| HMGP | Hazard Mitigation Grant Program |
| HMP | Hazard Mitigation Plan |
| IDF | Intensity-duration-frequency |
| LFA | Local Flood Analysis |
| LiDAR | Light Detection and Ranging |
| LOMA | Letter of Map Amendment |
| LOMR-F | Letter of Map Revision |
| MCS | Margaretville Central School |

| | |
|---|---|
| MFC | Margaretville Flood Commission |
| MPH | Miles per hour |
| NBI BIN | National Bridge Inventory Bridge Identification Number |
| NFIP | National Flood Insurance Program |
| NFIRA | National Flood Insurance Reform Act |
| NOAA | National Oceanic and Atmospheric Administration |
| NRCC | Northeast Regional Climate Center |
| NRCS | Natural Resources Conservation Service |
| NWI | National Wetlands Inventory |
| NYCDEP | New York City Department of Environmental Protection |
| NYCFFBO | New York City Funded Flood Buyout Program |
| NYRCR | New York Rising Community Reconstruction Program |
| NYS | New York State |
| NYSDEC | New York State Department of Environmental Conservation |
| NYSDOT | New York State Department of Transportation |
| PDM | Pre-Disaster Mitigation |
| RFC | Repetitive Flood Claims |
| RL | Repetitive Loss |
| SD | Substantially Damaged |
| SFHA | Special Flood Hazard Area |
| SLR | SLR Engineering, Landscape Architecture, and Land Surveying, P.C. |
| SMIP-FHM | Stream Management Implementation Program Flood Hazard Mitigation Grants |
| SMP | Stream Management Program |
| SRL | Severe Repetitive Loss |
| USACE | United States Army Corps of Engineers |
| US EPA | United States Environmental Protection Agency |
| USGS | United States Geological Survey |
| WBDR | West Branch Delaware River |

# Executive Summary

SLR Engineering, Landscape Architecture, and Land Surveying, P.C. was retained by Delaware County Soil and Water Conservation District to conduct a Local Flood Analysis in the Village of Margaretville. Delaware County has experienced nearly 100 flood events over the past century, many of which have directly impacted Margaretville, where low-lying areas along the East Branch of the Delaware River and its tributaries have been subject to flooding. The Binnekill, which departs from the East Branch upstream of the project area and flows through Margaretville before rejoining the East Branch, is also a source of flooding. During large floods, the valley bottom is inundated from the Binnekill to the East Branch Delaware River, including a large portion of the Village of Margaretville in large floods. A strategy that reduces water surface elevations in the village, and also provides flood protection measures for individual properties, especially critical facilities, is required to reduce flood damages and make Margaretville more resilient to flooding. This study offers recommendations for reducing the impact of low-magnitude, high-frequency floods as well as large, low-frequency flood events.

Climate change is causing a trend of wetter winters and drier summers in the region. SLR evaluated the effect of potential increases in peak flows under future climate change scenarios. We drew upon guidance from a range of sources to predict a range of flows within the study area that represent future climate change scenarios. SLR applied the future streamflow projections to existing hydraulic models to identify the roads, assets, and critical facilities that will be increasingly exposed to floodwaters under increasing frequencies of flooding.

Flood mitigation approaches aimed at reducing water surface elevations were evaluated in this analysis, including bridge and culvert removals or replacements, channel reconstruction, and floodplain bench creation. In addition, flood protection measures for individual properties were explored. These seek to reduce flood-related damages by either relocating, floodproofing, or elevating homes and businesses located in flood-prone areas.

Certain recommendations made here are aimed at optimizing the village's ability to secure funding for project implementation. For example, at the Margaretville Central School, rather than providing specific recommendations for floodproofing, a feasibility study is recommended to more fully assess opportunities to reduce flood damage at the school.

The New York State Department of Transportation has announced plans to replace the Bridge Street crossing over the East Branch of the Delaware River in 2029. It is recommended that the planning and design process include consideration of flood resilience measures. By remaining closely involved in the planning process, the village could receive not just the benefits of a new bridge but also of improved flood resiliency.

A flood committee was formed in Margaretville as part of the Local Flood Analysis process. It is recommended that the committee continue to meet regularly, multiple times per year, to promote and support flood mitigation measures such as those included in this report.

# 1.0 Introduction

## 1.1 Project Background and Overview

SLR Engineering, Landscape Architecture, and Land Surveying, P.C. (SLR) has been retained by Delaware County Soil and Water Conservation District (DCSWCD) to conduct a Local Flood Analysis (LFA) in the Village of Margaretville, Delaware County, New York. The LFA is a program specific to the New York City water supply watersheds that was initiated following Tropical Storm Irene to help communities identify long-term, cost-effective projects to mitigate flood hazards. As part of the water supply watershed, the Village of Margaretville is eligible for New York City Department of Environmental Protection (NYCDEP) funding for the completion of an LFA study. The funds are administered by the DCSWCD.

Rivers shape the landscape in mountainous regions and create flat areas in valleys known as floodplains. As rivers flow through valleys, they erode the surrounding land and deposit sediments along their banks during periods of high-water flow. Over time, these deposits build up to form broad, flat areas. These floodplains are often fertile and provide ideal conditions for agriculture and urban development due to their rich soil and relatively flat terrain. However, their proximity to rivers also makes them highly susceptible to flooding. When rivers overflow their banks, the water spreads across the floodplain, which can lead to significant damage to infrastructure and property. This dual nature of floodplains – offering both opportunities for development and risks of flooding – requires careful planning and management to mitigate potential hazards.

The Catskill Mountains are subject to large storm events that are often unevenly distributed across watersheds. As a result, local flash floods can occur in one basin while an adjacent basin receives little rainfall. In addition to local flash floods, larger storm events can cause widespread flooding. In 2011, Tropical Storm Irene brought heavy rainfall to the Catskill region. Many streams and rivers flooded with fast-moving water. Streamside villages, such as Margaretville, incurred extreme flooding and damages.

At Margaretville, the East Branch Delaware River (EBDR) drains 163 square miles. Bush Kill flows into Dry Brook, which together contribute about half the watershed area. The confluence with the EBDR is about half a mile upstream of the border of the Village of Margaretville. In the village, Bull Run and Scott's Brook, each with watersheds less than 3 square miles, flow into the EBDR. The Binnekill diverts from the EBDR and passes through the heart of the village, creates a pond behind a low head dam, then rejoins the main channel about a mile downstream. The 'island' between the Binnekill and main channel is low lying, flat, and prone to flooding. It is also home to farm fields, sports fields, businesses, parking lots, and private residences.

## 1.2 Terminology

In this report, all references to right bank and left bank refer to "river right" and "river left," meaning the orientation assumes that the reader is standing in the river, looking downstream. Stream stationing is used in the narrative and on maps as an address to identify specific points along the watercourse. For example, stream stationing begins at 00+00 on the EBDR at the upstream end of the Pepacton Reservoir. As another example, stream stationing on Bull Run begins at 00+00 at the point where it meets EBDR.

The Federal Emergency Management Agency (FEMA) is an agency of the United States Department of Homeland Security. 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 1 percent (one in 100) chance of occurring in any given year, and the base flood elevation (BFE) represents the level floodwaters are expected to reach in this event**. The 1 percent annual chance flood is also referred to as the 100-year flood. Other recurrence 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).

## 1.3 Study Area

The study area is primarily defined by the municipal boundaries in the Village of Margaretville (Figure 1-1). Locations outside of the study area that may contribute to flooding inside the study area are also assessed such as the Binnekill inlet to the east, Bull Run north of the village boundary, and the Dunraven bridge across the EBDR to the west.

**Figure 1-1: Margaretville Study Area**

## 1.4 Community Involvement

The LFA was undertaken in close consultation with Margaretville Flood Commission (MFC), which was established by the Village of Margaretville to assist in the LFA process. MFC is comprised of individuals with technical and nontechnical backgrounds and is meant to represent various interests and stakeholders at village and county levels. MFC met regularly over the course of the LFA process to review results and provide input on flood mitigation alternatives. MFC members include representatives from the following organizations and backgrounds:

- Village of Margaretville board members
- Village of Margaretville community members
- New York City Department of Environmental Protection
- Catskill Watershed Corporation
- Delaware County Soil & Water Conservation District
- SLR Engineering, Landscape Architecture, and Land Surveying, P.C.

Representatives from FEMA, New York State Department of Health (DOH), and Department of Transportation (NYSDOT) also attended the October 30 committee meeting to discuss any potential involvement in implementing recommendations from this study.

**Figure 1-2: Representatives from the Village of Margaretville and SLR at a public meeting**

The LFA process included three public meetings, all held at the Margaretville Village Clerk's office. The first public meeting took place near the start of the study and served to inform the public about the LFA process, gather input about past flood events, and record reported flood damages within the project areas. A second public meeting was held at the midpoint of the LFA process to share key findings. A third public meeting was held at the end of the LFA process to summarize final recommendations and make the community aware of the LFA technical report.

Table 1-1 summarizes MFC and public meetings that took place during the LFA process.

**Table 1-1: Margaretville Flood Commission and Public Meetings**

| Date | Type of Meeting | Topic |
|---|---|---|
| October 12, 2023 | Public Meeting #1 | Introduction to and overview of the LFA process to Margaretville residents; gathering flood information and areas of concern from the public |
| January 29, 2024 | Public Meeting #2 | Share examples of LFA projects that have been implemented in other communities; initial findings from one-dimensional model |
| April 25, 2024 | Committee Meeting #1 | Recap LFA process for flood committee, share and discuss findings for Fair Street, Cemetery Road, Bridge Street, and Margaretville Central School (MCS) |
| June 20, 2024 | Committee Meeting #2 | Updates on modeling, review recommendations for Fair Street, Bridge Street, MCS, and evacuation location |
| August 27, 2024 | Public Meeting #3 | Share draft recommendations and examples of similar projects that have been implemented in other communities |
| October 30, 2024 | Committee Meeting #3 | Review of all draft recommendations and discuss involvement of DOH, FEMA, and DOT (in attendance) |
| January 15, 2025 | Public Meeting #4 | Present findings and recommendations to the public |

# 2.0 Data Collection

Data were gathered from various sources related to the hydrology and hydraulics of EBDR and its tributaries, EBDR watershed characteristics, recent and historical flooding in the affected communities, and factors that may contribute to flood hazards.

## 2.1 Initial Data Collection

The initial data collection for this study included existing reports and adopted plans in the watershed.

### 2.1.1 East Branch Delaware River Stream Corridor Management Plan

The stream corridor management plan aims to get communities involved in local watershed management. Stream corridor management plans promote a better understanding of stream processes based on the principles of fluvial geomorphology. A stream is studied and evaluated, including its effect on local stakeholders and ensuring continued protection and preservation of the stream. These plans consider the watershed residents' needs and desires while outlining ways to conserve, preserve, and enhance the watershed itself.

The East Branch Delaware River Stream Corridor Management Plan studies the East Branch Delaware River Stream Corridor starting from the Pepacton Reservoir. Residents from the Village of Margaretville identified the following concerns: Bull Run (specifically at the “slide”), ice jams that have historically damaged homes and businesses along Main Street, and a protocol for debris removal prior to, during, and after a flood, which ensures the safety of Village residents, businesses, and highway infrastructure.

### 2.1.2 Delaware County All Hazard Mitigation Plan

The purpose of Hazard Mitigation Plans (HMP) is to identify policies and actions that will reduce risk in order to limit losses of property and life. Flood hazard mitigation, in particular, seeks to implement long- and short-term strategies that will successfully limit loss of life, personal injury, and property damage that can occur due to flooding (URS, 2009). Flood mitigation strategies are most successful when private property owners; businesses; and local, state, and federal governments work together to identify hazards and develop strategies for mitigation (Tetra Tech, 2009).

The 2021 Delaware County Multi-Jurisdictional Hazard Mitigation Plan (Delaware County, NY, 2021) lists critical facilities and infrastructure as well as a list of hazard vulnerabilities in the Village of Margaretville. The recommended actions in the Village of Margaretville include repairing the Binnekill inlet, which has been constructed.

### 2.1.3 NY Rising Community Reconstruction Plan

The NY Rising Community Reconstruction (NYRCR) Program was created to support communities impacted by Hurricane Irene, Tropical Storm Lee, and Super Storm Sandy in 2011 and 2012. The Village of Margaretville was awarded up to $6 million to implement projects proposed in the report. The proposed projects are:

- Feasibility study of flood resiliency opportunities in the Bridge Street bridge area
- Infrastructure improvements on the Binnekill bulkhead, Main Street culvert over Bull Run, Scott’s Brook culverts and Bull Run retaining wall.
- Back-up generators and additional mitigation for Margaretville Central School.

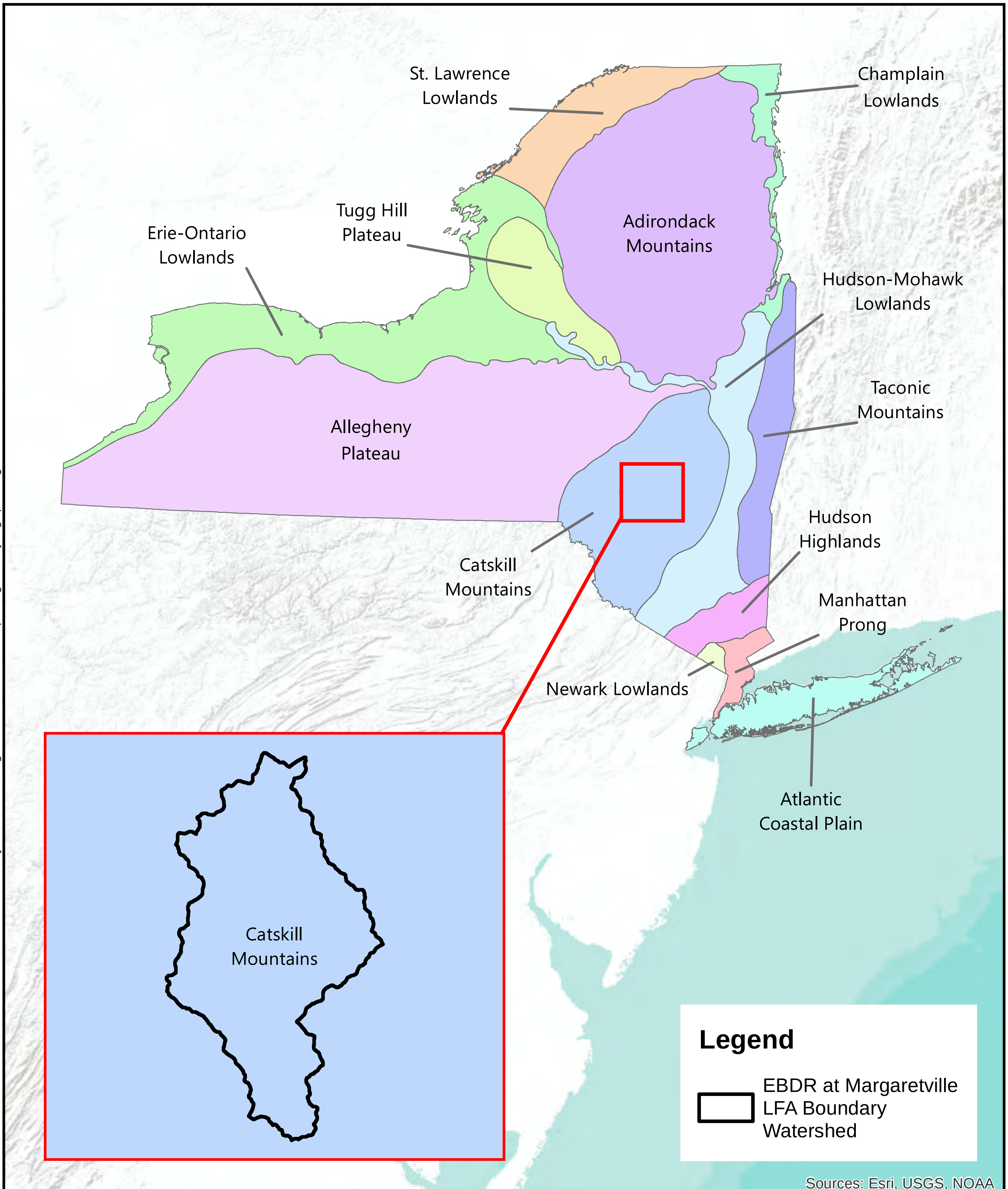
- Back-up generator for Fire Department and DPW
- Renovation assistance for commercial properties and incentives for small businesses
- Acquisition and renovation of Business Center on Main Street
- Solar arrays for back-up power at critical facilities
- Flood mitigation retrofits for flood-prone homes and businesses

## 2.2 East Branch Delaware River Watershed

The EBDR is located in Delaware County in southeast New York State. The watershed falls within the physiographic region of New York State known as the Catskill Mountains, as seen in Figure 2-1. The watercourse flows in a generally southwestwardly direction, draining the towns of Roxbury, Halcottsville, and Middletown and the Village of Margaretville before entering the Pepacton Reservoir. Figure 2-2 is a relief map of the EBDR watershed.

The bedrock geology of the Catskill Mountains consists of Devonian-age sedimentary rocks (Ver Straeten, 2013). Within the EBDR at Margaretville watershed, four bedrock formations are mapped: the Upper Walton Formation, Lower Walton Formation, Slide Mountain, and Oneonta Formation. Both the Upper and Lower Walton Formations consist of a mixture of sandstone, shale, and minor conglomerates. Similar in composition, the Slide Mountain and Oneonta Formations consist of minor conglomerates, sandstone, and shale.

The surficial geology of the EBDR watershed at Margaretville is a mixture of exposed bedrock and glacial legacy sediments. In the Pleistocene Epoch, New York State underwent a period of glaciation, during which the Catskill Mountains were covered by mountain glaciers. The retreat and advance of these glaciers eroded the landscape and then redeposited the eroded sediment onto the land. Glacial till is mapped throughout the watershed. Kame deposits are mapped sporadically throughout the watershed. Alluvium and outwash sand and gravel underlie Bush Kill and EBDR. Bedrock at or within a few feet of the ground surface is mapped along the outer edges (high peaks) of the watershed.




1

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SUITE 102
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NYS PHYSIOGRAPHIC REGIONS
VILLAGE OF MARGARETVILLE LOCAL FLOOD ANALYSIS
DELAWARE COUNTY S&WCD
TOWN OF MIDDLETOWN
DELAWARE COUNTY, NEW YORK

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DATE 9/16/2024
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**FIG. 2-1**

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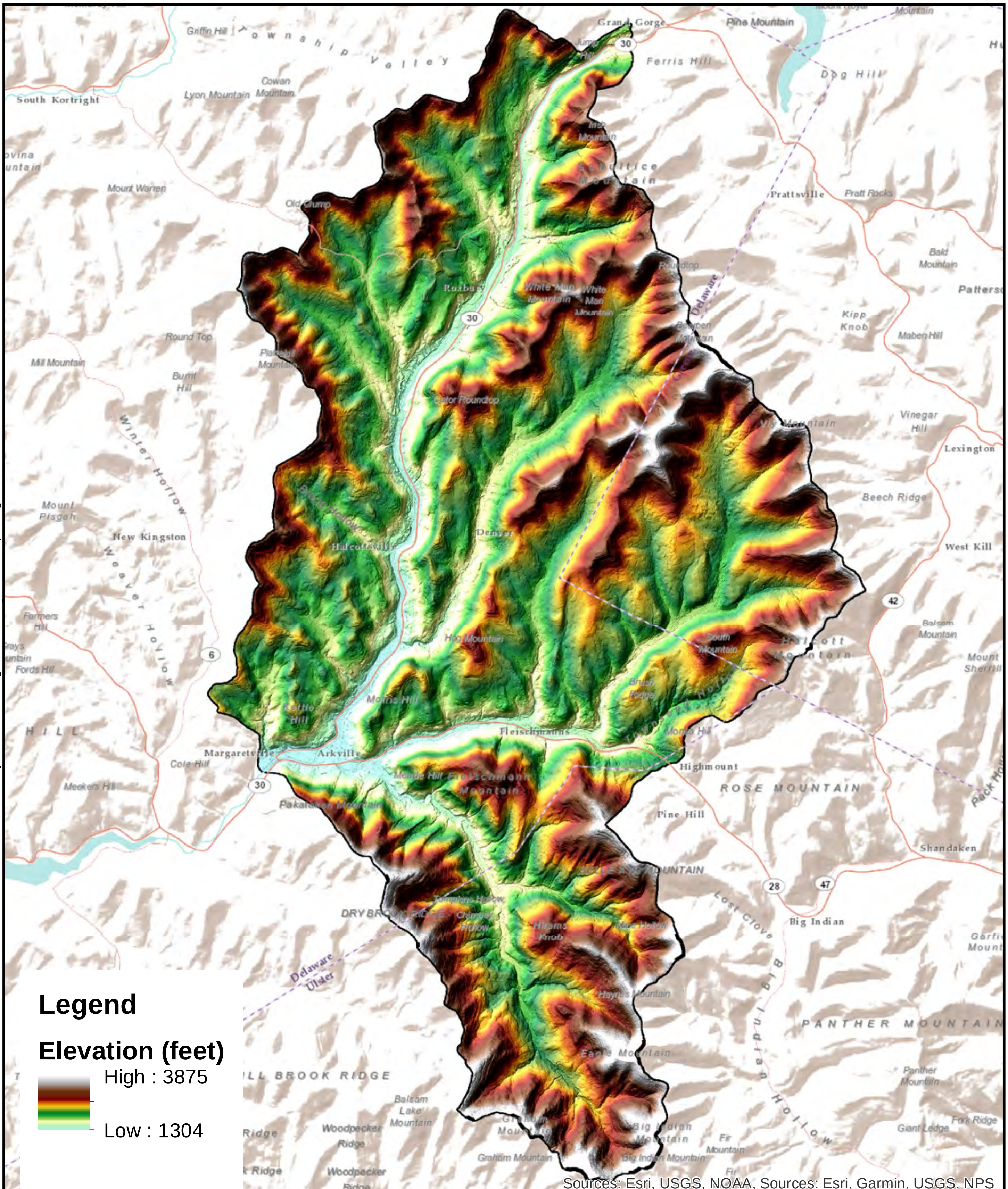


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RELIEF MAP

VILLAGE OF MARGARETVILLE LOCAL FLOOD ANALYSIS
DELAWARE COUNTY S&WCD

TOWN OF MIDDLETOWN
DELAWARE COUNTY, NEW YORK

N

0 6,500 13,000 Feet

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SUITE 102
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SCALE 1" = 14,200'

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**FIG. 2-2**

During a rainfall event, the proportion of rainfall that runs off directly into rivers and streams or that infiltrates into the ground is greatly influenced by the composition of soils within a watershed. Soils are assigned a hydrologic soil group identifier, which is a measure of the infiltration capacity of the soil. These are ranked A through D. A hydrologic soil group A soil is often very sandy, with a high infiltration capacity and a low tendency for runoff except in the most intense rainfall events; D-ranked soil often has a high silt or clay content or is very shallow to bedrock and does not absorb much stormwater, which instead is prone to runoff even in small storms. A classification of B/D indicates that when dry the soil exhibits the properties of a B soil, but when saturated, it has the qualities of a D soil. Around 84 percent of the soils in the EBDR watershed are classified as hydrologic soil group C or D, indicating that the watershed has a low infiltration capacity and high runoff potential in rain events (Figure 2-3).

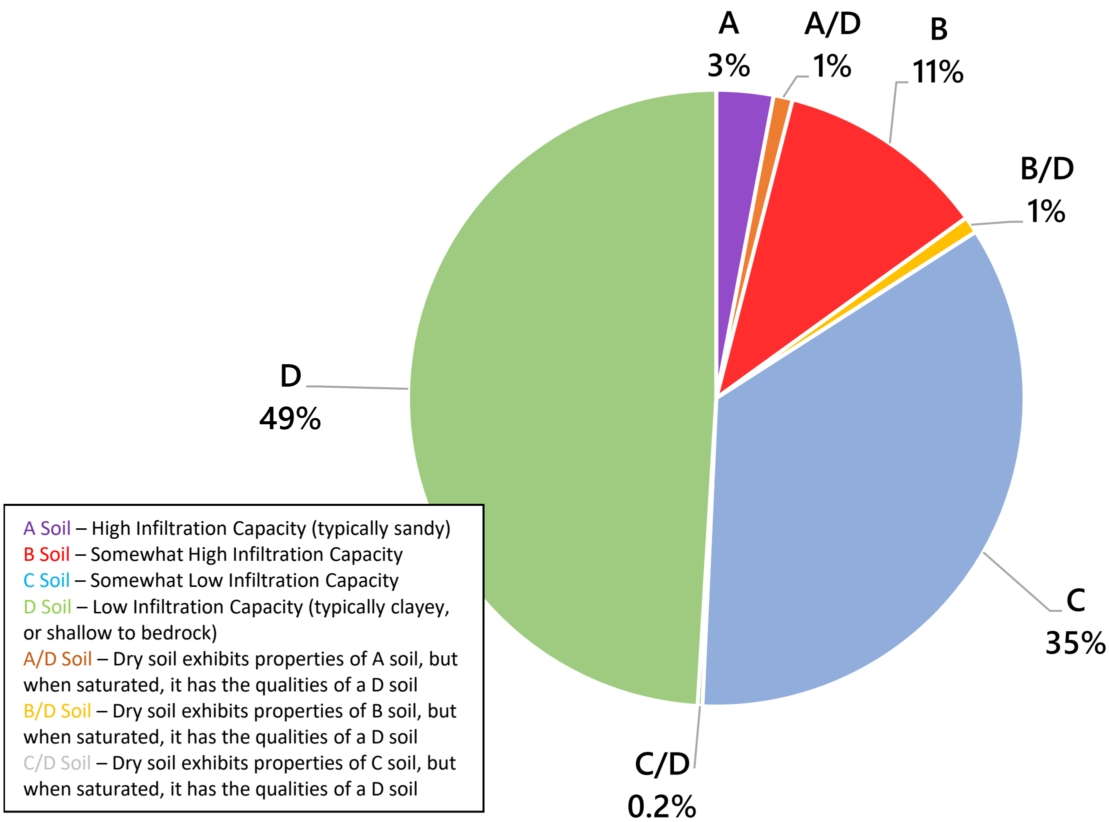



**Figure 2-3: Hydrologic Grouping of Soils within the EBDR Watershed**

Forested land makes up 85 percent of the EBDR watershed. Agricultural land makes up 8 percent while developed land makes up 5 percent. The remaining 2 percent of land cover consists of open water, wetlands, grassland and shrubland, and barren land (Figure 2-4).

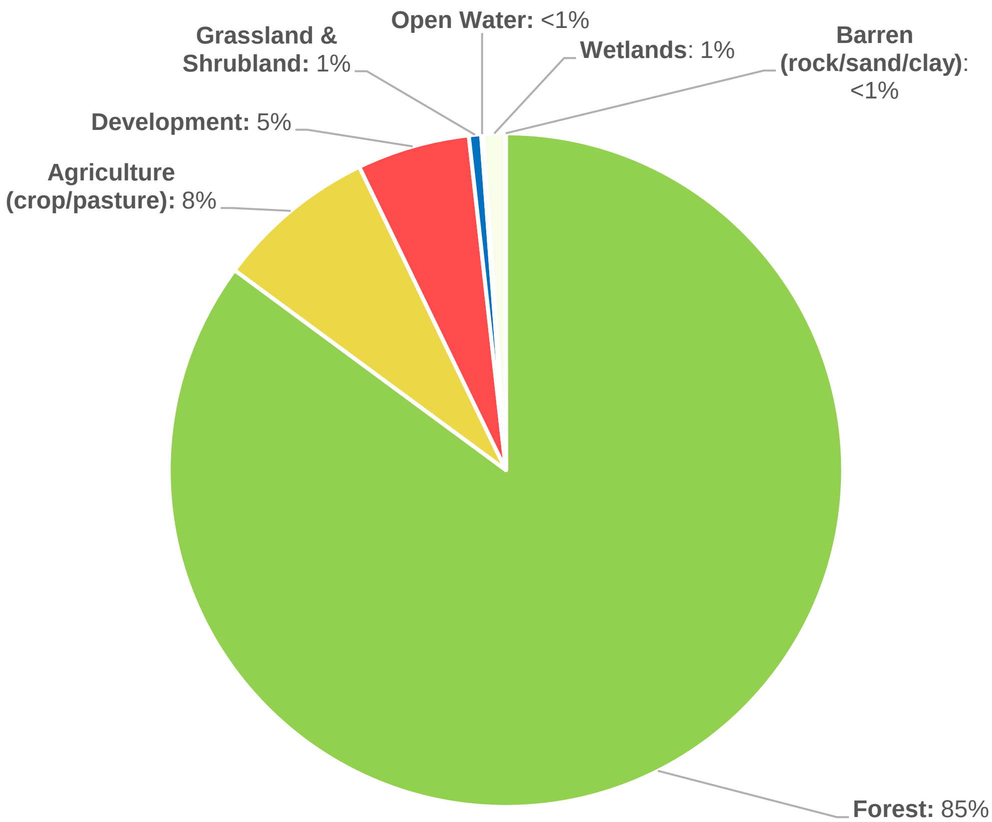



**Figure 2-4: Land Cover within EBDR Watershed**

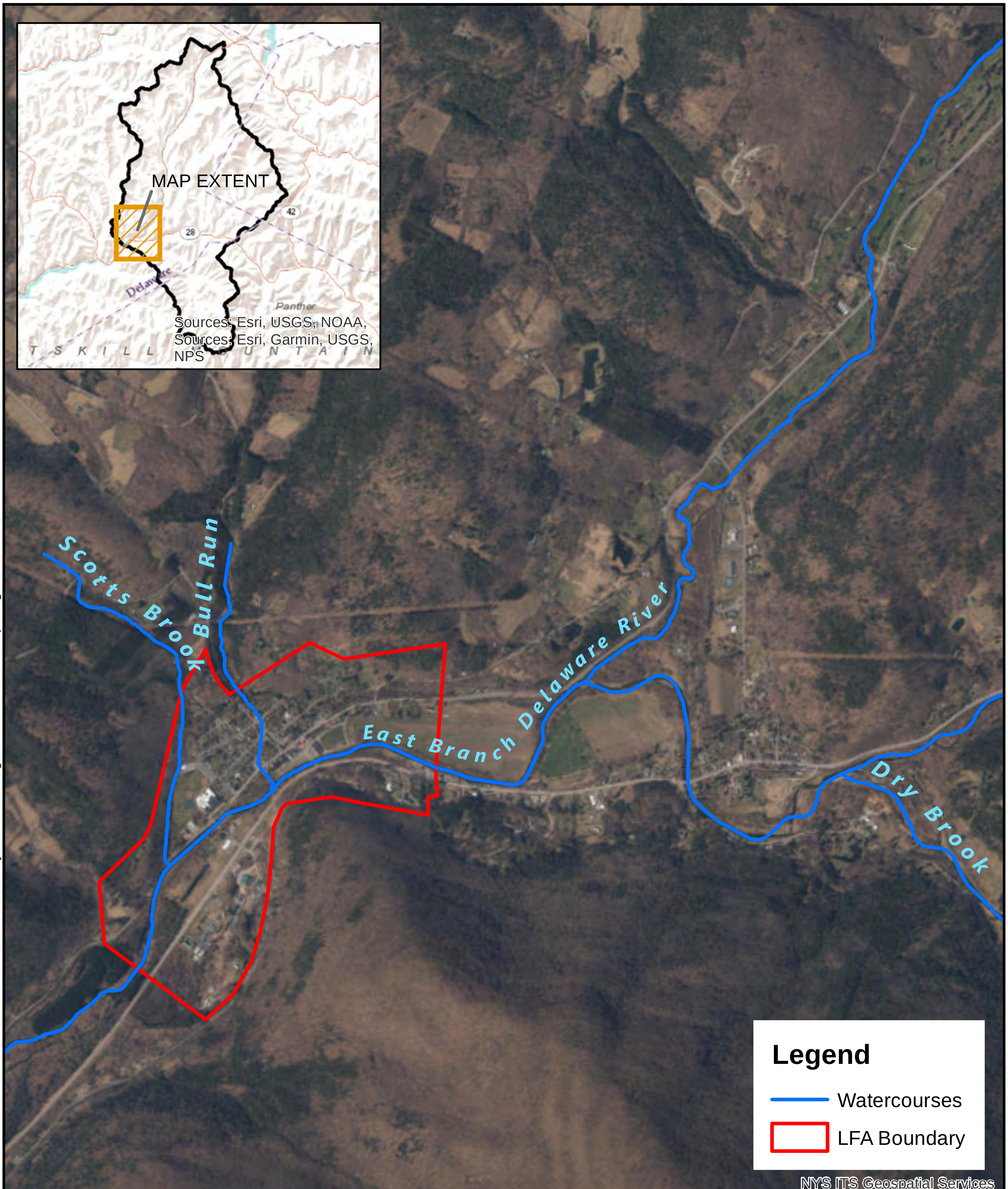
Wetland cover was also examined using information available from the U.S. Fish & Wildlife Service's National Wetlands Inventory (NWI). The NWI indicates that there are 2,175 acres of wetlands in the EBDR watershed, or approximately 2.1 percent of the watershed. This is slightly higher than the estimate above based on land cover and includes the following types of wetland habitats: freshwater emergent wetland, freshwater forested/shrub wetland, freshwater pond, lake, and riverine. Wetlands play an important role in flood mitigation by storing water and attenuating peak flows. It is estimated that since colonial times approximately 50 to 60 percent of the wetlands in the state of New York have been lost through draining, filling, and other types of alteration.

## 2.3 East Branch Delaware River Watercourse

The EBDR originates near the hamlet of Grand Gorge in Delaware County and flows south and west through the municipalities of Roxbury, Halcottsville, and Margaretville before entering the Pepacton Reservoir. The Pepacton Reservoir is operated by the NYCDEP as a part of the west-of-Hudson water supply system for New York City. Downstream of Pepacton Reservoir, the EBDR flows southwestward through the towns of Colchester and Hancock and joins with the West Branch Delaware River (WBDR) in the Village of Hancock to form the Delaware River along the New York/Pennsylvania state line. At the point where the EBDR drains into the Pepacton Reservoir, it measures 19 miles in length. Named tributaries to EBDR include Bush Kill, Bull Run, Scott’s Brook, Dry Brook, Batavia Kill, Vly Creek, and Meeker Hollow. The key tributaries and watersheds discussed in this report are shown in Figure 2-5 and Figure 2-6, respectively.

Stream order provides a measure of the relative size of streams by assigning a numeric order to each stream in a stream network. The smallest tributaries are designated as first-order streams, and the designation increases as tributaries join.

The main stem of EBDR can be characterized as a sixth-order stream at the southern boundary of the Village of Margaretville.

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WATERCOURSE OVERVIEW

VILLAGE OF MARGARETVILLE LOCAL FLOOD ANALYSIS
DELAWARE COUNTY S&WCD

TOWN OF MIDDLETOWN
DELAWARE COUNTY, NEW YORK

N

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Feet

SCALE 1 " = 2,300 '

DATE 9/16/2024

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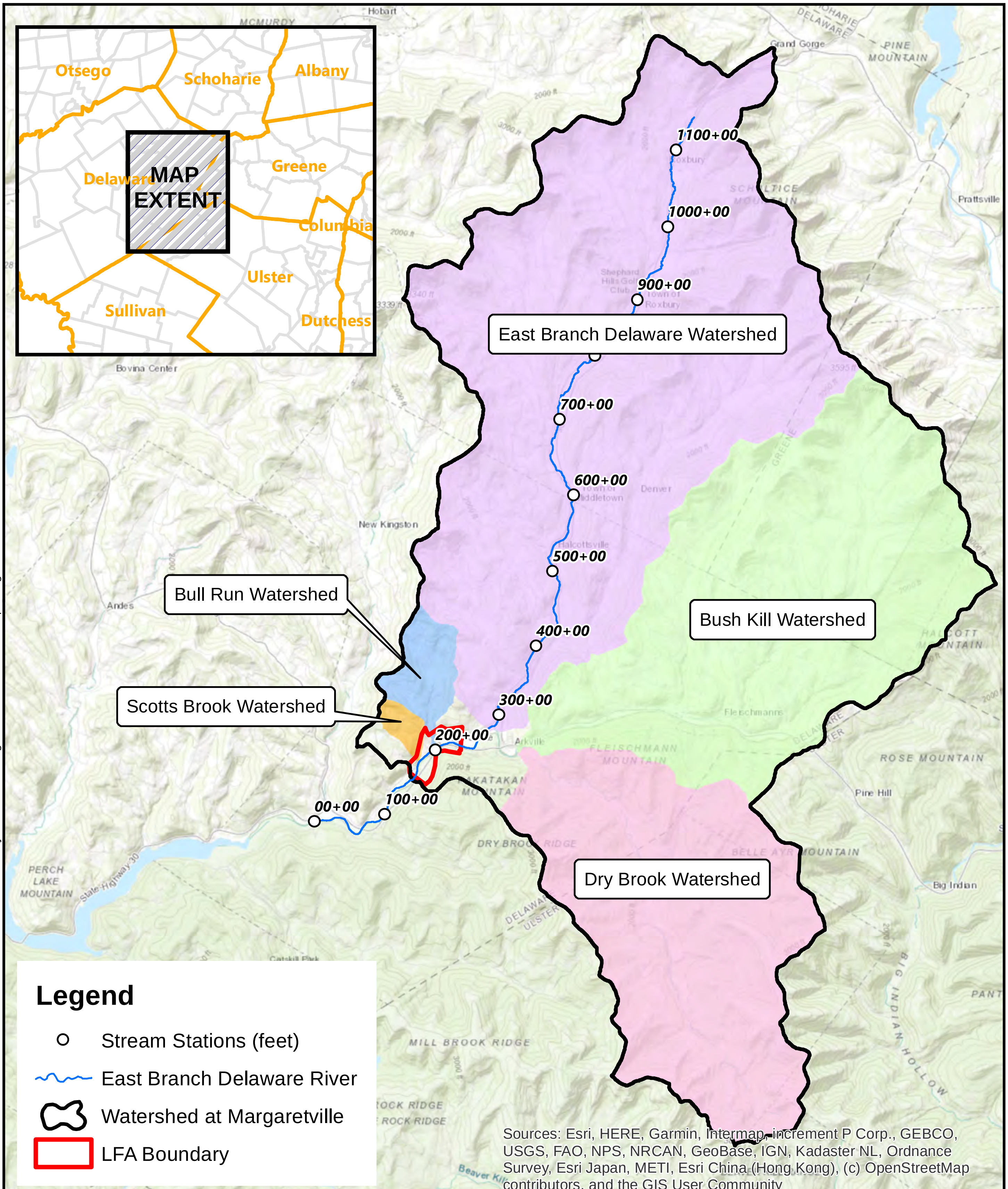
FIG. 2-5

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WATERSHED OVERVIEW

VILLAGE OF MARGARETVILLE LOCAL FLOOD ANALYSIS
DELAWARE COUNTY S&WCD
TOWN OF MIDDLETOWN
DELAWARE COUNTY, NEW YORK

N

0 6,500 13,000
Feet

SCALE 1 " = 15,000 '
DATE 10/24/2025
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FIG. 2-6

Figure 2-7 is a map depicting stream order in the EBDR watershed.

Characteristics of each order of stream (total length, average slope, and percentage of overall stream network) are summarized in Table 2-1 for EBDR. First- and second-order streams account for most of the overall stream length within the EBDR watershed (75.7 percent). The first- and second-order streams in the EBDR watershed are steeper in slope than third- and fourth-order streams.

**Table 2-1: Stream Order Characteristics in EBDR Watershed**

| Stream Order | Total Length (miles) | Percentage of Overall Network Length (%) | Average Slope (%) |
|---|---|---|---|
| 1st | 223.5 | 54.1 | 10.6 |
| 2nd | 89.4 | 21.6 | 6.5 |
| 3rd | 43.1 | 10.4 | 2.8 |
| 4th | 41.0 | 9.9 | 1.2 |
| 5th | 14.2 | 3.4 | 0.5 |
| 6th | 2.2 | 0.5 | 0.1 |
| **Total** | **413.3** | **100** | |

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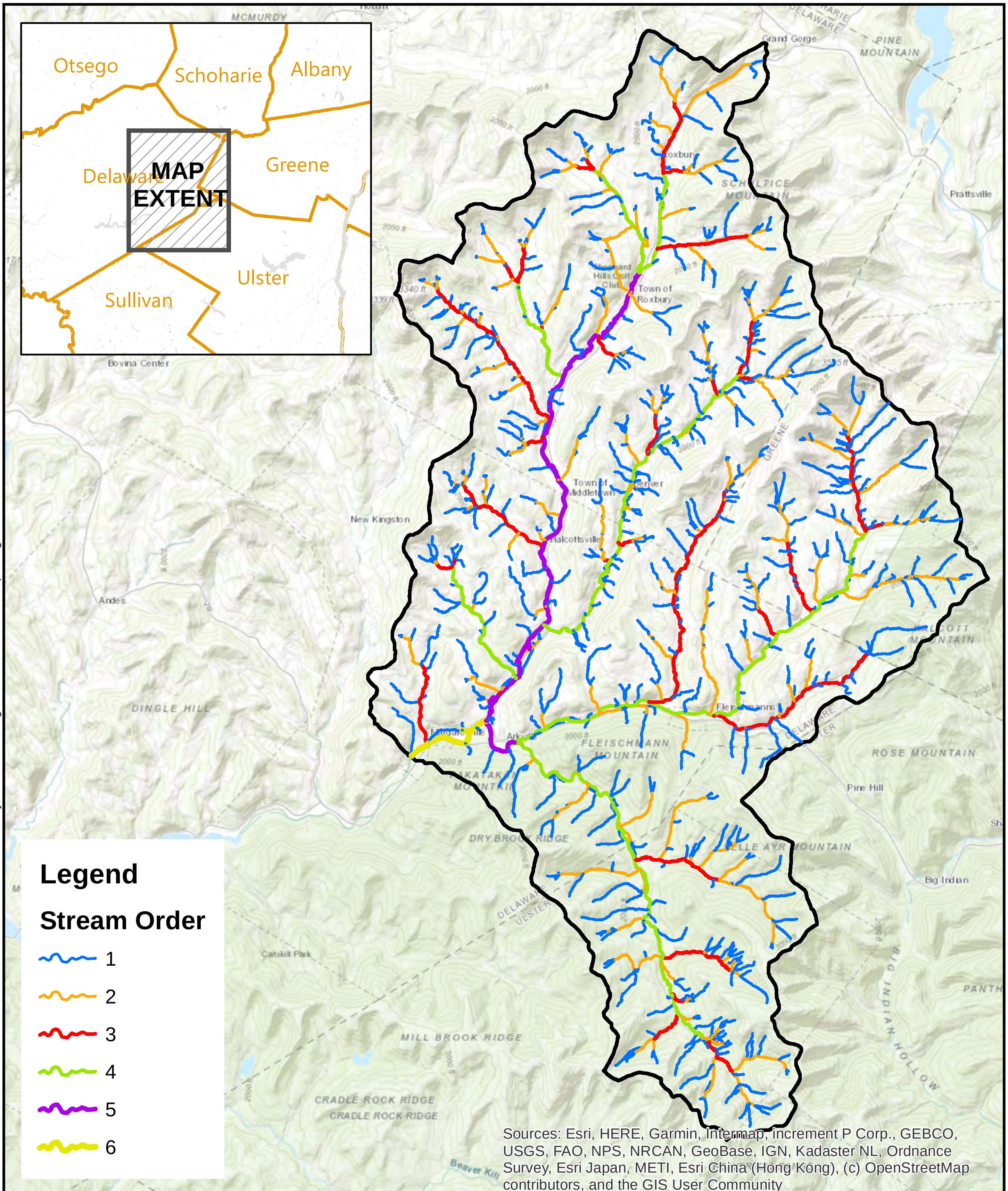


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STREAM ORDER

VILLAGE OF MARGARETVILLE LOCAL FLOOD ANALYSIS
DELAWARE COUNTY SWCD

DELAWARE COUNTY
NEW YORK

N

0 7,000 14,000
Feet

SCALE 1 " = 15,000 '

DATE 9/16/2024

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PROJ. NO.

FIG. 2-7

## 2.4 Hydrology

Hydrologic studies are conducted to understand historical, current, and potential future river flow rates, which are a critical input for hydraulic modeling software such as Hydrologic Engineering Center – *River Analysis System* (HEC-RAS) and HY-8. These often include statistical techniques to estimate the probability of a certain flow rate occurring within a certain period of time based on data from the past; these data are collected and maintained by the United States Geological Survey (USGS) at thousands of stream gauging stations around the country.

For the streams without gauges, the USGS has developed region-specific regression equations that estimate flows based on watershed characteristics such as drainage area and annual precipitation as well as various techniques to account for the presence of nearby stream gauges or to improve analyses of gauges with limited records. These are based on the same watershed characteristics as gauged streams in that region so are certainly informative although not as accurate or reliable as a gauge due to the intricacies of each unique basin. A simplified diagram of the hydrologic cycle is presented in Figure 2-8.

Along with the location, duration, and intensity of a storm, the flooding that may result from a rainfall event can vary widely depending on the unique hydrology of each basin. Characteristics of local topography, soils, vegetation cover and type, bedrock geology, land use and cover, river hydraulics and floodplain storage, ponding, wetland, and reservoir storage, combined with antecedent conditions in the watershed such as snowpack or soil saturation, can impact the timing, duration, and severity of flooding.

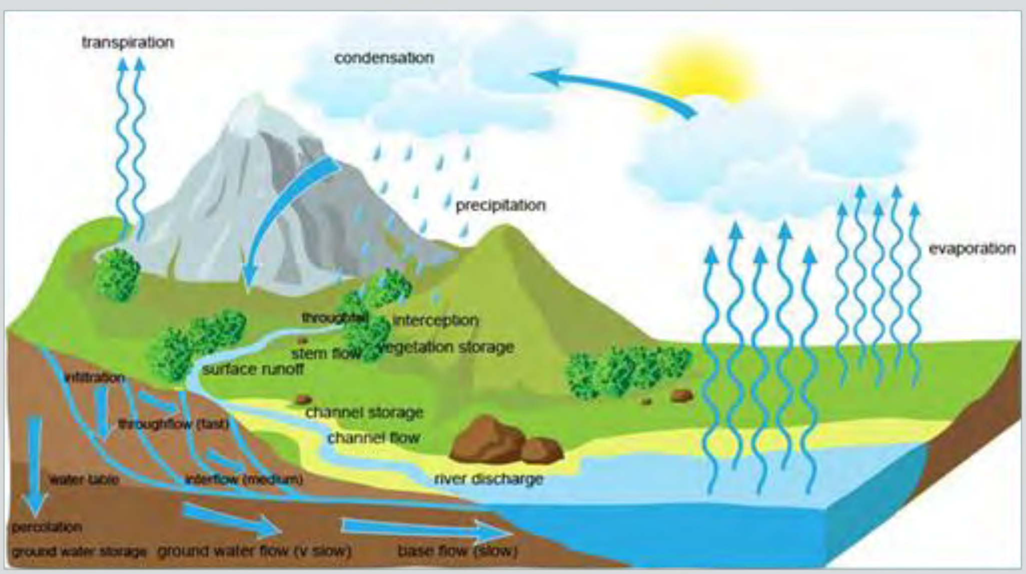


**Figure 2-8: Diagram of Simplified Hydrologic Cycle**

Hydrologic analyses may be conducted for the purposes of estimating low flows, high flows, or anywhere in between. The commonly termed “100-Year Flood” refers to the flow rate that is predicted to have a 1 percent, or 1 in 100, chance of occurring in any year. A “25-Year Flood” has a 1 in 25 chance of occurring (4 percent) every year. It is important to note that referring to a specific discharge as an “X-Year Flood” is a common and convenient way to express a statistical probability but can be misleading because it has no bearing whatsoever on when or how often such a flow actually occurs.

The USGS gauge at Fair Street (01413500) records annual peak flow of the EBDR. The gauge record begins in 1937 and is still active, providing valuable data about flow on the EBDR. A USGS Bulletin 17B analysis computes the statistical recurrence of flows based on gauge data. In Figure 2-9, the peak flow for each year plotted along with the Annual Exceedance Probability (AEP) recurrence flows from both the gauge analysis and FEMA Flood Insurance Study (FIS). The flows are tabulated in Table 2-2. The gauge analysis includes data from 1937 to 2022, where as the FEMA FIS hydrology was updated prior to the 2012 report. The additional data reduces the AEP flows. Additional data will continue to adjust the statistical values to better represent the actual statistical probability of events. With climate change, more extreme weather events expected in New York State, including a trend toward more short duration, high precipitation storms (Bader and Horton 2023). NYSDOT guidelines recommend designing a bridge with a 20 percent increase in peak flows to account for changes in future hydrology.

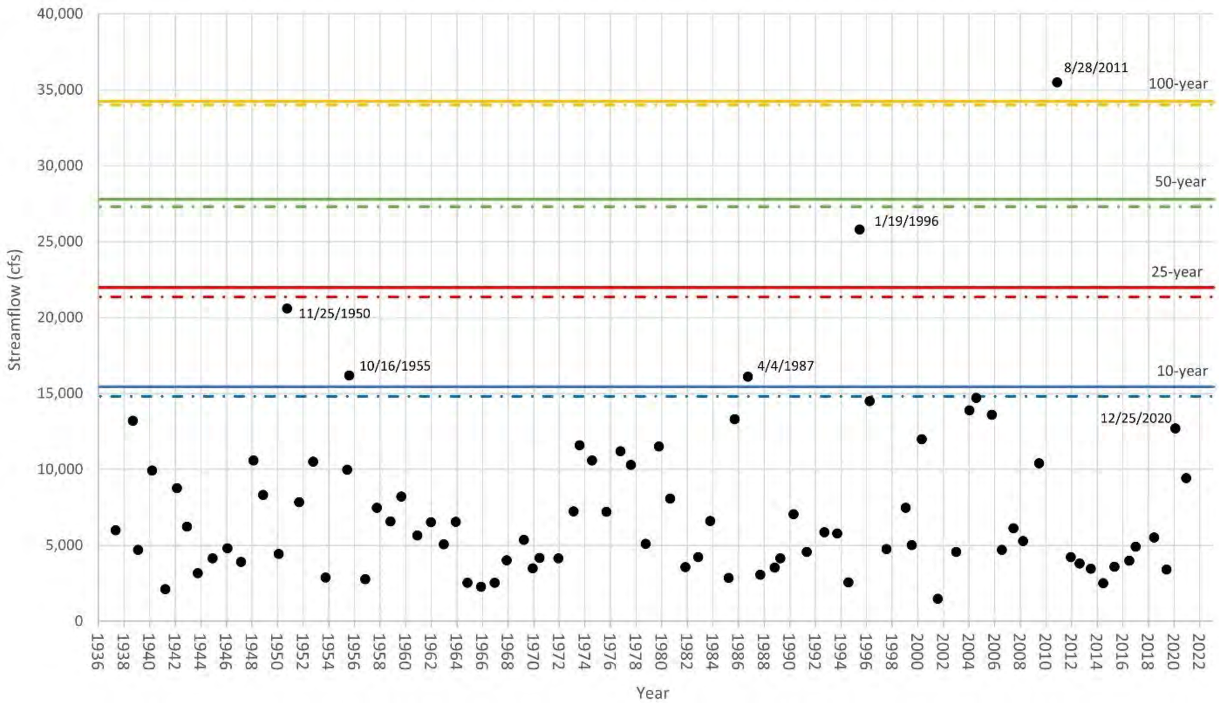


**Figure 2-9: Annual peak flow at USGS gauge at Fair Street with AEP flows as calculated by Bulletin 17B (dashed line) and FEMA FIS (solid line)**

**Table 2-2: Peak Flood Hydrology for EBDR at USGS Flow Gauge Station at Fair Street**

| Flood Event | Discharge from USGS gauge analysis using data from 1937-2022 (cfs) | FEMA FIS Discharge (cfs) |
|---|---|---|
| 2-year | 5,842 | n/a |
| 5-year | 10,017 | n/a |
| 10-year | 13,551 | 15,374 |
| 25-year | 18,997 | 21,802 |
| 50-year | 23,838 | 27,543 |
| 100-year | 29,411 | 33,901 |
| 500-year | 45,785 | 50,529 |

Bull Run is an ungauged tributary to the EBDR. Peak flows (Table 2-3) were determined using regional regression equations.

**Table 2-3: Bull Run Peak Flood Hydrology at Confluence with EBDR from FEMA FIS**

| Flood Event | FEMA FIS Discharge (cfs) |
|---|---|
| 10-year | 323 |
| 25-year | 448 |
| 50-year | 559 |
| 100-year | 677 |
| 500-year | 988 |

Climate change is causing a trend of wetter winters and drier summers in the region. To account for these changes and the resulting increase in peak flows, several approaches were examined. One approach involves the use of regional regression equations (Lumia et al., 2006) and predicted future runoff from the “National Climate Change Viewer,” a web-based tool developed by the USGS (Alder and Hostetler, 2013). The predicted future runoff shows an increase in the winter months and a decrease in the summer months. To apply this to the change in future peak flows, the average increase in runoff in the winter months was used in the regional regression equations. The results allow for modeling of flood conditions that may occur in future decades, enabling proactive flood mitigation measures. Note that the current version of *StreamStats* uses the 2006 regional regression equations for New York (USGS SIR 2006-5112). An update to these regressions is anticipated in 2025, which may produce different results than the 2006 version.

Runoff data were evaluated for two future scenarios, termed “Representative Concentration Pathways” or RCPs, that provide estimates of the extent to which greenhouse gas concentrations in the atmosphere were likely to change through the 21$^{st}$ century. RCPs are based on potential future emissions trajectories of greenhouse gases such as carbon dioxide. RCP 4.5 is considered a midrange-emissions scenario, and RCP 8.5 is a high-emissions scenario. The future runoff estimates are based on 20 different climate models, which have been scaled to Delaware County. The runoff values are used in regional regression equations to estimate the change in peak flows for the East Branch Delaware River watershed.

Mean estimated increases for the 10-, 50-, and 100-year floods based on the climate models for 2075-2099 are presented in Table 2-4. In both future climate change scenarios, RCP 4.5 and RCP 8.5, the increase in peak flow is greatest for the higher-frequency floods than the lower-frequency floods. High-frequency storms are projected to become proportionally more severe than lower-frequency storms.

**Table 2-4: Projected Increase in Peak Flood Discharge at Fair Street Gauge**

| Flood Event Return Period | Current Climate Conditions | RCP 4.5 for 2075-2099 | | RCP 8.5 for 2075-2099 | |
|---|---|---|---|---|---|
| | Discharge (cfs) | Percent Increase (%) | Discharge (cfs) | Percent Increase (%) | Discharge (cfs) |
| 2-year | 5,842 | 14.3 | 6,677 | 14.8 | 6,707 |
| 5-year | 10,017 | 11.0 | 11,119 | 11.4 | 11,159 |
| 10-year | 13,551 | 9.1 | 14,784 | 9.4 | 14,825 |
| 50-year | 23,838 | 5.9 | 25,244 | 6.1 | 25,292 |
| 100-year | 29,411 | 4.5 | 30,734 | 4.7 | 30,793 |

Future flooding can also be estimated by projecting future precipitation rates. The Northeast Regional Climate Center (NRCC) has developed projected precipitation intensity-duration-frequency (IDF) curves for New York State (NRCC, 2015). These storm projections are associated with individual storm events, rather than annual statistics. The projected IDF curves from NRCC are based on a suite of four regional climate models and 25 downscaled global climate models for New York State for RCP 4.5 and RCP 8.5.

Margaretville is located near several weather stations: Delhi station, 15.4 miles to the northwest; Slide Mountain, 14.7 miles to the southeast; and Windham, 26 miles to the northeast. The IDF data for the projected future precipitation for RCP 8.5 in 2070-2099 is compared with the current precipitation estimates from NOAA Atlas 14 for the same locations in

Table 2-5. Windham shows the greatest increase, followed by Slide Mountain, and Delhi has the most modest change. At all three sites, the high-frequency 2- and 5-year storm events are projected to have a greater relative increase in precipitation than the mid-frequency 10-year storms. The relative increase in precipitation increases again for the low-frequency 50- and 100-year storms.

**Table 2-5: Precipitation for 24-Hour Storm Under Current (NOAA Atlas 14) and Projected Future RCP 8.5 (2070-2099) (NRCC) Climate Conditions**

| Event Return Period | Delhi | | | Slide Mountain | | | Windham | | |
|---|---|---|---|---|---|---|---|---|---|
| | Current Precip. (in) | Projected Future Precip. (in) | Percent Increase (%) | Current Precip. (in) | Projected Future Precip. (in) | Percent Increase (%) | Current Precip. (in) | Projected Future Precip. (in) | Percent Increase (%) |
| 2-year | 2.9 | 3.1 | 8.3 | 4.6 | 5.5 | 21.1 | 3.6 | 4.8 | 33 |
| 5-year | 3.6 | 3.8 | 6.7 | 6.0 | 6.7 | 12.0 | 4.8 | 6.0 | 25 |
| 10-year | 4.3 | 4.3 | 0.0 | 7.2 | 7.7 | 6.7 | 5.8 | 7.0 | 20.8 |
| 50-year | 6.0 | 6.2 | 4.0 | 10.1 | 11.3 | 11.9 | 7.9 | 9.8 | 24.2 |
| 100-year | 6.7 | 7.4 | 10.7 | 11.5 | 13.4 | 16.7 | 9.1 | 11.8 | 29.0 |

Note that a percent increase in precipitation does not translate to the same increase in stream flow. However, storm totals can be compared. For example, at the Slide Mountain station, the projected future 50-year precipitation is similar to the current 100-year precipitation values, 11.3 inches and 11.5 inches, respectively. Therefore, the future 50-year peak flows in that watershed are projected to be similar to the existing 100-year peak flow. In Windham, the projected future 2-year precipitation equals the current 5-year precipitation value. The projected future 50-year precipitation exceeds the current 100-year precipitation value, 9.8 and 9.1 inches, respectively.

A hydrologic model can be used to determine how precipitation converts to stream flow. For the Upper Esopus Creek watershed (which includes Slide Mountain) and Schoharie Creek watershed (which includes Windham), an HEC-HMS hydrologic model was developed by FEMA for the FEMA FIS. These models were provided to SLR by the NYCDEP Stream Management Program (SMP). Applying the projected future precipitation rates to the hydrologic model, the projected stream flow can be obtained. The Upper Esopus Creek model shows a 40 percent increase in flows using the projected future 100-year 24-hour storm precipitation rates compared the current 100-year 24-hour storm precipitation rates; the Schoharie Creek model shows a 32.4 percent increase (Table 2-6).

**Table 2-6: Precipitation and Stream Flow for Current and Projected Future Climate Conditions**

| | **Upper Esopus Creek** (Slide Mountain) | | **Schoharie Creek** (Windham) | |
|---|---|---|---|---|
| | 100-year Precipitation (inches) | Peak Stream Flow (cfs) | 100-year Precipitation (inches) | Peak Stream Flow (cfs) |
| Current Conditions | 11.5 | 51,036 | 9.1 | 22,196 |
| Projected Future (RCP 8.5 2070-2099) | 13.4 | 71,425 | 11.8 | 29,382 |
| Percent Increase (%) | 16.7 | 40.0 | 29.0 | 32.4 |

All projected future flow conditions come with uncertainty. Since the hydrologic model and precipitation data is not available for the EBDR watershed, an interpolation of trends from neighboring watersheds can be used. For the purposes of this study, the future flow condition of the EBDR is estimated to be between 20 percent and 30 percent greater than existing peak flows (Table 2-7). Note that the NYSDOT uses a 20 percent increase in peak flows as the estimated future peak flows in the region.

**Table 2-7: Estimated Future Peak Flows for EBDR**

| Flood Event | Discharge from USGS Gauge Analysis using Data from 1937-2022 (cfs) | Estimated Future Peak Discharge 2070-2100 (cfs) |
|---|---|---|
| 2-year (50% AEP) | 5,842 | 7,000-7,600 |
| 5-year (20% AEP) | 10,017 | 12,000-13,000 |
| 10-year (10% AEP) | 13,551 | 16,300-17,600 |
| 25-year (4% AEP) | 18,997 | 22,800-24,700 |
| 50-year (2% AEP) | 23,838 | 28,600-31,000 |
| 100-year (1% AEP) | 29,411 | 35,300-38,200 |
| 500-year (0.2% AEP) | 45,785 | 54,900-59,500 |

This analysis suggests that the projected 50-year peak discharge will be similar to the current 100-year peak discharge. Put another way, the annual chance of a 29,000 cfs peak flow event will double, from 1 percent to 2 percent. Similarly, the annual chance of a 24,000 cfs peak flow event will also double, from 2 percent to 4 percent. The pattern continues with the future 5-year (20 percent AEP) peak flows nearly reaching the existing 10-year (10 percent AEP) peak flows.

## 2.5 Hydraulics

To develop hydraulic modeling to assess flood mitigation alternatives, effective FEMA HEC-RAS one-dimensional hydraulic models were obtained for EBDR and Bull Run. The effective FEMA modeling was updated for the 2016 revision of the Delaware County FIS (36025CV001B). Survey of the EBDR for the revision was completed in 2012, after the 2011 floods from Hurricane Irene.

SLR expanded on the FEMA models to create a two-dimensional hydraulic model for a section of the EBDR included in the LFA area. Model geometry was based on a combination of surveyed channel cross sections included in effective FEMA modeling, field measurements by SLR, and light detection and ranging (LiDAR)-derived topographic mapping from the NYS Geographic Information System (GIS) Clearinghouse. Roughness coefficients were applied to the model domain based on field observations and aerial orthophotography.

The two-dimensional model was calibrated to the flooding caused by Tropical Storm Irene in 2011, which was between a 100- and 500-year peak flow. The model results for low-magnitude floods such as 5- or 10-year recurrence peak flows show more flooding in the floodplains than was observed and recorded by local residents in recent, comparable storms. For example, the Christmas flood in 2020 had a peak flow of 12,700 cfs, which is similar to the 10-year peak flow of 13,551 cfs. However, model results of a 10-year flood showed significantly more flooding in the village than the residents experienced. Residents said the modeled 5-year peak flow, at

10,000 cfs, was a better representation of the flooding. This suggests that the modeled channel of the EBDR has less capacity than the physical channel. Additional updated survey of the EBDR channel as well as calibration of the model to more frequent storms can improve the accuracy of the model. These updates are outside of the scope of this study. While the recurrence intervals of low-magnitude floods do not accurately match experienced flooding, the water surface elevations and flow paths are valid. Therefore, recommendations to reduce flooding in low-level storms are applicable but lack a correlated peak flow recurrence interval. For example, the model can show that a road has 2 feet of water on it when the stream rises to an elevation of 1,000 feet, but it cannot accurately say that the flooding occurs when the stream flow is 700 cubic feet per second (cfs), or a 10-year peak flow. The low-magnitude flood model shown in the depth mapping later in this report uses a peak flow of 6,400 cfs, which is between a 2- and 5-year peak flow, but resembles the flooding experienced in a 5-year flood according to members of the MFC.

**Figure 2-10: Footbridge over Binnekill during Christmas Flood, December 25, 2020**
(Photo courtesy of Morgan Spaulding)

Hydraulic analyses for the EBDR and Bull Run were conducted using HEC-RAS computer software. This program was developed by the United States Army Corps of Engineers (USACE) Hydraulic Engineering Center and is the industry standard for riverine flood analysis. The model is used to compute water surface profiles for one- and two-dimensional, steady- and unsteady-state flow conditions. 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. Water surface profiles are computed 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 equations where the water surface profile is rapidly varied such as a hydraulic jump, mixed-flow regime calculations, hydraulics of dams and bridges, and evaluation profile at a river confluence.

Sites outside of the HEC-RAS model area, namely those along Scott's Brook, were modeled with the Federal Highway Administration's (FHWA) *HY-8 Culvert Hydraulics Analysis Program* (Version 7.70.1.0; FHWA, 2021). This software uses several input parameters to perform hydraulic calculations for structures, but with limited contextual data relative to the surrounding stream. For this reason, these models are relatively simple and useful for approximate sizing of culverts but are not substitutes for complete hydraulic analyses of proposed culvert upgrades, especially if projects are expected to impact flow dynamics beyond their immediate vicinity.

For HY-8 models, culvert geometry, including dimensions of the hydraulic opening, barrel material, slope, and inlet configurations, as well as roadway embankment characteristics and stream channel profiles and cross sections were measured in the field. Culvert capacity and potential roadway overtopping were then assessed.

## 2.6 Infrastructure and Critical Facilities

An important component of the LFA information-gathering stage is the identification of critical facilities and anchor businesses. Critical facilities are defined as follows: public facilities such as a firehouse, school, town hall, drinking water supply treatment or distribution facility, or wastewater treatment plant or collection facility, which if destroyed or damaged would impair the health and/or safety of the community. Anchor businesses are defined as those that are vital to the health and safety of a community as well as the ability to recover from damaging floods. Examples of anchor businesses include gas stations, grocery stores, hardware stores, pharmacies, and medical doctor's offices.

A list and map of critical facilities (Table 2-8 and Figure 2-11) were developed based on community input and previous reports and studies such as the HMP (Tetra Tech, 2013).

**Table 2-8: Critical Facilities and Anchor Businesses in Margaretville and Modeled Flood Depths**

| Map Label | Facility | 100-year Flood Depths |
|---|---|---|
| A | Sewage Treatment Plant | 0 feet |
| B | Town Highway Depot | 2 feet |
| C | Margaretville Central School – Evacuation Site | 1.5 to 2 feet |
| D | Hardware Store (Brookside) | 0.25 feet |
| E | Pharmacy and Grocery Store (CVS & Freshtown) | 7 to 8 feet |
| F | Fire Department | 0 feet |
| G | Village DPW | 0 feet |
| H | Church – Evacuation Site | 0 feet |
| I | Helipad | 10 to 11 feet |
| J | Village Hall | 0 feet |
| K | Bank (NBT) | 0 feet |
| L | Hospital | 0 feet |
| M | Long-Term Care Facility | 0 feet |
| N | Water Supply Pump House | 1.5 feet |
| O | Water Supply Pump House | 3.5 feet |
| P | Post Office | 3 to 4 feet |
| Q | Grocery/Supplies (Dollar General) | 3 to 4 feet |
| R | Margaretville Telephone Company | 2 feet |
| S | Gas Station (Sunoco) | 2 feet |
| T | Propane Supplier (Suburban Propane) | 0 feet |

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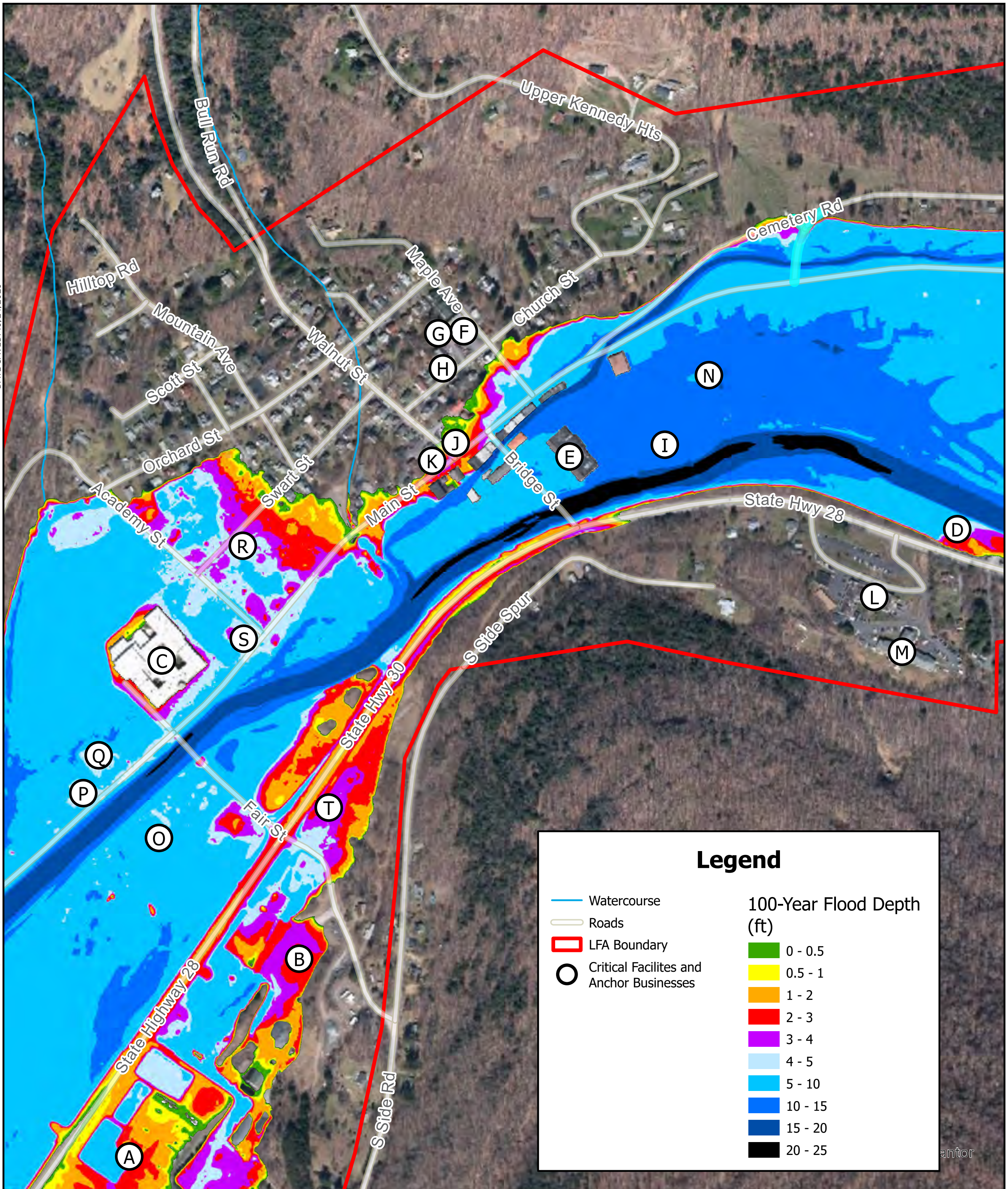


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CRITICAL FACILITES

MARGARETVILLE LOCAL FLOOD ANALYSIS
VILLAGE OF MARGARETVILLE, NY

N
0 250 500
Feet

SCALE 1 in=600 ft
DATE 10/27/2025
PROJ. NO. 142.15197.00023

**FIG. 2-11**

## 2.7 Potential Impacts on Water Quality Due to Flooding

In addition to helping communities identify and mitigate flood hazards, the LFA program mandate includes protecting water quality in the New York City water supply watershed. Flooding is known to cause impaired water quality. Reduction of flooding reduces water quality impairment by reducing the area of land and buildings exposed to floodwaters and by reducing the depth and velocity of floodwaters that mobilize pollutants.

When flooding occurs in Margaretville, roads and parking lots are inundated by floodwaters, causing oils, gasoline, and other pollutants to be mobilized. When flooding is severe, vehicles can become inundated; yards, buildings, and storage areas can be flooded; and tanks and fuel drums can be washed into the EBDR and its tributaries, severely impacting water quality. Septic systems are also vulnerable to flooding and potentially to scour, especially when located within the floodway. Flood mitigation scenarios that prevent or reduce flooding will reduce associated impacts to water quality.

# 3.0 Identification of Flood Hazards

## 3.1 Flooding History

According to the FIS report for Delaware County (36025CV001B), flooding in Delaware County usually occurs during late winter-early spring months when precipitation events combine with snow. Late summer flooding is also a possibility due to thunderstorms and tropical storms/hurricanes. According to the National Oceanic and Atmospheric Administration (NOAA) historical records, Delaware County experienced 92 flood events between April 30, 1950, and October 31, 2011. In the Village of Margaretville, low-lying areas near the EBDR and the confluence of Dry Brook are subject to flooding. Table 3-1 is a summary of flood events that impacted Delaware County. The flood history is summarized from the FEMA FIS report for Delaware County, the Delaware County All Hazard Mitigation Plan, and NOAA historical records.

**Table 3-1: Delaware County Flood History**

| Date | Flood Event | Notes |
|---|---|---|
| **November 1950** | Unnamed Storm Event | The USGS Margaretville gauge (01413500) recorded 20,600 cfs, which is the largest discharge on record at this gauge prior to 1996. |
| **March 1986** | Unnamed Storm Event | The combination of heavy rains and snowmelt caused the East Branch of the Delaware River to overflow its banks. |
| **January 1996** | Unnamed Storm Event | The USGS Margaretville gauge (01413500) recorded 25,800 cfs, a new record, since only passed by TS Irene in 2011. Over 4 inches of rain fell on a melting snow pack, leading to over $20 million of damage in Delaware County. In Margaretville, 30 businesses and the school were damaged. Following the storm, 21 properties were bought out by FEMA. |
| **September 18 and 19, 2004** | Remnants of Tropical Storm Ivan | The remnants of Tropical Storm Ivan produced heavy rains in the upper Delaware River basin. Rainfall amounts ranged from 4 to approximately 6 inches in less than 24 hours. Significant flooding occurred across the basin, resulting in over 1,000 people being displaced and more than 100 homes being damaged. |
| **April 2-5, 2005** | Unnamed Storm Event | A slow-moving storm dropped 2 to 3 inches on Delaware County and, in combination with snowmelt, caused flooding in the area. Damages totalled $4.7 million in Delaware County. One of the hardest hit towns was Margaretville. |
| **June 28, 2006** | Unnamed Storm Event | This is the second most significant recorded flooding event in the Delaware River basin. Around 6 to 15 inches of rain fell in the Upper Delaware River watershed. Flash flooding and record to near-record flood crests along many streams and river throughout the basin, including the main stem. |

| Date | Flood Event | Notes |
|---|---|---|
| **August 28-29, 2011** | Tropical Storm Irene | Hurricane Irene formed from a tropical wave on August 21, 2011, in the tropical Atlantic Ocean. It moved west-northwestward before becoming a hurricane. Irene struck Puerto Rico as a tropical storm. Hurricane Irene steadily strengthened to reach peak winds of 120 miles per hour (mph) on August 24. Irene then gradually weakened and made landfall on the Outer Banks of North Carolina with winds of 85 mph on August 27. It slowly weakened over land and re-emerged into the Atlantic on the following day. On August 28, Irene was downgraded to a tropical storm and made two additional landfalls, one in New Jersey and another in New York.<br>Irene produced heavy damage over much of New York, totaling $296 million. The storm is ranked as one of the costliest in the history of New York, after Hurricane Agnes in 1972. Much of the damage occurred due to flooding, both from heavy rainfall in inland areas and storm surge in New York City and on Long Island. Tropical storm force winds left at least 3 million residents without electricity in New York and Connecticut. Ten fatalities are directly attributed to the hurricane.<br>The USGS gauge on the EBDR at Margaretville (01413500) recorded a new period of record maximum discharge of 35,500 cfs. The recurrence interval was greater than 100 years but less than 500 years. |
| **September 7-8, 2011** | Tropical Storm Lee | Just 2 weeks after Tropical Storm Irene, Lee brought more heavy rains to an already saturated landscape. With precipitation totals reaching up to 13 inches, the Susquehanna River basin was hit hard with many gauges setting new flood elevation records.<br>On the EBDR, Irene, not Lee, was the annual maximum flow, so Lee is not included in peak annual flood statistics. |
| **December 25, 2020** | Unnamed Storm Event | Two to four inches of rain was dropped on Delaware County by a complex storm system. The warmer air melted a substantial snowpack and caused flash flooding in the area, followed by flooding of main river channels on Christmas Day. The EBDR flooded multiple roads throughout the Village of Margaretville. |
| **October 26, 2021** | Unnamed Storm Event | Deep moisture from the Atlantic Ocean was fed into a warm frontal zone located over Central New York. This led to areas of moderate to heavy rainfall totaling between 3 to 5 inches of rain falling over the area. Numerous roads were flooded in Margaretville. |
| **August 8-10, 2024** | Remnants of Tropical Storm Debby | Delaware County issued a State of Emergency and received a Major Disaster Declaration for flooding caused by heavy rains. |

**Figure 3-1: Flood damage in Village of Margaretville after Tropical Strom Irene**
(Photo courtesy of NYCDEP Stream Management Program)

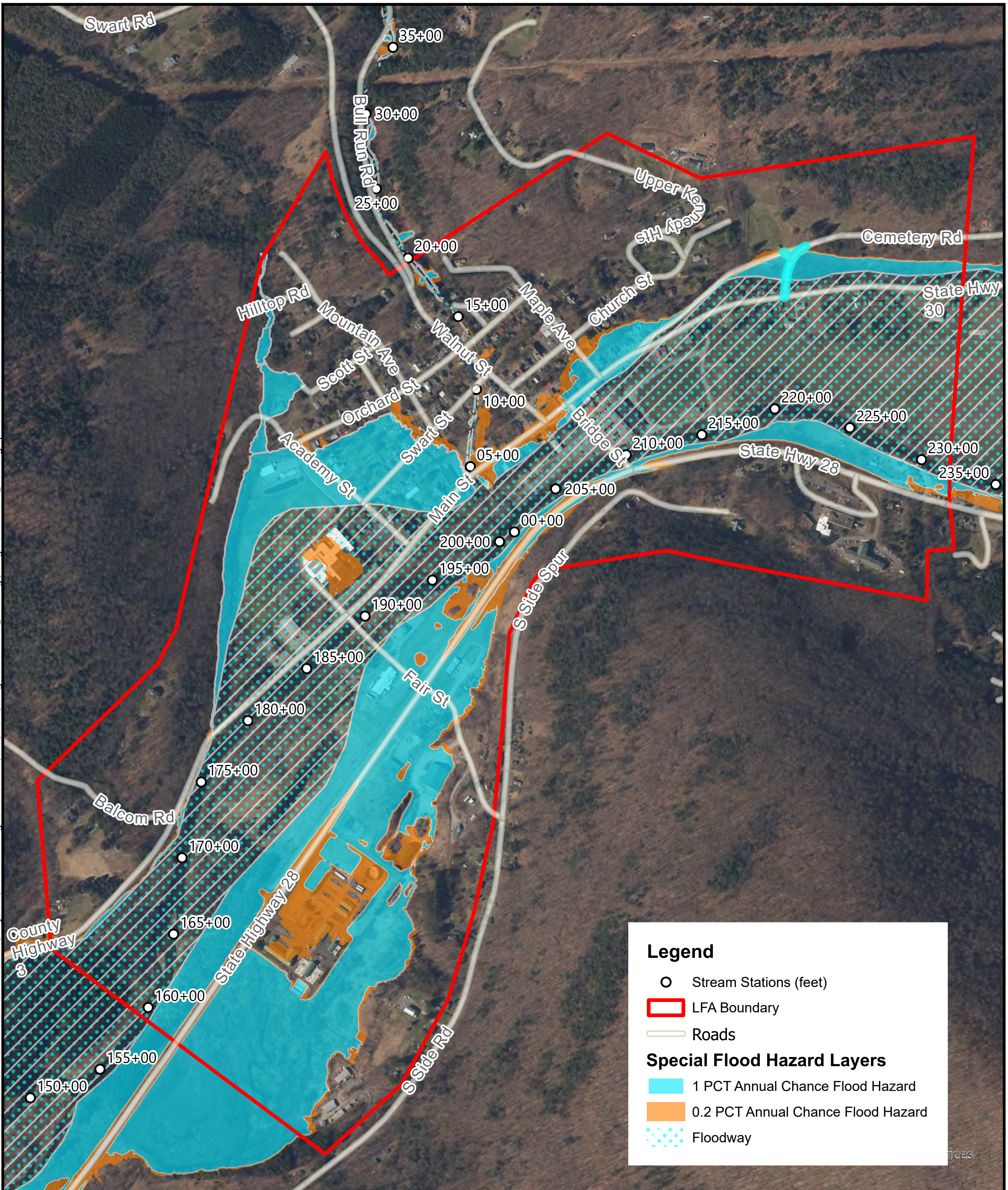
## 3.2 FEMA Mapping

As part of the NFIP, FEMA produces Flood Insurance Rate Maps (FIRMS) that demarcate the regulatory floodplain boundaries. As part of an FIS, the extents of the 100-year and 500-year floods are computed or estimated as well as the regulatory floodway, the area reserved to carry a base flood. The area inundated during the 100-year flood event is also known as the Special Flood Hazard Area (SFHA). In addition to establishing flood insurance rates for the NFIP, the SFHA and other regulatory flood zones are used to enforce local flood damage prevention codes related to development in floodplains.

The current FIS for Delaware County (36025CV001B) has an initial effective date of June 19, 2012, with revisions to some areas of the county effective June 16, 2016. The flood hazard areas delineated by FEMA are mapped for the EBDR. For the 2016 FIS revision, detailed hydrologic and hydraulic analyses were conducted for the section of EBDR within the hamlet of Margaretville. Figure 3-2 depicts flood hazard mapping along the EBDR corridor. The map displays the Special Flood Hazard Layers delineated by FEMA for each focus watercourse in the report, including the 1 percent annual chance flood hazard layer (100-year flood), 0.2 percent annual chance flood hazard layer (500-year flood), and the floodway hazard layer.

The figures provide an overview of what FEMA data is available on each focus watercourse. Residents are encouraged to consult the most recent products available from the FEMA Flood Map Service Center (https://msc.fema.gov/portal/home) for a more complete understanding of the flood hazards that currently exist.

As part of their detailed studies in Delaware County FIS, FEMA developed a series of hydraulic models for focus watercourses using the HEC-RAS computer software. These models are available for professional use and are a valuable component of the LFA. A key element of the HEC-RAS analysis is the determination of the area flooded during the 100-year frequency event, referred to as the SFHA. A detailed HEC-RAS model was created for the LFA study reach of EBDR.

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FEMA MAPPING

VILLAGE OF MARGARETVILLE LOCAL FLOOD ANALYSIS
DELAWARE COUNTY S&WCD
TOWN OF MIDDLETOWN
DELAWARE COUNTY, NEW YORK

N
0 250 500
Feet

SCALE 1" = 850'
DATE 10/27/2025
142.15197.00023
PROJ. NO.

**FIG. 3-2**

# 4.0 Flood Analysis and Recommendations

Multiple flood mitigation approaches to reduce water surface elevations, including bridge and culvert replacements and floodplain bench alternatives, were evaluated in the project area. These are listed below and described in more detail in the sections that follow. Alternatives target minimal alterations of roadways and alignments unless necessary. Complete hydraulic assessments are recommended prior to any upgrades to ensure that replacement structures meet NYSDOT standards and New York State Department of Environmental Conservation (NYSDEC) guidelines for new culverts in terms of hydraulic opening, permissible headwater depths, and aquatic organism passage. Meeting these criteria frequently requires a substantial capital investment, so upgrades must be prioritized to maintain a robust transportation network and efficiently improve flood resiliency. Unscheduled upgrades such as replacement of a failed culvert following a flood are often ad hoc, intended to quickly reopen roads in the aftermath of a storm. In these cases, the replacement structure is frequently the same size or just slightly larger than the one that failed, and the crossing is likely to be damaged again in future floods. Flood resiliency may be improved if undersized culverts have been identified and replacement structures adequately sized, even if only approximately, before damage occurs. Regular culvert inspections and an up-to-date asset inventory may help to prioritize culverts for scheduled replacement and prepare for appropriate repairs in case of flooding damage.

In addition to the flood mitigation approaches listed above, which seek to reduce or eliminate flood damages by reducing water surface elevations, flood protection measures for individual properties were explored. These scenarios were evaluated case by case and seek to reduce flood-related damages by either relocating, floodproofing, or elevating homes and businesses located in flood-prone areas.

## 4.1 Infrastructure Recommendations

Undersized crossings or stream channels can increase flooding. Based on the hydraulic modeling completed for this report, infrastructure improvements at Cemetery Road, Fair Street, Bridge Street, and along Bull Run can reduce the risk of flooding in the Village of Margaretville.

### 4.1.1 Cemetery Road Crossing of Binnekill

Cemetery Road crosses the Binnekill at the intersection with Main Street (Route 30). The existing crossing is a twin pipe culvert (Figure 4-1). It is undersized and reportedly clogs with branches and debris, further reducing flow through the Binnekill. During times of high flow on the Binnekill, the culvert can be overwhelmed and lead to increased flooding of Main Street, making it dangerous to pass. Flood depths for the existing conditions are shown in Figure 4-2 andFigure 4-4.

It is recommended to replace the existing crossing with an open-bottom box culvert with a span of 20 feet. A box culvert has a greater flow capacity and is less prone to being clogged than two pipes. To further increase the flow capacity, the village is to provide debris removal along the Binnekill annually and after storms. The recommended culvert will reduce the risk of flooding along Main Street from the Binnekill in low-magnitude flood events (Figure 4-3). The modeled low-magnitude flood depths decrease by 0.5 feet with the replaced culvert. During larger flood events, like a 100-year peak flood, the benefits will be negated as the full valley floodplain fills and Cemetery Road is overtopped by 4 feet of water (Figure 4-5). Under future 100-year conditions, the model shows Cemetery Road overtopped by 5.5 to 6 feet of water.

**Figure 4-1: Inlet of Cemetery Road culvert, with debris in the channel**

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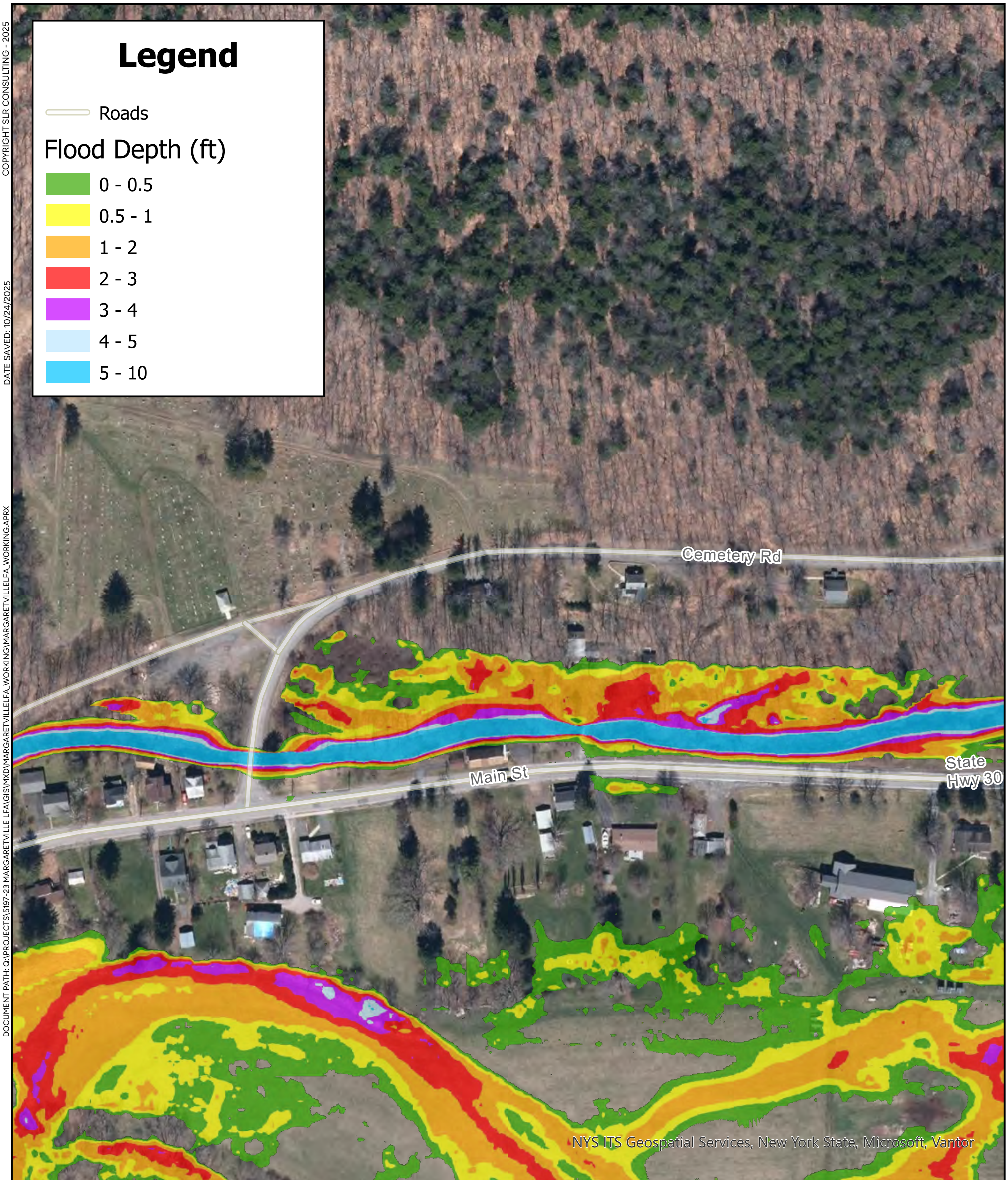


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EXISTING CONDITIONS CEMETERY ROAD LOW LEVEL FLOOD DEPTH

MARGARETVILLE LOCAL FLOOD ANALYSIS

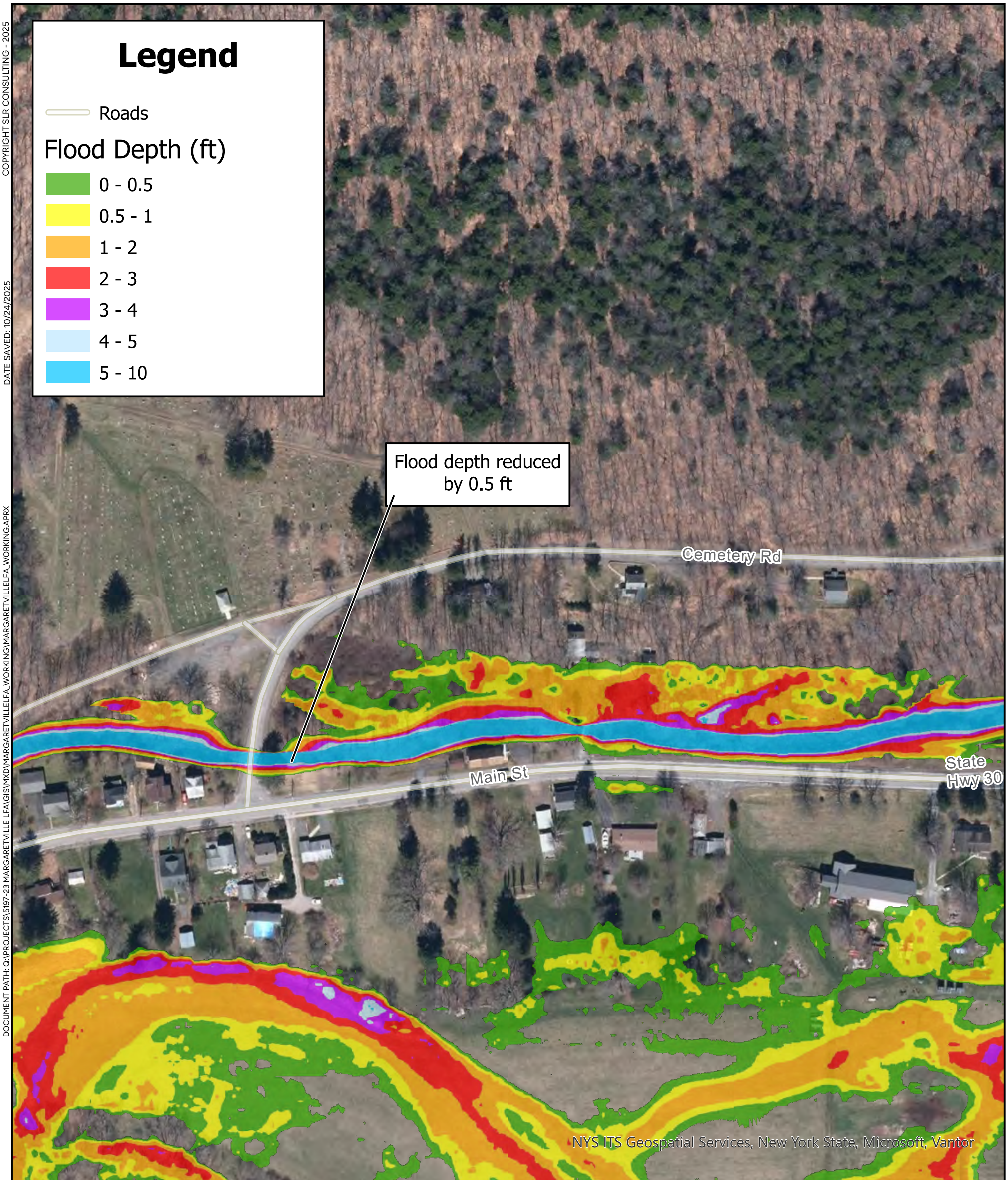
VILLAGE OF MARGARETVILLE, NY

N

0 100 200
Feet

| | |
|---|---|
| SCALE | 1 in=200 ft |
| DATE | 10/27/2025 |
| PROJ. NO. | 142.15197.00023 |

**FIG. 4-2**



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PROPOSED CONDITIONS CEMETERY ROAD LOW LEVEL FLOOD DEPTH

MARGARETVILLE LOCAL FLOOD ANALYSIS

VILLAGE OF MARGARETVILLE, NY

N

0 100 200

Feet

| | |
|---|---|
| SCALE | 1 in=200 ft |
| DATE | 10/27/2025 |
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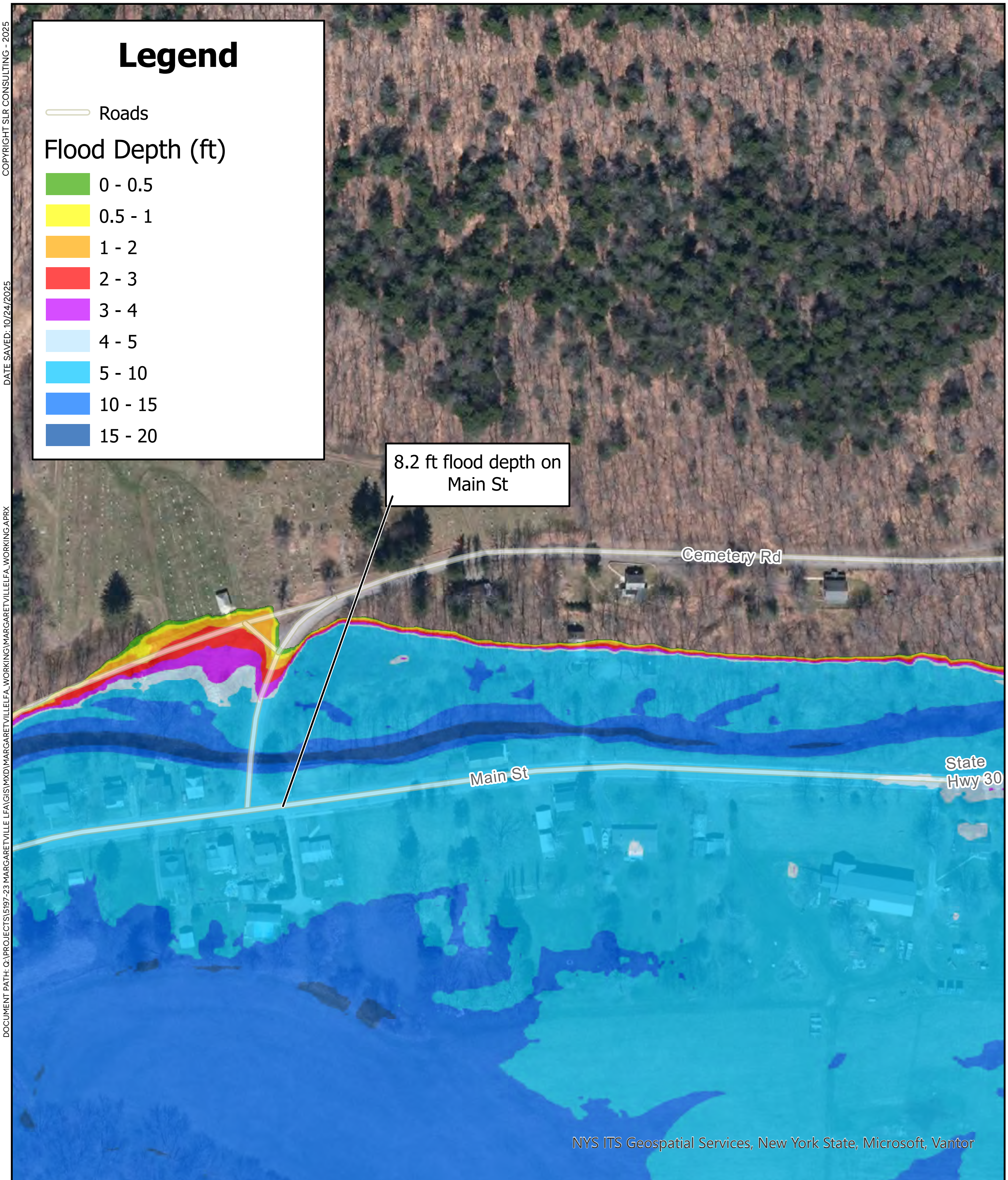
**FIG. 4-3**



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EXISTING CONDITIONS CEMETERY ROAD 100-YEAR FLOOD DEPTH

MARGARETVILLE LOCAL FLOOD ANALYSIS

VILLAGE OF MARGARETVILLE, NY

N

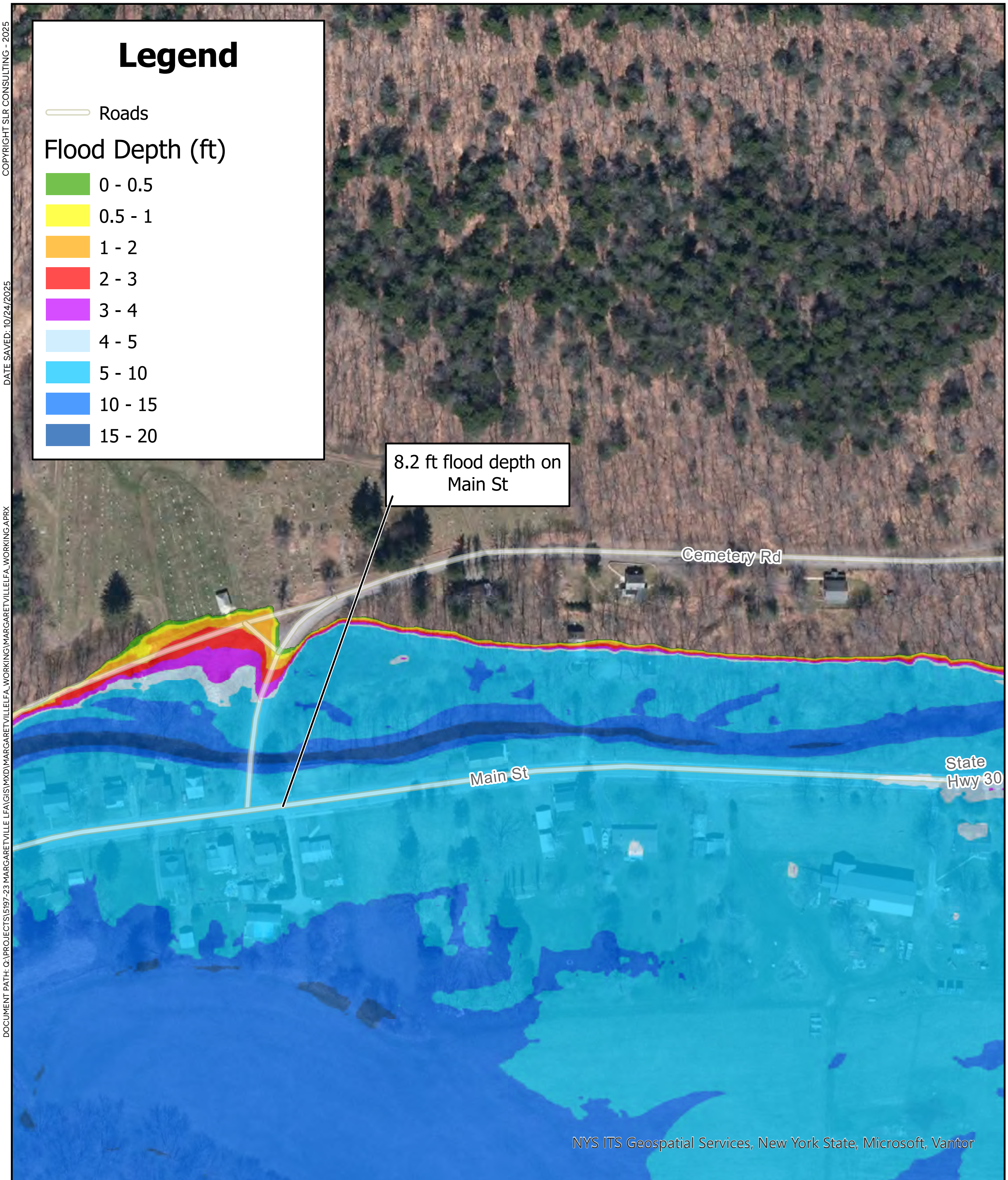
0 100 200
Feet

SCALE 1 in=200 ft

DATE 10/27/2025

PROJ. NO. 142.15197.00023

FIG. 4-4



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PROPOSED CONDITIONS CEMETERY ROAD
100-YEAR FLOOD DEPTH

MARGARETVILLE LOCAL FLOOD ANALYSIS

VILLAGE OF MARGARETVILLE, NY

N

0 100 200
Feet

SCALE 1 in=200 ft

DATE 10/27/2025

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FIG. 4-5

### 4.1.2 Bridge Street Crossings

Bridge Street crosses both the EBDR (BIN 1053430, Figure 4-8) and Binnekill (BIN 1020840, Figure 4-7). The road between the two crossings is the primary access to the parking lot for the grocery store, pharmacy, and other businesses (Figure 4-9). The road is in a low-lying area that is prone to flooding. During the flooding caused by Hurricane Irene, the Bridge Street bridge over the EBDR overtopped and flooding damaged a several buildings between the EBDR and Binnekill (Figure 4-6). The analysis completed for this report shows that the bridge creates a backwater and increases the flood depths upstream of the bridge (Figure 4-10).

**Figure 4-6: Damage in Margaretville, near Bridge Street, after Tropical Storm Irene**
(Photo courtesy of NYCDEP Stream Management Program)

The Bridge Street crossings and Fair Street (Section 4.1.3) are the main access routes between Margaretville and Route 28, which leads to the nearest hospital and other critical facilities.

NYSDOT has stated that the Bridge Street crossing over the EBDR is due for replacement in 2029. Based on the analysis in this study, it is recommended that the design process for the replacement structure includes consideration of the following:

- An option to span from Route 28 to Main Street. Alternative traffic routes to the parking area may be available via New York City-owned property on Main Street.
- Scenarios in which the structure at 36-60 Bridge Street is removed and the businesses, currently including CVS and Freshtown Marketplace, are relocated out of the SFHA. The

building was severely damaged during the 2011 flood and may not be rebuilt after another large flood event.

- Alternative designs of the Fair Street bridge over the EBDR (see Section 4.1.3)
- Alternative designs at the Binnekill inlet (see Section 4.1.5)
- Seek opportunities to reduce flood depth and velocity

Note that any changes must be outside of the 200-foot buffer surrounding the water supply located in the field behind 36-60 Bridge Street, following Department of Health guidelines.

**Figure 4-7: Bridge Street bridge over the Binnekill (BIN 1020840)**

A layout of the configuration at Bridge Street and surrounding area is shown in Figure 4-9. Figure 4-10 and Figure 4-11 show the 100-year flow conditions, with and without Bridge Street and its supporting structures respectively. Removal of the bridge from the model results in a reduction in water surface elevations by approximately 1.5 feet during the 100-year flood event. The model does not show significant additional reduction in flood depths when the CVS/Freshtown Marketplace building is removed as well. The bridge is the primary constriction.

Under the existing conditions, a 100-year peak flow overtops the Bridge Street bridge over the EBDR by 4 feet and the bridge over the Binnekill by about 6.5 feet, according to the hydraulic model. Under future flow conditions, these depths are expected to increase by 1 to 2 feet during the next 50 years.

**Figure 4-8: Bridge Street bridge (BIN 1053430) over the EBDR is scheduled for replacement in 2029**

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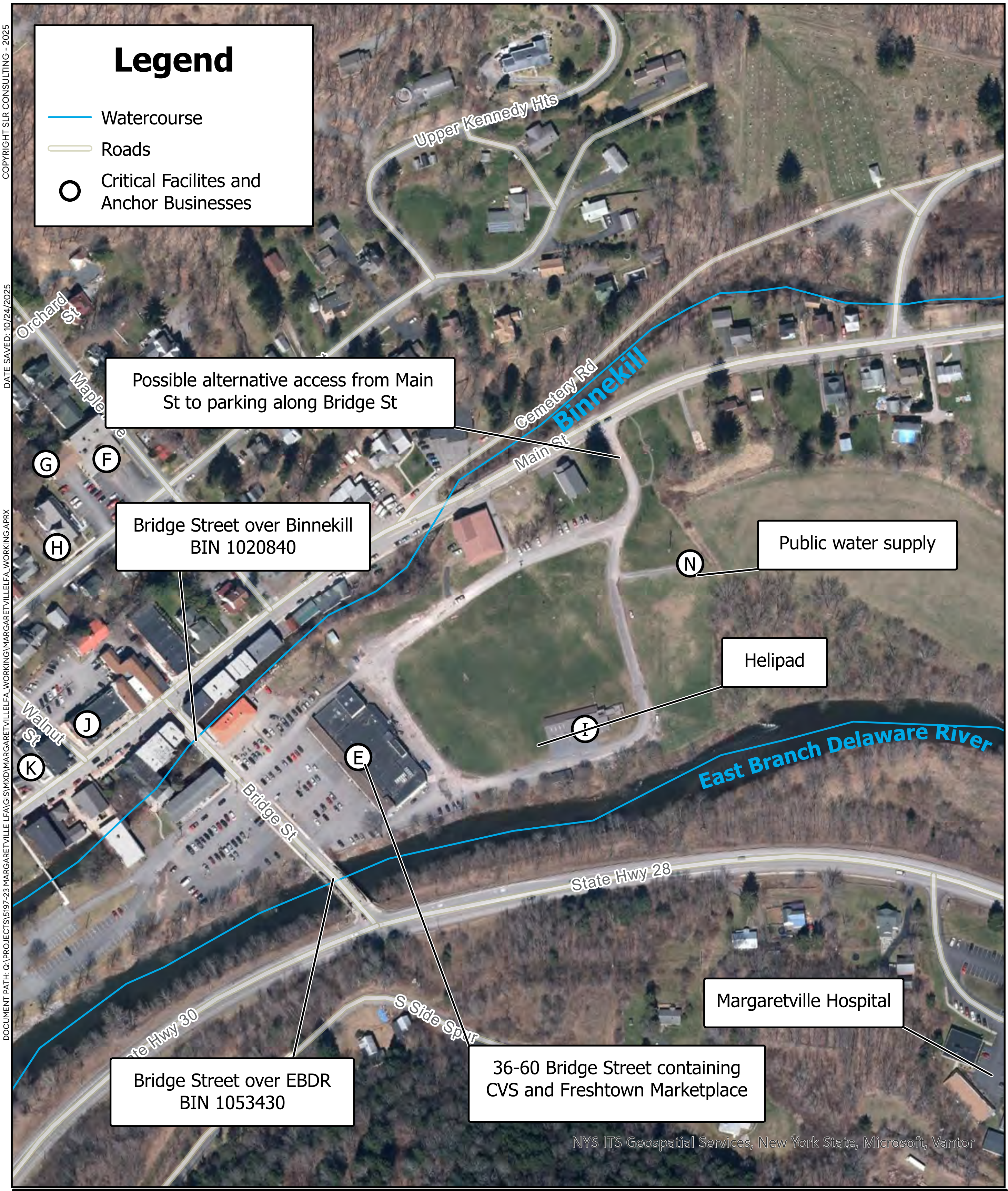


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BRIDGE STREET BRIDGES REMOVED
100-YEAR FLOOD DEPTHS

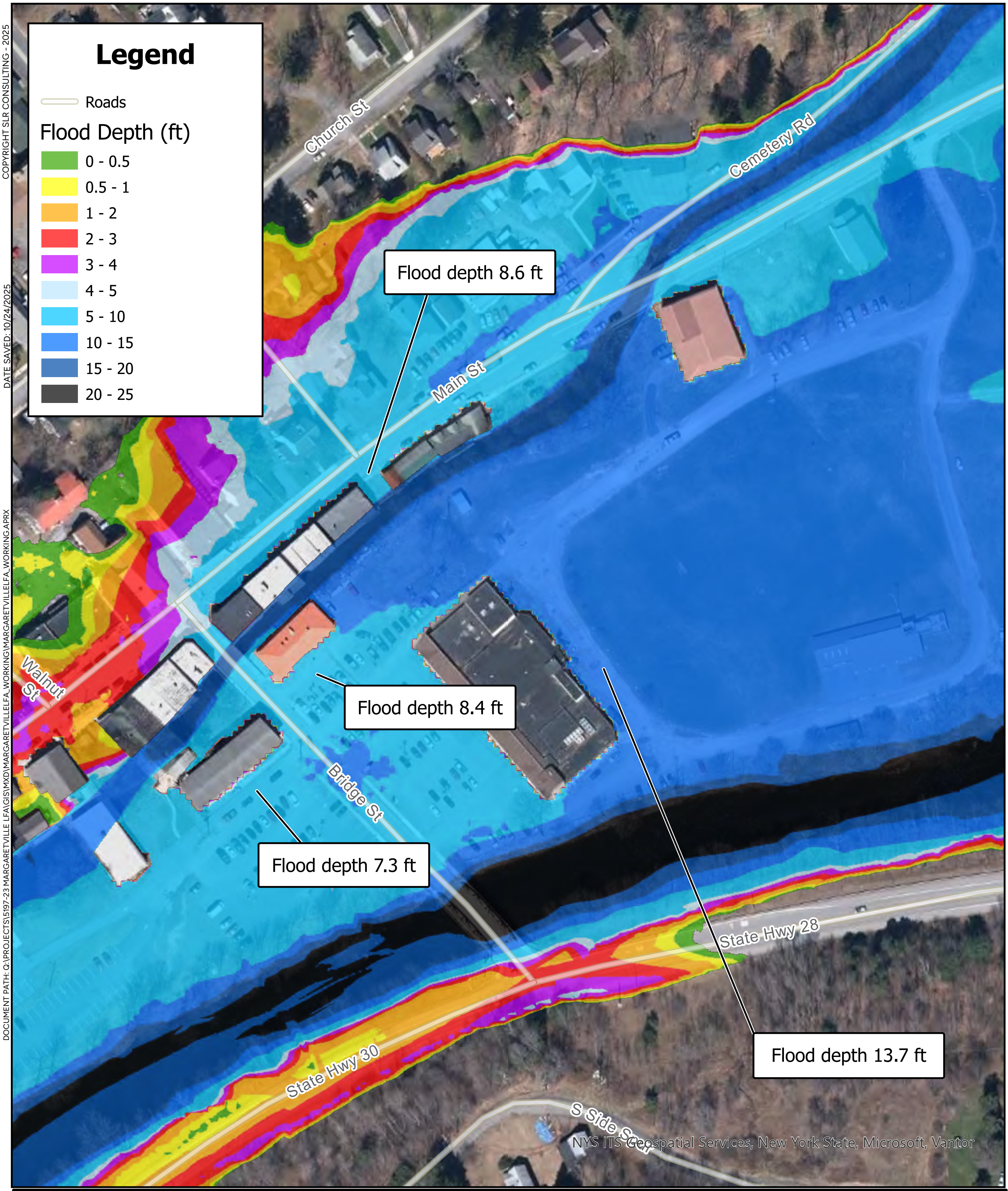
MARGARETVILLE LOCAL FLOOD ANALYSIS

VILLAGE OF MARGARETVILLE, NY

N

0 100 200
Feet

| | |
|---|---|
| SCALE | 1 in=250 ft |
| DATE | 10/27/2025 |
| PROJ. NO. | 142.15197.00023 |
| | FIG. 4-9 |

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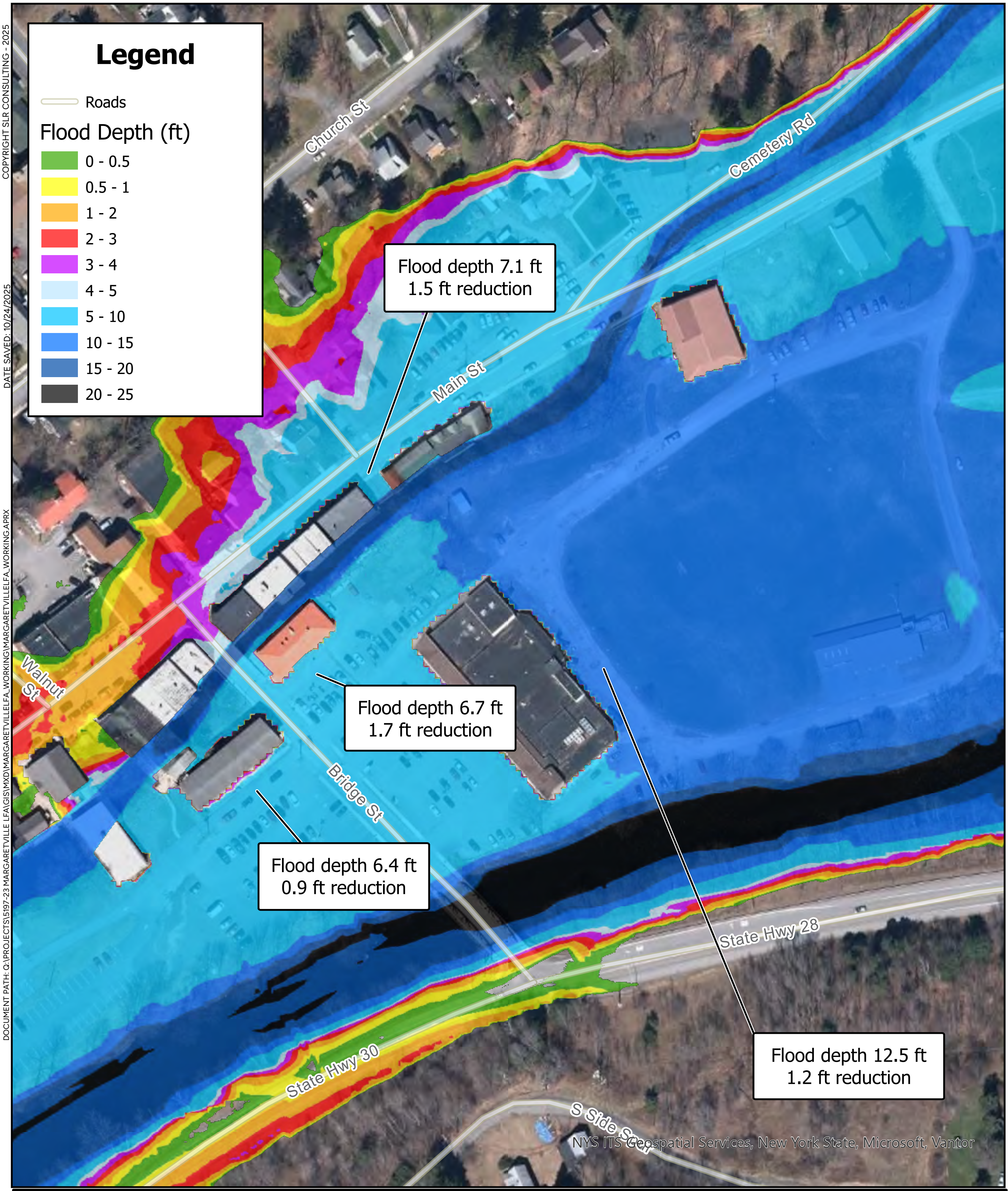
BRIDGE STREET EXISTING CONDITIONS
100-YEAR FLOOD DEPTH

MARGARETVILLE LOCAL FLOOD ANALYSIS

VILLAGE OF MARGARETVILLE, NY

SCALE 1 in=150 ft
DATE 10/27/2025
PROJ. NO. 142.15197.00023

**FIG. 4-10**

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BRIDGE STREET WITH BRIDGES REMOVED
100-YEAR FLOOD DEPTH

MARGARETVILLE LOCAL FLOOD ANALYSIS

VILLAGE OF MARGARETVILLE, NY

N

0 100 200
Feet

SCALE 1 in=150 ft
DATE 10/27/2025
PROJ. NO. 142.15197.00023

**FIG. 4-11**

### 4.1.3 Fair Street

Fair Street (BIN 3353060) crosses the EBDR downstream of the Bridge Street crossing. Along with Bridge Street, it is one of the two main access points to the Village of Margaretville from Route 28. It is across from Margaretville Central School and is heavily used for school traffic. South of the bridge, Fair Street passes through a low-lying flood-prone area before reaching Route 28. During periods of high water, the Fair Street bridge may be passable, but the roadway approaches flood and are unsafe to pass. A layout of Fair Street and the surrounding roads is given in Figure 4-13.

Based on the modeling completed for this study, the Fair Street bridge can pass the 10-year peak flow and future 10-year peak flows but overtops in the current and future 50- and 100-year peak flows. The bridge creates a maximum of about half a foot of backwater, which does not extend to Bridge Street. The roadway east of the bridge is lower than the bridge deck and floods with a few feet of water during low-magnitude floods, around 10-year peak flows (Figure 4-14). Although the bridge is passable, the roadway is not. It is not safe to drive on flooded roads. All of Fair Street is flooded during a 100-year peak flow (Figure 4-16).

On the upstream side of the bridge, the southern span has been partially filled in by a sediment bar, which can reduce the bridge's flow capacity during times of flood (Figure 4-12). See Section 4.3 for recommendations for sediment management.

A feasibility study is recommended to assess the impacts and benefits of removing the Fair Street crossing when it is due for replacement. The study should include any changes made to Bridge Street, which is due for replacement in 2029 (see Section 4.1.2), as well as a traffic assessment for the school, emergency routes, and daily travel.

Removal of the bridge and supporting structures leads to a modest reduction in flood depths in low-level, high-frequency floods (Figure 4-15). The benefit is much less significant in high-level, low-frequency floods such as the 100-year flood (Figure 4-17).

**Figure 4-12: Sediment bar on upstream side of Fair Street bridge**


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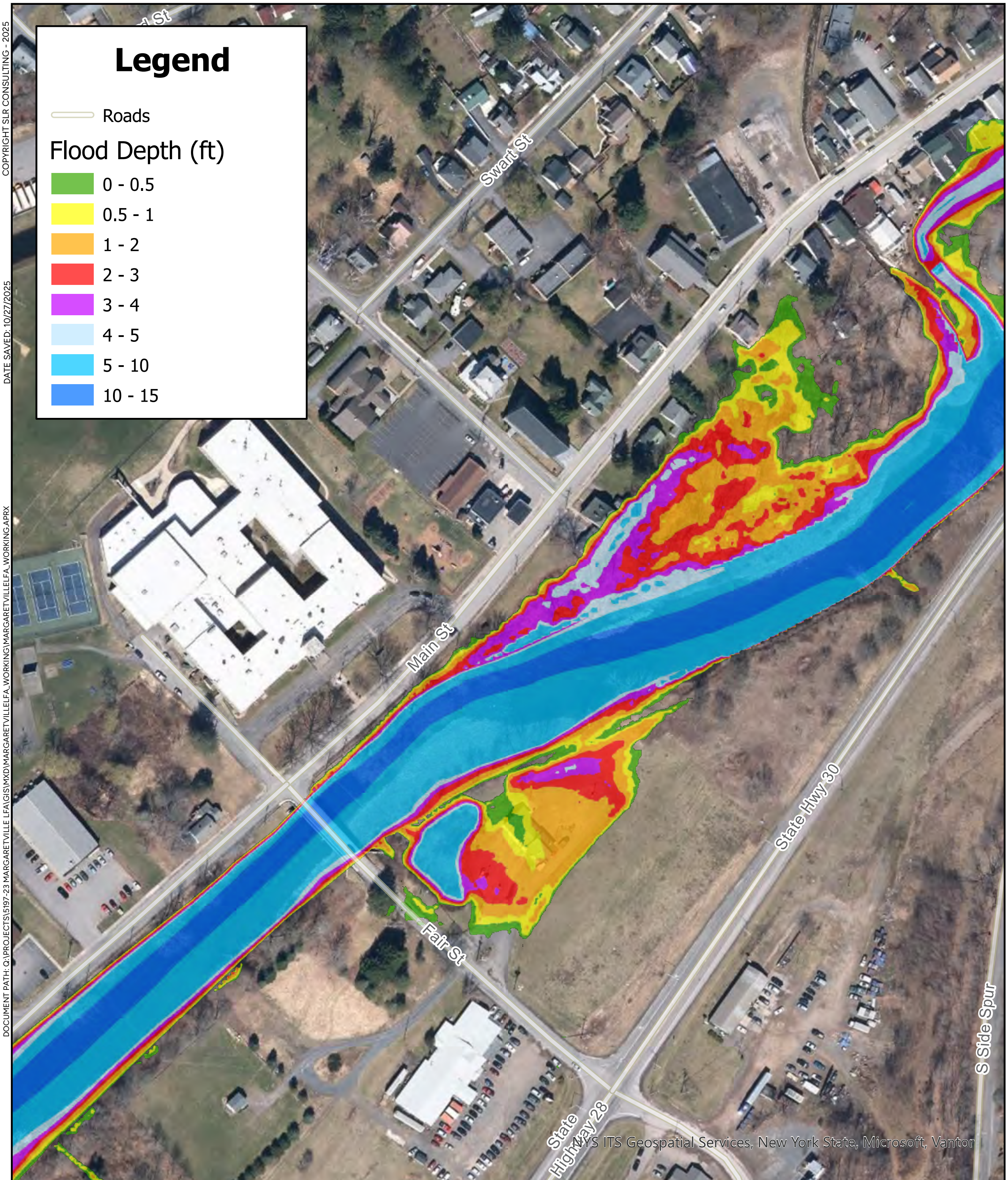
FAIR STREET LAYOUT

MARGARETVILLE LOCAL FLOOD ANALYSIS
VILLAGE OF MARGARETVILLE, NY

N
0 100 200
Feet

| | |
|---|---|
| SCALE | 1 in=200 ft |
| DATE | 10/27/2025 |
| PROJ. NO. | 142.15197.00023 |
| | FIG. 4-13 |

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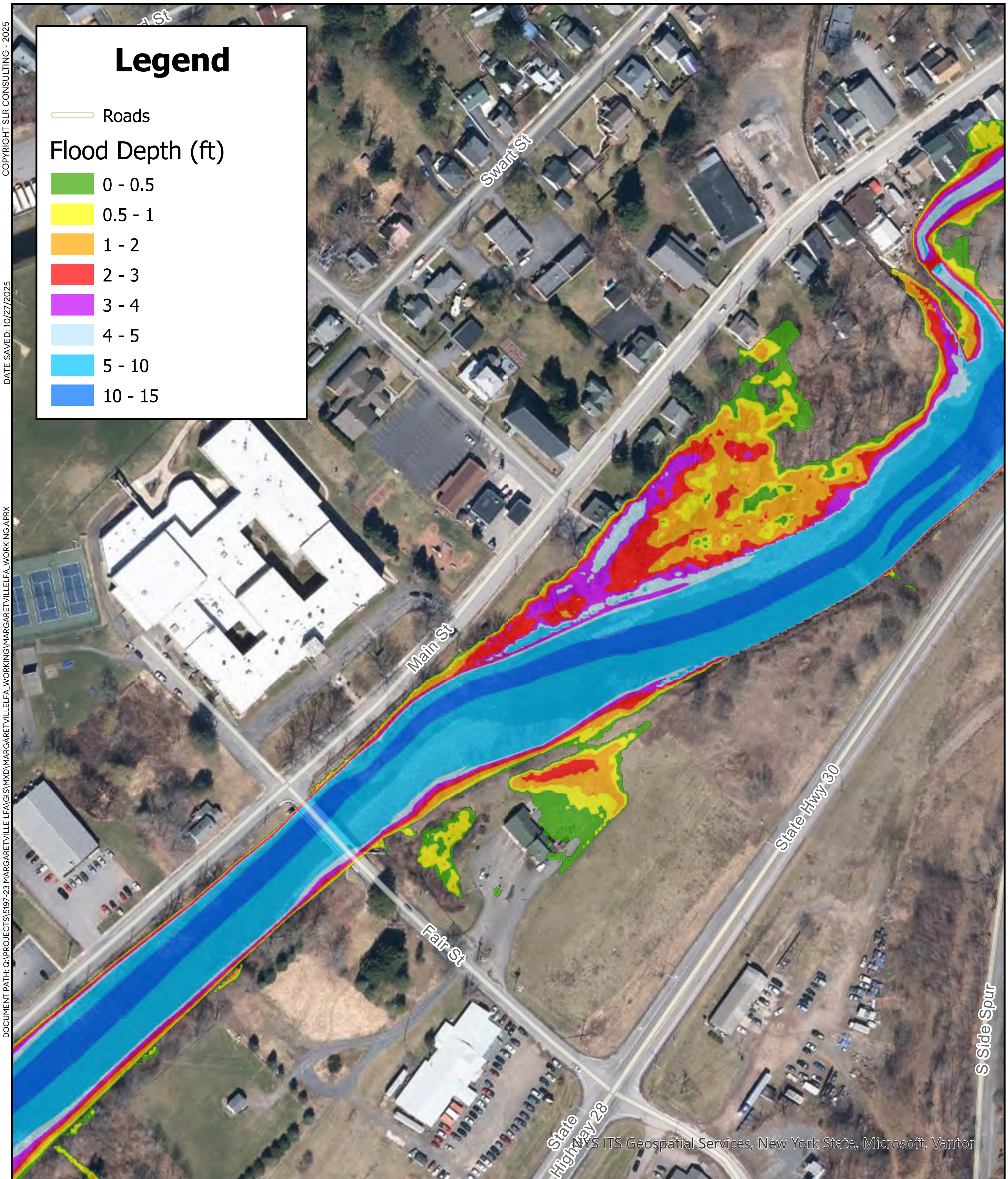
FAIR STREET EXISTING CONDITIONS
LOW LEVEL FLOOD DEPTHS

MARGARETVILLE LOCAL FLOOD ANALYSIS
VILLAGE OF MARGARETVILLE, NY

N
0 100 200
Feet

SCALE 1 in=200 ft
DATE 10/27/2025
PROJ. NO. 142.15197.00023

**FIG. 4-14**



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FAIR STREET WITH BRIDGE REMOVED
LOW LEVEL FLOOD DEPTHS

MARGARETVILLE LOCAL FLOOD ANALYSIS
VILLAGE OF MARGARETVILLE, NY

N

0 100 200
Feet

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| SCALE | 1 in=200 ft |
| DATE | 10/27/2025 |
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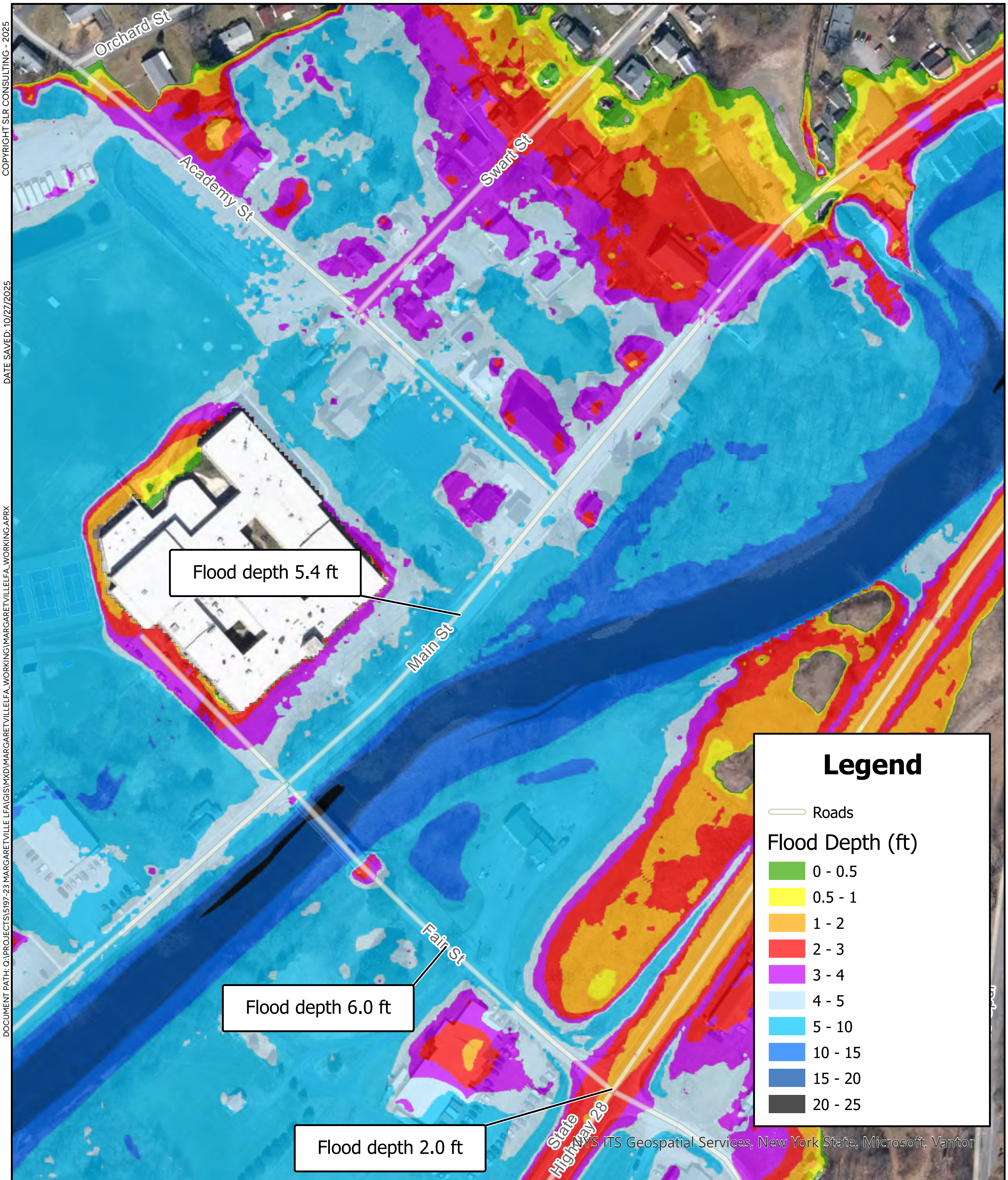
**FIG. 4-15**





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FAIR STREET EXISTING CONDITIONS
100-YEAR FLOOD DEPTHS

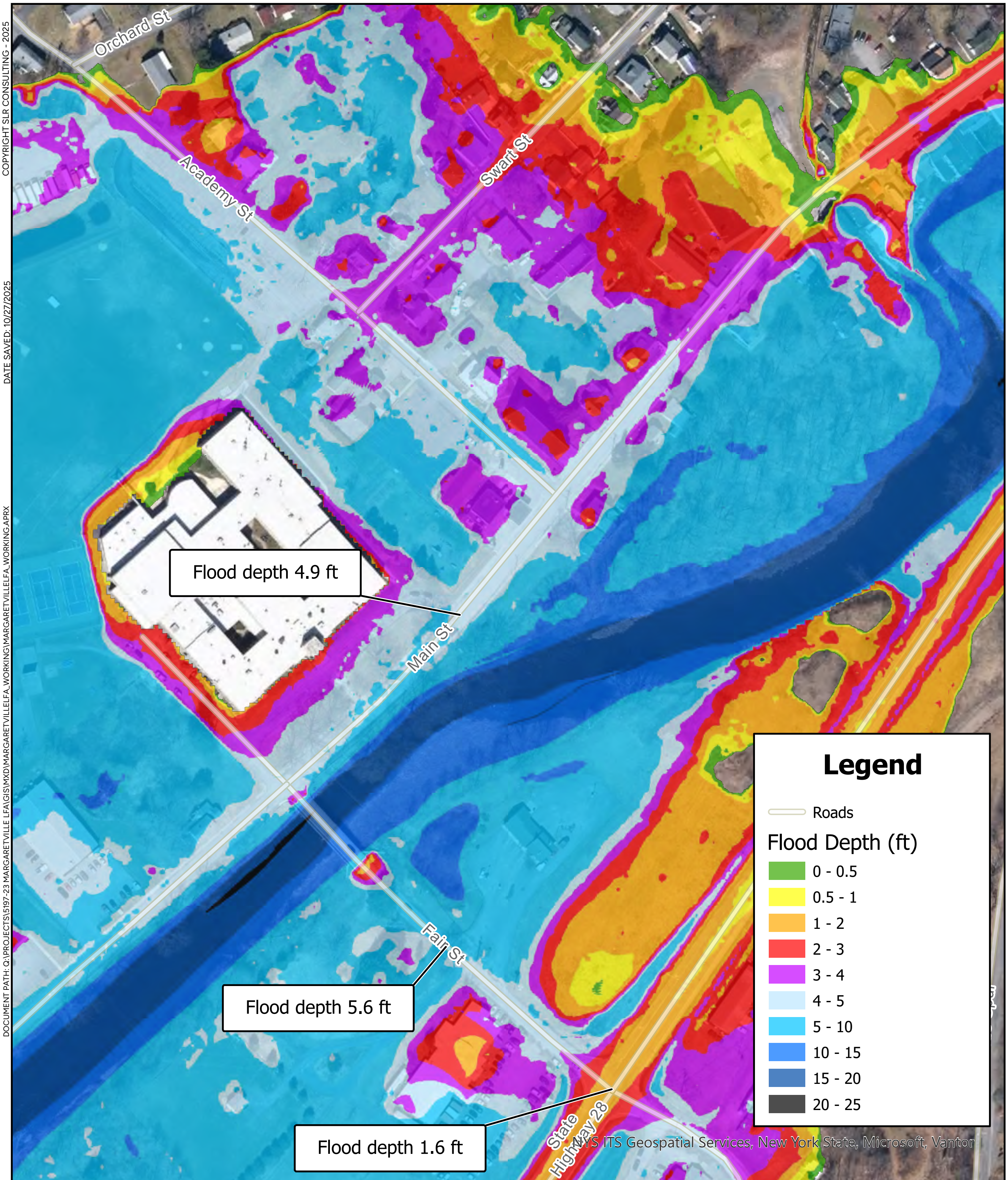
MARGARETVILLE LOCAL FLOOD ANALYSIS
VILLAGE OF MARGARETVILLE, NY

N

0 100 200
Feet

SCALE 1 in=200 ft
DATE 10/27/2025
PROJ. NO. 142.15197.00023

**FIG. 4-16**

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FAIR STREET WITH BRIDGE REMOVED
100-YEAR FLOOD DEPTH

MARGARETVILLE LOCAL FLOOD ANALYSIS
VILLAGE OF MARGARETVILLE, NY

N

0 100 200
Feet

SCALE 1 in=200 ft
DATE 10/27/2025
PROJ. NO. 142.15197.00023

**FIG. 4-17**

### 4.1.4 Bull Run Channel and Crossings

Bull Run was evaluated using the FEMA one-dimensional model, which was updated to include the replaced bridge and channel widening at Swart Street (BIN 3370900) (Figure 4-18). Since the completion of construction in 2017, aggradation in the widened section of the channel has risen the streambed about 2 feet (Figure 4-19). The added sediment has decreased the hydraulic opening of the bridge significantly.

The bridge replacement project follows good stream management practices of creating a multistage channel, with a low-flow channel, and widening the previously constricted stream. However, this improved section is isolated. The velocity decreases in the widened reach, reducing sediment transport, leading to aggradation. The velocity increases again downstream of the reach. It is recommended to extend the 25-foot-wide multistage channel upstream about 600 feet upstream to the start of the retaining wall and 1,000 feet downstream to the confluence with the EBDR (Figure 4-20). The peak flood depths are modeled to decrease by about 2 feet in the 50-year flow and nearly 3 feet in the 100-year flow near Swart Street, which allows flows to stay in the channel, rather than overtopping and flooding the roadway and neighboring properties.

It is recommended to start with projects at the downstream end of the Bull Run and move upstream to reduce downstream impacts. Increasing the capacity of Bull Run upstream of a section of undersized channel may increase flooding and cause scour of bed material. Widening the channel will require permission of the creek side property owners. The south (downstream) side of the Main Street culvert crossing is the only place that the stream is constrained by buildings on both sides such that, with property owner approval, it may be possible to design the widened stream in a way that only requires removal of one structure.

A sediment transport model is recommended to properly size the low-flow channel and floodplain bench. Additionally, it is recommended to reduce the sediment supply in Bull Run as further described in Section 4.3. The alignment of the outlet of Bull Run into the EBDR is constrained by a berm. With the sediment transport model, it is recommended to assess realignment of the outlet and berm, including during high flows on the EBDR.

**Figure 4-18: Inlet of Swart Street bridge over Bull Run with low-flow channel**

**Figure 4-19: Sediment has deposited under the Swart Street bridge, reducing the rise to about 2 feet on the northeast side**




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BULL RUN CONCEPT PLAN

MARGARETVILLE LOCAL FLOOD ANALYSIS
VILLAGE OF MARGARETVILLE, NY

| | |
|---|---|
| SCALE | 1 in=200 ft |
| DATE | 10/27/2025 |
| PROJ. NO. | 142.15197.00023 |

**FIG. 4-20**

### 4.1.5 Binnekill Inlet Berm

Using the two-dimensional model, an option to extend the berm at the Binnekill inlet was evaluated. The Binnekill inlet was repaired in 2021 to replace the inlet pipe that was in poor condition and had become crushed. As part of the construction, a berm was created to angle water towards the EBDR downstream of the inlet. During some high-water events, water goes around the berm, back to the Binnekill, which is then more prone to flooding and inundating structures along Main Street while the EBDR still has additional capacity (Figure 4-21). The aim of extending the berm is to keep flow directed toward the EBDR, across a farm field, rather than prematurely overwhelming the Binnekill and causing additional damage. In the two-dimensional hydraulic model, extending the berm by 300 feet and raising it to an elevation of 1,330 feet was effective in reducing the water surface elevation by up to 2 feet along the Binnekill in a low-magnitude flood (Figure 4-22). In larger floods, such as the 100 year flood shown in Figure 4-23 and Figure 4-24, the berm would overtop as the valley floodplain fills in and connects the EBDR to the Binnekill, with little change in flood depths between the existing and proposed conditions. The initial modeling supports that extending the berm would reduce the impact of low-magnitude flooding on some homes along Main Street east of Maple Street.

It is recommended that a feasibility study evaluates extending and raising the berm from the Binnekill inlet. It is necessary to prove that the creation of the berm, likely combined with lowering floodplain, will not cause a rise in water surface elevation.

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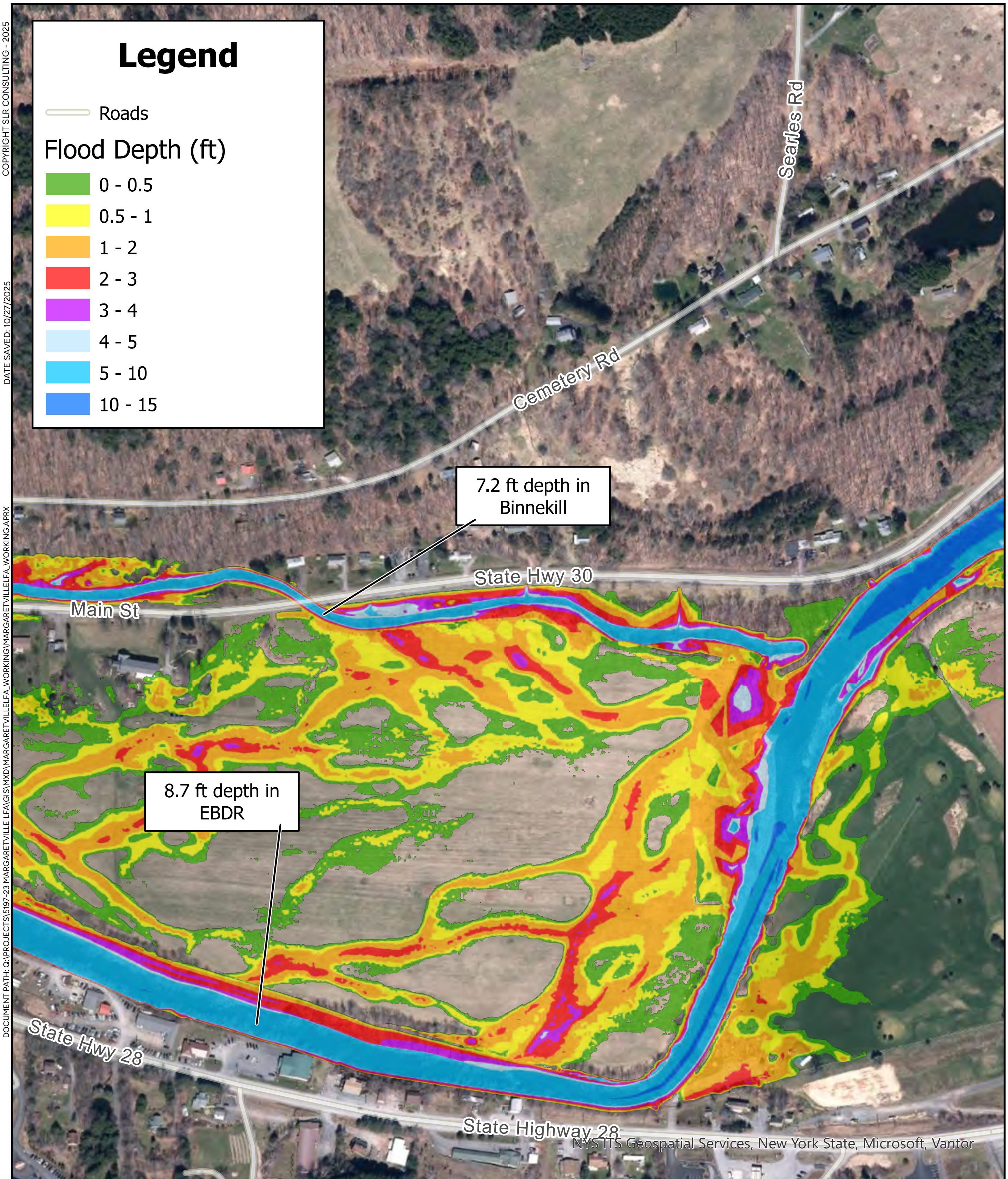


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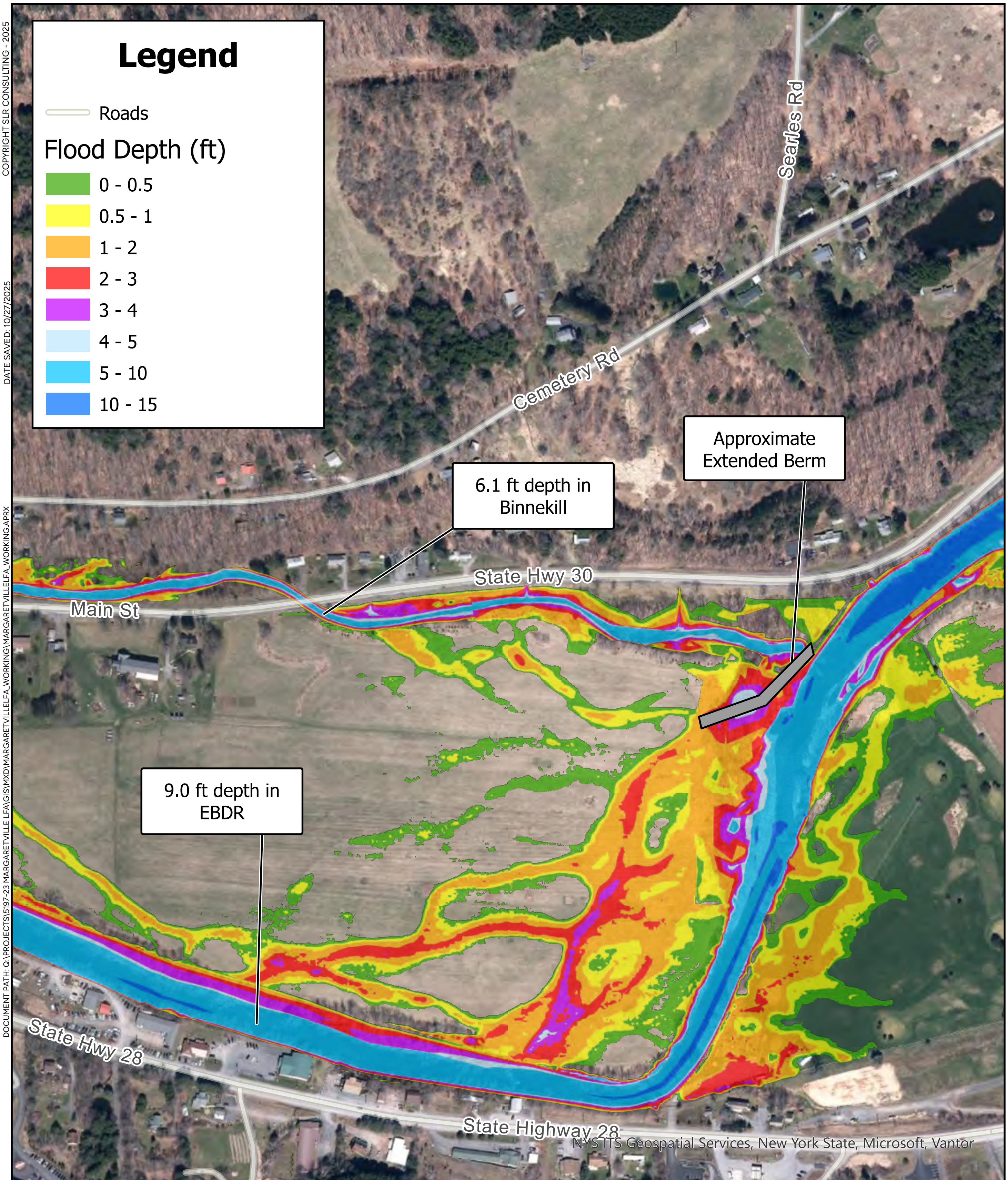
EXISTING CONDITIONS INLET BERM
LOW LEVEL FLOOD DEPTH

MARGARETVILLE LOCAL FLOOD ANALYSIS

VILLAGE OF MARGARETVILLE, NY

N
0 200 400
Feet

| | |
|---|---|
| SCALE | 1 in=400 ft |
| DATE | 10/27/2025 |
| PROJ. NO. | 142.15197.00023 |
| | FIG. 4-21 |

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PROPOSED CONDITIONS INLET BERM
LOW LEVEL FLOOD DEPTH

MARGARETVILLE LOCAL FLOOD ANALYSIS

VILLAGE OF MARGARETVILLE, NY

N

0 200 400
Feet

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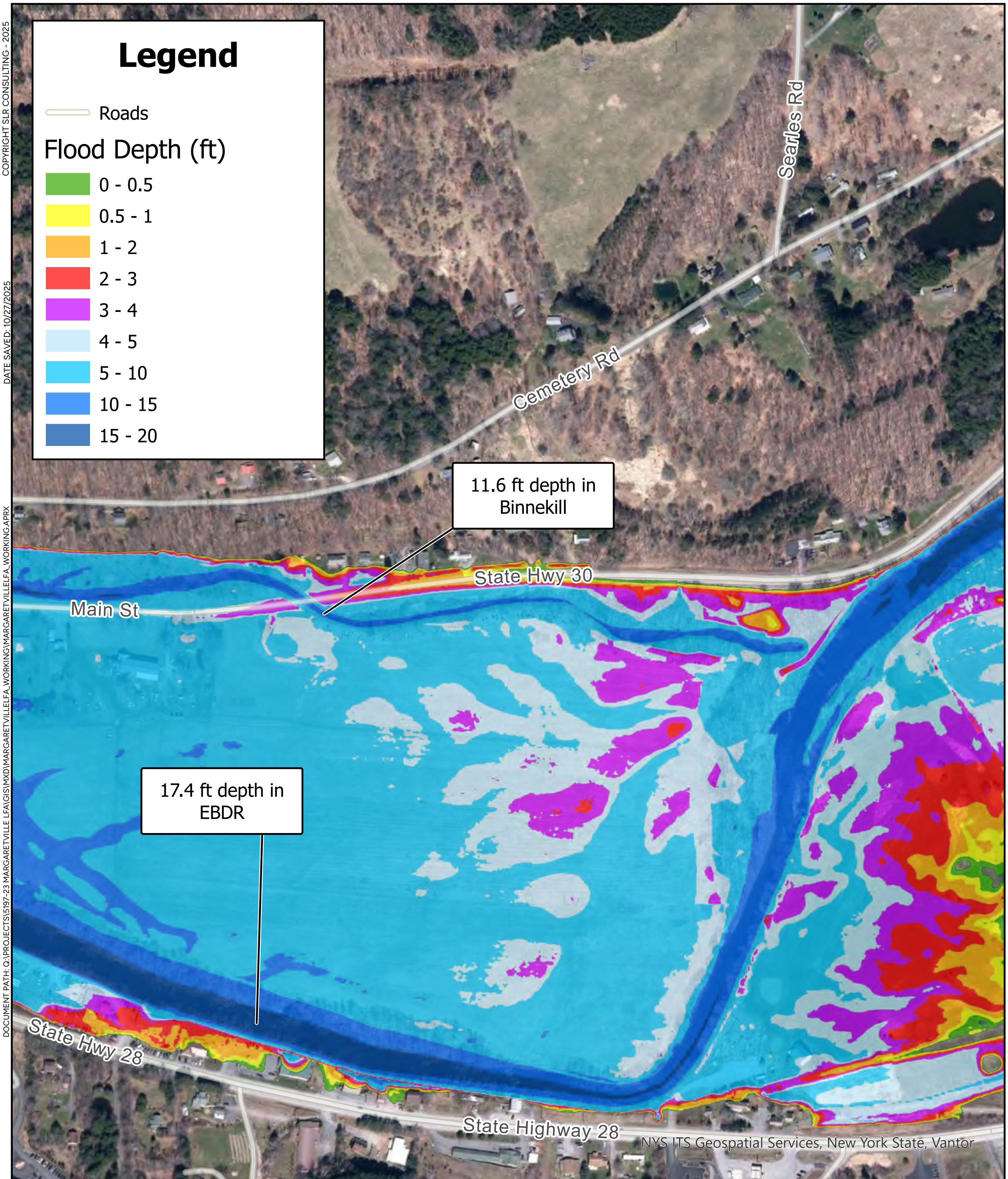
| SCALE | 1 in=400 ft |
| DATE | 10/27/2025 |
| PROJ. NO. | 142.15197.00023 |
| | FIG. 4-22 |





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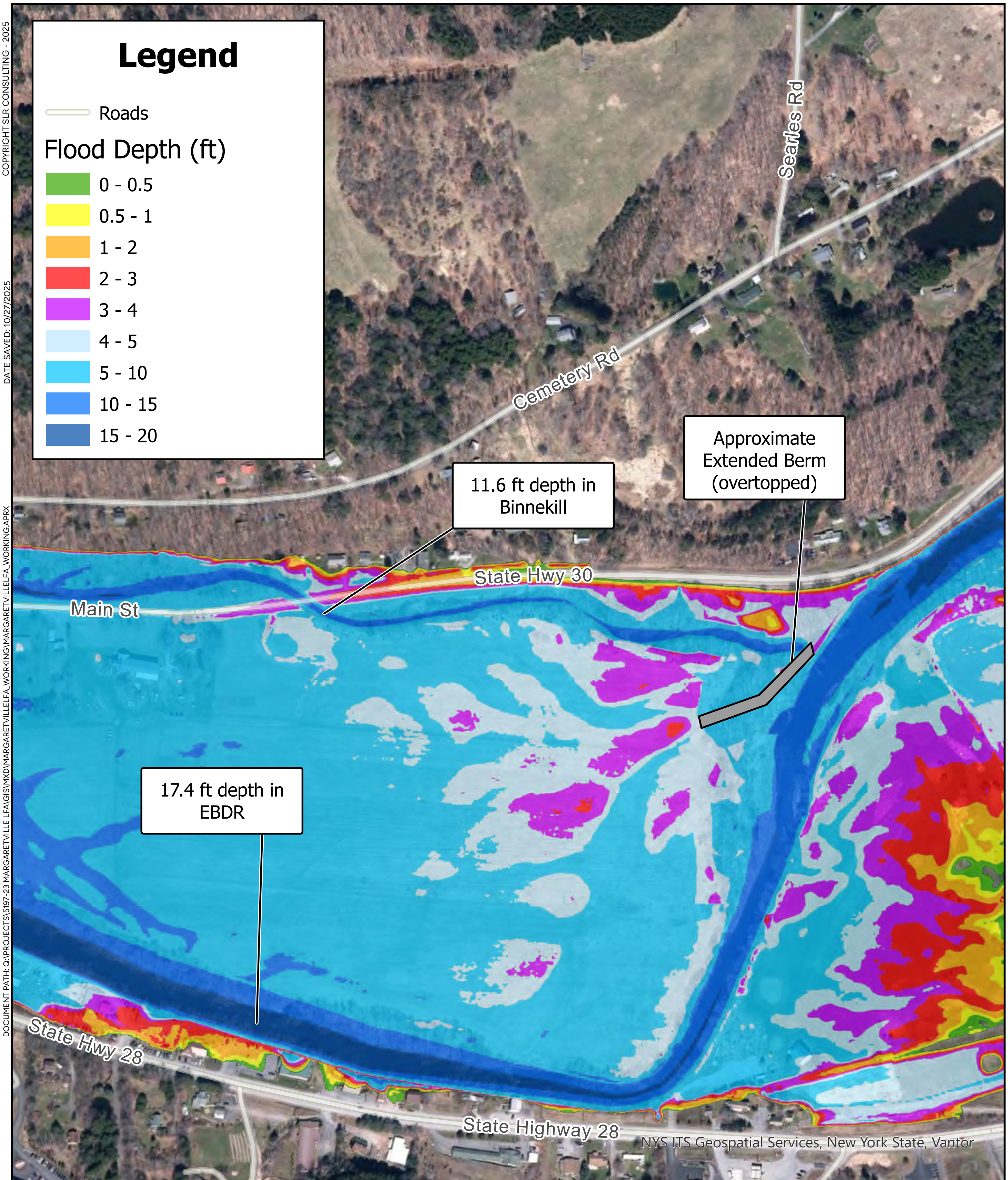
EXISTING CONDITIONS INLET BERM
100-YEAR FLOOD DEPTH

MARGARETVILLE LOCAL FLOOD ANALYSIS

VILLAGE OF MARGARETVILLE, NY

| | |
|---|---|
| SCALE | 1 in=400 ft |
| DATE | 10/27/2025 |
| PROJ. NO. | 142.15197.00023 |

**FIG. 4-23**

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PROPOSED CONDITIONS INLET BERM
100-YEAR FLOOD DEPTH
MARGARETVILLE LOCAL FLOOD ANALYSIS
VILLAGE OF MARGARETVILLE, NY

| | |
|---|---|
| SCALE | 1 in=400 ft |
| DATE | 10/27/2025 |
| PROJ. NO. | 142.15197.00023 |

**FIG. 4-24**

### 4.1.6 Additional Crossings

The culvert that carries Scott’s Brook under Main Street (Figure 4-25) was also analyzed in this study due to concerns about increased flooding of the sports fields behind Margaretville Central School. Based on the HY-8 model developed for this study, the culvert sufficiently passes storm flows and overtops only in the 500-year flow scenario. However, the crossing is heavily influenced by the water surface elevations of the EBDR. As the EBDR rises, the outlet water surface level of the culvert rises, reducing the flow capacity and increasing the risk of flooding upstream. It is not recommended to replace the culvert for flood reduction at this time.

**Figure 4-25: Outlet of Scott's Brook culvert under Main Street**

Residents of Margaretville also expressed concern that the Route 28/30 bridge (BIN 1053400, Figure 4-26) over the EBDR at Dunraven is increasing flooding and aggradation at Fair Street. The crossing is approximately two river miles downstream of the village boundary. The area between the bridge and the village is mostly forested and undeveloped. The profile in Figure 4-27 shows the water surface elevations of the EBDR as it passes through the bridge and creates a backwater in the 100- and 500-year peak flows. Figure 4-28 illustrates the upstream extent of the backwater influence of the bridge. The bridge passes the 100-year flow and projected future 100-year flow without overtopping but creates a backwater that reaches to the downstream end of the village boundary. The bridge overtops in the 500-year flood and future 500-year flood and has a backwater that reaches approximately the confluence with Scott’s Brook. The backwater does not have a significant influence on flooding in Margaretville.

**Figure 4-26: Route 28/30 bridge over the EBDR**

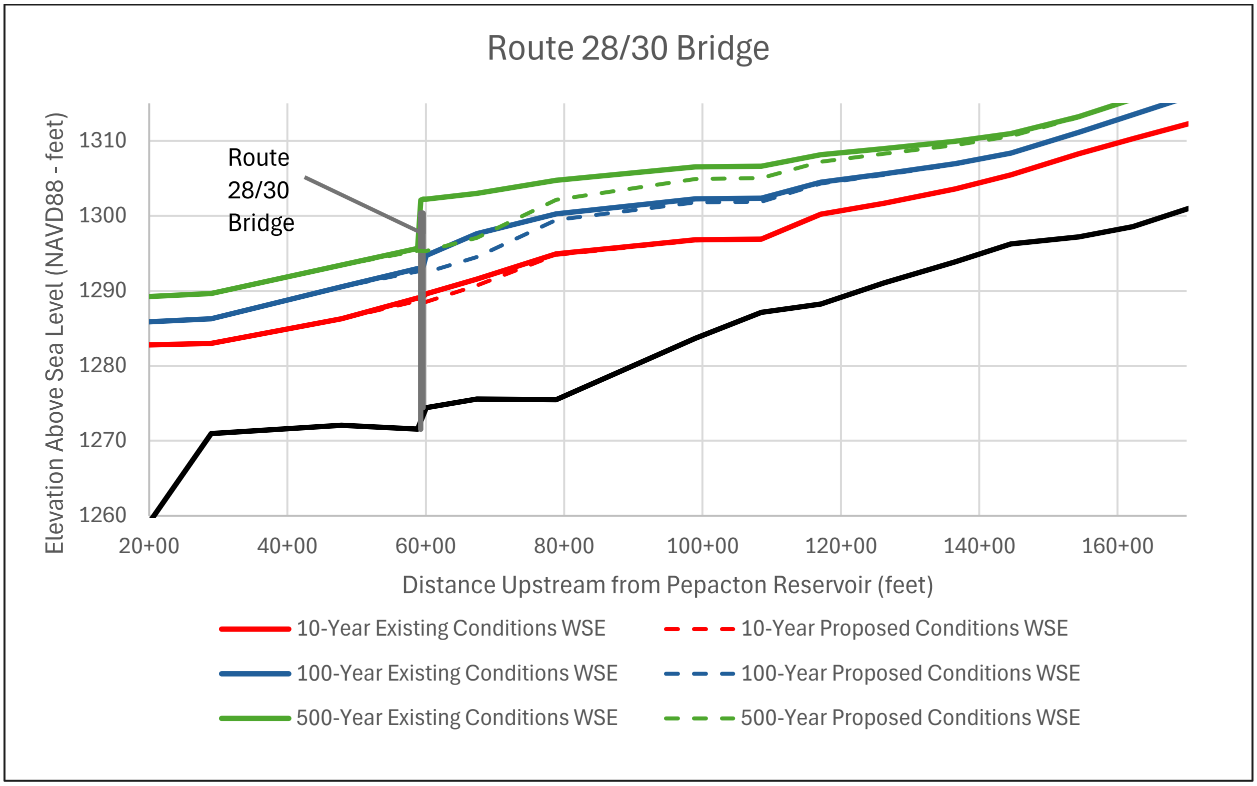


**Figure 4-27: Profile of EBDR at Dunraven**


SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

BACKWATER EXTENTS FROM DUNRAVEN BRIDGE

MARGARETVILLE LOCAL FLOOD ANALYSIS
VILLAGE OF MARGARETVILLE, NY

N
0 500 1,000
Feet

| | |
|---|---|
| SCALE | 1 in=1,200 ft |
| DATE | 10/27/2025 |
| PROJ. NO. | 142.15197.00023 |

**FIG. 4-28**

## 4.2 Recommendations for Buildings and Planning

### 4.2.1 Margaretville Central School

Margaretville Central School has experienced repeated flooding in the basement. The structure is on higher ground such that it is in the 500-year flood area and surrounded by the floodway on all sides, according to the FIS. The bus depot to the north of the school building is in the 100-year flood area.

While the first floor of the school has not sustained damage in past floods, the basement has been inundated multiple times. The basement has multiple levels and houses field maintenance equipment as well as utilities. Some utilities have been elevated to the first floor. A ramp leads from the room with the field maintenance equipment up to the parking lot on the southwest side of the building (Figure 4-29). The ramp is a low point and inlet for floodwaters.

A floodproofing feasibility study is recommended to assess opportunities to reduce flood damage at the school and the bus depot.

**Figure 4-29: Ramp access to basement of Margaretville Central School**

### 4.2.2 Evacuation Location

In past floods, the fire house at 77 Church Street has served as the emergency command center as well as an evacuation location. This has reportedly led to confusion and overcrowding. According to the Delaware County HMP, approximately 180 people in Margaretville may be displaced in a 100-year storm (Tetra Tech, 2013). It is recommended that a feasibility study identifies an alternate evacuation location for the Village of Margaretville.

### 4.2.3 Individual Structures

Many homes and businesses in Margaretville, particularly those along Main Street (Figure 4-30), are subject to flooding. The projects recommended in this report are intended to reduce, but are not able to eliminate, flood risk. Flood mitigation for individual structures can help reduce the damage caused by flooding and is recommended for all flood-prone structures in the Village.

Flood mitigation varies for each structure, depending on location, elevation, and type of structure, among other factors. Common treatments for homes and businesses can include floodproofing, elevation, and relocation.

For some structures with low flood depths, floodproofing is an appropriate mitigation option. Wet floodproofing allows for water to pass through an area without causing significant structural or material damage. Dry floodproofing, only applicable for non-residential properties, prevents water from entering an area, through permanent or temporary measures.

Structures that are prone to deeper flood depths can consider elevating. Elevating a structure should raise the first furnished floor and utilities at least 2 feet over the BFE.

Finally, for some structures or locations, the elevation or floodproofing may not be sufficient or cost effective. In these cases, relocation to higher, safer ground is recommended.

The flow charts in Figure 4-31 and Figure 4-32 can help property owners determine which flood mitigation strategy may be best for them. A feasibility study can determine the appropriate flood mitigation option for an individual structure. See Section 5.2 for information on funding support.


**Figure 4-30: Flooding on Main Street due to Tropical Storm Irene**
(Photo courtesy of Graydon Dutcher)

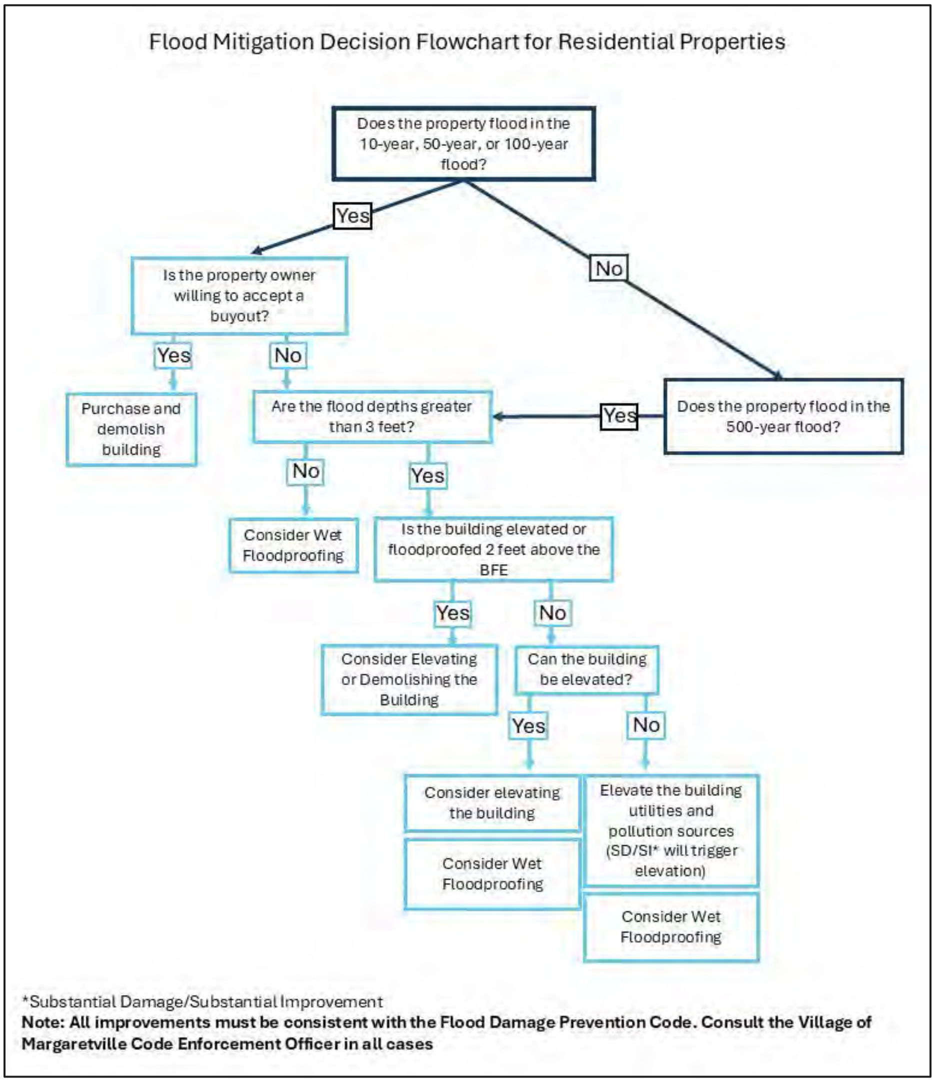


**Figure 4-31: Flood mitigation decision flow chart for residential properties**

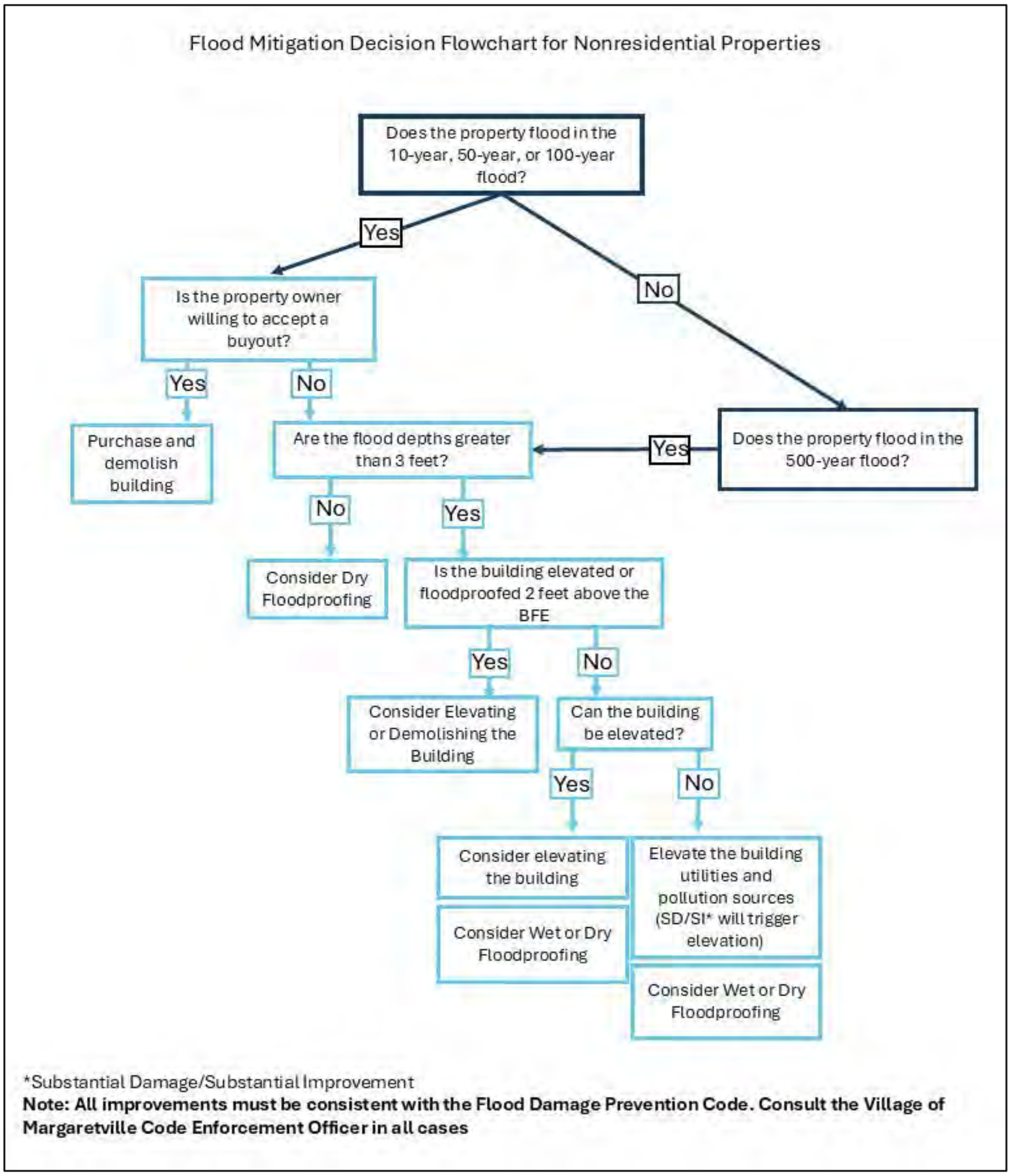


**Figure 4-32: Flood mitigation decision flow chart for non-residential properties**

### 4.2.4 Flood Committee

As part of the LFA process, a flood committee was formed for the Village of Margaretville. Throughout the study, the committee met with SLR to provide feedback and input. It is recommended that the committee continue to meet regularly, multiple times per year, to provide sustained initiative and support for flood mitigation projects in the village.

## 4.3 Sediment and Debris Management Recommendations

Streams carry sediment and water downstream. Typically, mountain streams such as Bull Run start in steep areas, with the slope and flow velocity decreasing in the downstream direction.

Changes in velocity lead to a change in the sediment capacity of the watercourse. For example, a sudden increase in velocity leads to greater sediment capacity, as seen by erosion or scour downstream of a culvert after high flows. The inverse is also true; a decrease in velocity leads to a decrease in sediment capacity such that sediment is deposited.

As Bull Run enters Margaretville, the slope is decreasing, and the velocity is starting to slow. As discussed in Section 4.1.4, the Swart Street bridge replacement and channel widening leads to a reduction in velocity, reduction in sediment capacity, and sediment deposition. About 1,000 feet downstream, Bull Run flows into the EBDR, a slower-moving river. Between the confluence and the Fair Street bridge, a sediment bar has formed on the south bank of the EBDR. Sediment can reduce the flow capacity of structures. However, removal is often only a short-term, and expensive, solution. A more effective solution is to address the sediment supply. It is recommended to identify sites of sediment supply such as scour holes and bank failures and stabilize them. It is recommended to complete a study of sediment and debris sources along Bull Run.

Woody debris accumulation is a common concern that was raised in the public meetings. Wood in streams can have ecological and geomorphological benefits but can also contribute to stream instabilities or damage to property and infrastructure.

Benefits of wood in streams include the following:

- Streambed stability
- Stream bank and hillslope stability
- Sediment storage
- Aquatic habitat and ecology

Hazards of wood in streams include the following:

- Blockage of bridges and culverts
- Erosion, lateral adjustment, avulsion
- Danger to recreational users

Wood and debris jams that threaten public infrastructure are often removed by local, county, state highway, and public works departments. Federal involvement (e.g., National Guard deployment) may also occur in particularly damaging events. However, no agency is responsible for addressing logjams that only affect private property, whether or not there is an associated hazard.

Private landowners may remove wood and debris from streams on their property at their own risk and generally at their own expense; little to no public funding is available for such actions. Wood and debris removal may require a permit from NYSDEC, depending on site conditions, access requirements, and the proposed means of removal.

Removing, cutting, or handling wood in or near streams can be extremely dangerous. Powerful and unpredictable forces can act on wood and debris that is in or has been deposited by flowing water. Cutting, pulling, or otherwise moving or disturbing jammed materials can result in unexpected and/or abrupt movement that can cause injury or death.

Streamside landowners affected by wood or debris accumulations are encouraged to reach out to DCSWCD’s Stream Management Program.

## 4.4 Stormwater Recommendations

### 4.4.1 Swart Street Neighborhood

Residents along Swart Street and Orchard Street regularly experience flooding in their backyards and basements (Figure 4-33). A stormwater drainage system was installed along Swart Street. Not all properties were connected to the system when it was implemented. It is recommended to extend the reach of the drainage system and connect additional properties. Records of the original project have not been located, so part of any future work should include mapping the existing system. It is also recommended that property owners consider filling basements that are prone to flooding.

**Figure 4-33: Standing water between Swart Street and Orchard Street**
(Photo courtesy of Annie Klebanoff)

### 4.4.2 Kennedy Heights

During public meetings for this study, Kennedy Heights was noted for roadway flooding and erosion after heavy rains. The upper part of Upper Kennedy Heights Road drains into an open channel that runs alongside the cemetery, into the Binnekill. The lower part of Upper Kennedy Heights Road and Lower Kennedy Heights Road has a drainage ditch along side the road. Improvements to both are recommended. As stated in the Margaretville Gateway Implementation Project Recommended Improvements report, the recommended improvements include restoring and stabilizing the channel through the cemetery and of the drainage swale from Upper Kennedy Heights Road (Milone & MacBroom, Inc, 2019).

## 4.5 Riparian Buffers

The Natural Resources Conservation Service (NRCS) (2016) defines a riparian buffer as, "a corridor of trees and/or shrubs planted adjacent to a river, stream, wetland or water body." The definition continues to note that the width of the buffer and the distance of the buffer from the water body are essential characteristics determining the functioning of the buffer.

The benefits provided by riparian buffers to their adjacent water bodies have been well documented. These benefits can include those to the physical stability of the stream as well as those to habitat and water quality. Riparian buffers along Bull Run can support the recommendations in Section 4.3 by reducing bank erosion.

The physical benefit of a riparian buffer to a stream has been shown to include increased stability, reduced stream bank erosion, and reduced channel migration. Scientific studies have found that intertwining roots within a stream bank can increase stream bank strength, increase resistance to erosion caused by high flows, and provide greater channel stability (Sweeney and Newbold, 2014). One study found that following major floods bank erosion was 30 times more prevalent along stream bends without forests than those with forests (Beeson and Doyle, 1996). Other studies have also shown that forested stream reaches exhibit slower channel migration and thus provide more stability than deforested channels (Hession et al., 2003; Allmendinger et al., 2005). The NRCS (2016) notes that stabilized stream banks also help maintain the geometry of the stream, including characteristics such as the meander length and profile.

The dimensions of the riparian buffer have been shown to play an important role in the functioning of the buffer. Burckhardt and Todd (1998) found that streamside forests with widths of around 10 meters (approximately 33 feet) provide some protection from channel migration. Similarly, Zaimes et al. (2006) found bank erosion was lowered significantly by the presence of a streamside forest approximately 33 feet wide along reaches within an agricultural landscape. Sweeney and Newbold (2014) found that the influence of vegetation appears to be greatest when the roots extend to the toe of banks (Thorne, 1990; Anderson et al., 2004). Otherwise, the stream bank is susceptible to erosion from the stream as it flows. According to the NRCS Practice Standard for Riparian Forest Buffers, the minimum width should be at least 35 feet from the top of the bank.

In terms of the vegetation making up the riparian buffer, the NRCS recommends utilizing native species, if available, that are as follows:

- Adapted to the soil and climate of the planting site
- Water-loving or water-tolerant species and tolerant of extended periods of flooding (depending on the width of the planting and distance from the stream banks)

- Moderate to aggressive root and crown spread to occupy the site quickly and provide adequate litter fall
- Resistant to pests and herbicides (if adjacent to farmland)

The benefits of riparian buffers to habitat include providing food and cover for wildlife and shade, which helps to lower water temperatures. Buffers can also increase habitat diversity in several ways. The addition of large woody debris to a stream provides habitat to a range of species, and a reduction in sedimentation helps prevent silt from covering large rocks or stones and from filling pools in the streambed, both of which serve as habitat. In terms of improvements to water quality, buffers have been shown to protect water resources from pollutants in surface runoff such as sediment and nutrients. Vegetated riparian buffers serve to slow water velocity, thus allowing sediment to settle out of the runoff water. The nitrogen and phosphorus attached to the sediment settle out of the surface runoff as well. To a lesser extent, dissolved nitrogen and phosphorus and other pollutants can be sequestered, degraded, and processed within the riparian buffer.

It is recommended to implement riparian buffers along Bull Run and the EBDR. It is also recommended to enhance and protect the existing riparian buffers along the EBDR.

## 4.6 General Recommendations

Flooding of and damage to bridges, culverts, and roadways during flood events has been reported at numerous locations in the LFA study area. Most flood-related fatalities occur in vehicles, often when drivers attempt to cross flooded roadways. It is impossible to tell if a flooded roadway is safe just by looking at it. It is recommended that risks associated with the flooding of bridges and roadways be reduced by temporarily closing flood-prone roads during high flow events. This requires effective signage, road closure barriers, and consideration of alternative routes. Because it is impossible to prepare for every contingency, and closing roads and establishing detours in a flash flood event is not always possible, it is critical that residents be advised of the extreme dangers of attempting to cross flooded roadways and reminded not to do so when flooding occurs or is forecasted. Informed and prepared residents are the foundation of life safety preservation in floods.

In the event of future flooding, it is highly recommended that the Village of Margaretville collect and maintain clear, detailed records of all damages and associated repair costs, including materials and labor. These should be distinguished by site so that problem areas can be identified and addressed and not lost amongst the overall total. Where possible, once waters recede and it is safe to do so, high water marks and other evidence of flooding extents should be photographed and carefully documented and their elevations measured from a permanent reference point. These data may be extremely valuable when seeking funding for flood mitigation assistance.

Public welfare depends on awareness and proper enforcement of the village's local Flood Prevention Law. It is recommended that village government staff seek training regarding the content and implementation of this law, especially the Code Enforcement Officer. As the Local Floodplain Administrator, this individual is responsible for administering, implementing, and enforcing the local Flood Damage Prevention Code. This will allow village officials to successfully disseminate important information regarding the law to the public and to implement the law accurately to meet its stated purposes.

FEMA Elevation Certificates are an important administrative tool of the NFIP and are necessary to provide elevation information to ensure compliance with community floodplain management ordinances. Elevation certificates are also useful to landowners to determine proper flood insurance premium rates and support the request of a Letter of Map Amendment or Revision (LOMA or LOMR-F). As part of the agreement for making flood insurance available to a community, the NFIP requires the Village of Margaretville to obtain the elevation of the lowest floor (including basement) of all new and substantially improved buildings. Clear records should be maintained of any such information and filed within the floodplain administrative offices so that they are readily accessible. FEMA encourages communities to use the Elevation Certificate document developed by FEMA, which can be accessed at https://www.fema.gov/glossary/elevation-certificate since it can also be used by property owners to obtain flood insurance. Property owners can contact the DCSWCD Stream Management Program or CWC for guidance in obtaining an elevation certificate.

# 5.0 Project Costs and Funding Sources

## 5.1 Rough Order of Magnitude Cost Estimates

To assist with prioritization of the above recommendations, Table 5-1 provides an estimated cost range for projects. Due to the conceptual nature of recommended actions and the significant amount of data required to produce a reasonable rough order of magnitude cost, it is not feasible to further quantify the cost of all actions. Costs of land acquisition and easements are not included in the costs.

**Table 5-1: Cost Range of Projects**

| Project | <$100k | $100k-$500k | $500k-$1M | $5M-$10M | >$10M |
|---|---|---|---|---|---|
| Cemetery Road replacement | | | X | | |
| Cemetery Road debris removal and monitoring | | X | | | |
| Bridge Street over Binnekill and EBDR bridge replacement | | | | | X |
| Fair Street bridge removal | | | X | | |
| Bull Run channel widening and crossing replacements | | | | X | |
| Binnekill inlet berm | | X | | | |
| Individual structure floodproofing | | X | | | |
| Bull Run bank erosion reduction project | | | X | | |
| Swart Street and Academy Street stormwater survey | X | | | | |
| Connect additional buildings to Swart Street stormwater system | | X | | | |
| Kennedy Heights stormwater design | | X | | | |
| Margaretville Central School flood reduction feasibility study | X | | | | |
| Evacuation location feasibility study | X | | | | |
| Individual structure feasibility study | X | | | | |

## 5.2 Funding Sources

Funding for culvert replacements and other infrastructure upgrades is often scarce in a small community. In a 2017 survey of county, city, town, and Village officials in New York State conducted by Aldag et al. of Cornell University, 80 percent of responders reported that infrastructure needs contribute to local fiscal stress, and 86 percent said that fiscal stress affects local infrastructure budgeting. The consequence is that local governments that are fiscally stressed are likely to have substantial needs for infrastructure investment but must defer addressing them (Aldag, 2017). Because of this, external funding is often necessary, and a concerted effort is required to secure these grants, although small local governments may not have staff available to dedicate to these endeavors.

Several funding sources may be available for the implementation of recommendations made in this report (listed in Table 5-2). These and other potential funding sources are discussed in further detail below. Note that these may evolve over time as grants expire or are introduced.

**Table 5-2: Potential Funding Source for Flood Mitigation Alternatives**

| Recommendation | Potential Eligibility | | |
|---|---|---|---|
| | Federal | State | Local |
| Replacement of assessed bridges and culverts with an appropriately sized structure | | Bridge NY, NYSDOT | Delaware County, CWC |
| Debris removal following floods | USACE, NRCS | | CWC |
| Floodplain enhancements | FEMA | NYSDEC, EFC | DCSWCD |
| Install floodproofing at critical facilities and anchor businesses | FEMA | | CWC |
| Floodproof flood-vulnerable properties where there is owner interest | FEMA | | CWC |
| Anchor fuel tanks | | | CWC |
| Feasibility study to assess individual flood mitigation alternatives for individual properties | | | CWC |
| Riparian buffer restoration projects | | NYSDEC, EFC | DCSWCD |

CWC = Catskill Watershed Corporation
DCSWCD = Delaware County Soil and Water Conservation District
EFC = Environmental Facilities Corporation
FEMA = Federal Emergency Management Agency
NRCS = Natural Resource Conservation Service
NYSDEC = New York State Department of Environmental Conservation
NYCDEP = New York City Department of Environmental Protection
NYSDOT = New York State Department of Transportation
USACE = United States Army Corps of Engineers

*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 offsite 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 SMP in their respective counties.

*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:

Hydraulic Study Properties

1. Properties identified in community LFAs
2. Anchor businesses, critical community facilities, and LFA-identified properties applying to the CWC for relocation assistance

Special Case Properties

1. Properties needed for a stream project
2. Erosion hazard properties
3. Inundation hazard properties

Risk assessments and authorization or supporting resolutions are required by the Village of Margaretville 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 such as gazebos and pavilions.

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.

*Local Flood Hazard Mitigation Implementation Program*

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 of public infrastructure that are expected to reduce/minimize flood damage
- Private property protection measures such as elevation or floodproofing of a structure
- Elimination of sources of man-made pollution such as the relocation or securing of fuel oil/propane tanks
- Stream-related construction (Ineligible projects include construction of floodwalls, berms, or levees; stream dredging; or annual maintenance.)
- Relocation assistance for a residence or business recommended by an LFA to a location within the same town or village

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, although their relocation does NOT have to be recommended in the LFA. These include gas stations, grocery stores, lumber yards and 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 the purchase of a former property (does NOT have to be in an LFA community)
- Stream debris removal after a serious flood event (does NOT have to be recommended in an LFA)

*Emergency Watershed Protection Program (EWP)*

Through the EWP program, the U.S. Department of Agriculture's 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. More information about the EWP program can be found here:

https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/

It is important to note that for repetitive loss homes in the LFA area where the municipality supports buyouts, FEMA has developed precalculated benefits for acquisition and elevation of buildings. The following is excerpted from a FEMA memorandum regarding Hazard Mitigation Assistance (HMA) precalculated benefits (FEMA, 2013):

*FEMA's Risk Reduction Division analyzed over 11,000 structures acquired or elevated and found that the average benefits for each project type are $323,000 and $205,000, respectively. Therefore, FEMA has determined that the acquisition or elevation of a structure located in the 100-year floodplain as delineated on the FIRM or based on best available data that costs less than or equal to the amount of benefits listed above is considered cost effective. For projects that contain multiple structures, the average cost of all structures in the project must meet the stated criterion. This methodology is available for all HMA grant programs.*

Homeowners in the SFHA floodplain may qualify if relocation or elevation costs are projected to be less than these average benefit values.

*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.

https://www.fema.gov/pre-disaster-mitigation-grant-program

*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.

https://www.fema.gov/hazard-mitigation-grant-program

*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 SRL 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, the individual property mitigation options described in this LFA 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.

http://www.fema.gov/flood-mitigation-assistance-grant-program

*FMA Swift Current*

The Flood Mitigation Assistance (FMA) Swift Current program is funded by FEMA and administered by the New York State Division of Homeland Security and Emergency Services (DHSES). Properties must have an NFIP policy and be defined as Repetitive Loss (RL), Severe Repetitive Loss (SRL), or Substantially Damaged (SD).

Swift Current funds Individual Flood Mitigation Projects for Flood Mitigation Assistance and/or NFIP-defined Repetitive Loss (RL), Severe Repetitive Loss (SRL), or properties deemed Substantially Damaged after the applicant's disaster declaration incident period start date.

Eligible Individual Flood Mitigation Projects include the following project types, which may be referenced in the Hazard Mitigation Assistance Program and Policy Guide:

- Property acquisition and structure demolition/relocation
- Structure elevations
- Dry floodproofing of historic residential structures or nonresidential structures
- Nonstructural retrofitting of existing structures and facilities
- Mitigation reconstruction
- Structural retrofitting of existing structures

For fiscal year 2024, Swift Current now offers Project Scoping as an eligible activity for applicants. Applicants may submit Project Scoping applications up to 1 percent of the total maximum set-aside amount, and tribes and territories applying as applicants may submit up to 5 percent. Project Scoping is considered a part of the maximum set-aside amount.

https://www.fema.gov/grants/mitigation/learn/flood-mitigation-assistance/swift-current

*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 Stream Bank 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 flood-prone 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.

*Historic Homeownership Rehabilitation Credit Program*

Rehabilitation of historic residential buildings may qualify for a New York State tax incentive. The Historic Homeownership Rehabilitation Credit program offers a state income tax credit equal to 20 percent of qualified rehabilitation expenses associated with repair, maintenance, and upgrades to historic homes. The value of the credit is applied to the property owner's NYS tax liability to reduce the amount owed. The program covers 20 percent of qualified rehabilitation expenses up to a credit value of $50,000 per year.

https://parks.ny.gov/shpo/tax-credit-programs/#:~:text=Rehabilitation%20of%20historic%20residential%20buildings%20may%20qualify%20for,with%20repair%2C%20maintenance%2C%20and%20upgrades%20to%20historic%20homes.

*NYS Resilient Watershed Grant Program (RWG)*

The Resilient Watersheds Grant (RWG) program is a competitive, statewide grant program open to local governments, Indian Nations, County Soil and Water Conservation Districts, State agencies, and not-for-profit corporations. The overall goal of the RWG program is to implement projects that build community resilience to extreme weather events, promote flood risk and ice jam reduction and/or restoration, enhance flood and climate resilience, implement natural and nature-based feature construction, or ecologically sustainable projects while supporting healthy riparian habitats. This funding is for the construction/implementation of projects, not projects exclusively for planning and/or design.

The RWG program, created by the New York State Environmental Facilities Corporation (EFC) in collaboration with NYSDEC, primarily focuses on implementing projects specifically identified and recommended through DEC's Resilient NY Program or similar studies such as this Local Flood Analysis.

https://dec.ny.gov/sites/default/files/2025-02/rwgprogramoverview.pdf.

**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, providing a one-stop location that streamlines the way grants are administered by the State of New York.

https://grantsmanagement.ny.gov/

*Climate Smart Communities (CSC)*

Climate Smart Communities (CSC) is a New York State program that helps local governments take action to reduce greenhouse gas emissions and adapt to a changing climate. The program offers free technical assistance, grants, and rebates for electric vehicles. Registered communities have made a commitment to act by passing the CSC pledge. Certified communities are the foremost leaders in the state; they have gone beyond the CSC pledge by completing and documenting a suite of actions that mitigate and adapt to climate change at the local level.

https://climatesmart.ny.gov/

*Environmental Facilities Corporation (EFC)*

The Environmental Facilities Corporation (EFC) helps local governments and eligible organizations undertake water infrastructure projects. EFC provides grants and financing to help ensure projects are affordable while safeguarding essential water resources. EFC administers state and federal grants as well as interest-free and low-cost financing to help minimize the tax burden for communities.

https://efc.ny.gov

The EFC's Green Innovation Grant Program (GIGP) supports projects across New York State that utilize unique Environmental Protection Agency (EPA)-designated green stormwater infrastructure design and creates cutting-edge green technologies. Competitive grants are awarded annually to projects that improve water quality and mitigate the effects of climate change through the implementation of one or more of the following green practices: Green Stormwater Infrastructure, Energy Efficiency, and Water Efficiency.

https://efc.ny.gov/gigp

*Bridge NY Program*

The Bridge NY program, administered by NYSDOT, is open to all municipal owners of bridges and culverts. Projects are awarded through a competitive process and support all phases of project development. Projects selected for funding are evaluated based on the resiliency of the structure, including such factors as hydraulic vulnerability and structural resiliency; the significance and importance of the bridge, including traffic volumes, detour considerations, number and types of businesses served, and impacts on commerce; and the current bridge and culvert structural conditions.

https://www.dot.ny.gov/BRIDGENY

*Private Foundations*

Private entities such as foundations are potential funding sources in many communities. The Village of Margaretville and MFC members 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, aquatic ecosystems, and water resources.

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

# 6.0 Benefit-Cost Analysis and Project Prioritization

FEMA has developed specific methodologies for conducting a Benefit-Cost Analysis (BCA), which is used to validate the cost effectiveness of a proposed hazard mitigation project. A BCA is a method by which the projected benefits of a project are compared to its estimated cost to determine a benefit-cost ratio (BCR), which is calculated by a project's total net benefits divided by the total project cost. The BCR is a numerical expression of the cost effectiveness of a project. FEMA considers a project to be cost-effective when the BCR is greater than or equal to 1.0, indicating that the benefits of the project are sufficient to justify its cost.

The BCA does not include benefits that could have been generated for avoiding future street cleanup, avoided detours, avoided emergency response, etc., although these costs are often considerable. Similarly, water quality benefits may be significant but are difficult to quantify and are not directly accounted for in a FEMA BCA.

## 6.1 Project Areas

None of the flood hazard mitigation projects recommended in this LFA are expected to attain a BCR of 1.0 or greater. This is largely related to the way that project benefits are quantified into cost savings. The recommended significant public infrastructure upgrades, like bridge and culvert replacements or highway improvements, are projected to be far more costly than the direct flood mitigation benefits that may be possible for a limited number of nearby properties. The FEMA BCA methods do not account for intangibles like loss of access due to flooded roadways or damaged stream crossings that can have profound impacts on residents. It is also challenging to perform an accurate BCA without detailed information regarding the costs of historical damages.

Critical contingencies such as the potential unavailability of detours are not considered in the BCR calculations, nor is a structure's importance as part of a detour route in the event of another crossing's failure. The consequences of loss of access for emergency responders are not accounted for either. These are vital considerations in Margaretville, which is susceptible to being cut off from assistance in damaging floods.

The applicability of the FEMA BCA is limited in these instances because it does not adequately consider the costs of certain severe but potentially indirect hazards that are faced by a small number of properties. Economic losses due to the interruption of traffic are the primary considerations in the BCR for roads and bridges, not life safety.

It may therefore be difficult to obtain FEMA-linked funding for the recommended bridge, culvert, and roadway improvements.

## 6.2 Individual Properties

Margaretville is part of FEMA's Community Rating System (CRS), through which floodplain management projects and regulations lead to discounted flood insurance premium rates. Margaretville is currently a Class 8 community, which gives policy holders a 10 percent discount. Implementation of some proposed projects in this report can lead to greater discounts.

FEMA has developed precalculated benefits for acquisition and elevation of buildings located in the SFHA. The following is excerpted from a FEMA memorandum regarding Hazard Mitigation Assistance (HMA) precalculated benefits (FEMA, 2013):

*"FEMA's Risk Reduction Division analyzed over 11,000 structures acquired or elevated and found that the average benefits for each project type are $276,000 and $175,000, respectively. Therefore, FEMA has determined that the acquisition or elevation of a structure located in the*

*100-year floodplain as delineated on the FIRM or based on best available data that costs less than or equal to the amount of benefits listed above is considered cost effective. For projects that contain multiple structures, the average cost of all structures in the project must meet the stated criterion. This methodology is available for all HMA grant programs."*

Precalculated benefits have most recently been updated in July 2024, as listed below:

- Acquisitions in the SFHA: $775,411 per structure
- Elevations in the SFHA: $355,552 per structure
- Mitigation Reconstruction in the SFHA: $335,552 per structure

This dramatically simplifies the BCA process for homeowners in the SFHA if acquisition, elevation, or mitigation costs are projected to be less than these average benefit values. Homeowners would require support for any acquisitions in the form of a resolution by the municipality that identifies the property as an inundation or erosion hazard.

Homeowners who do not qualify, or do not wish to participate in the FEMA buyout program, may be eligible for the New York City Funded Flood Buyout Program, which is described in Section 5.2.

## 6.3 Project Prioritization

To facilitate the next steps towards flood mitigation projects, the MFC and project partners have developed a project prioritization list based on the potential impact, timeline, and complexity of the projects. This list (Table 6-1) is intended to be a starting point, not a restriction to prevent action on projects that are listed as lower priority.

**Table 6-1: Suggested Project Prioritization**

| Project | Prioritization |
|---|---|
| Cemetery Road replacement | B |
| Cemetery Road debris removal and monitoring | A |
| Bridge Street over Binnekill and EBDR bridge replacement | A |
| Fair Street bridge removal | B |
| Bull Run channel widening and crossing replacements | B |
| Binnekill inlet berm | C |
| Individual structure floodproofing | A |
| Bull Run bank erosion reduction project | B |
| Swart Street and Academy Street stormwater survey | A |
| Connect additional buildings to Swart Street stormwater system | B |
| Kennedy Heights stormwater design | C |
| Margaretville Central School flood reduction feasibility study | A |
| Evacuation location feasibility study | A |
| Individual structure feasibility study | B |

# 7.0 References

Aldag, Austin M., Warner, M.E., Kim, Y. "What causes local fiscal stress? What can be done about it?" Cornell University: Department of City and Regional Planning (May 2017)

Alder, J. R. and S. W. Hostetler, 2013. USGS National Climate Change Viewer. US Geological Survey https://doi.org/10.5066/F7W9575T

Bader, David, and Radley Horton. 2023. *New York State Climate Change Projections Methodology Report*. Prepared for the New York State Climate Impacts Assessment.

Dahl, T.E., 1990. Wetland Losses in the United States ~ 1780s to 1980s. U.S. Department of the Interior, Fish & Wildlife Service, Washington. D.C. 13pp.

Delaware County, NY, 2021. Hazard Mitigation Plan. https://delaware.mitigateny.org/

Isachsen, Y.W., Landing, E., Lauber, J.M., Rickard, L.V., and Rogers, W.B., 2000. Geology of New York: A Simplified Account. New York State Museum/Geological Survey, Albany, New York.

Lumia, Richard, 1991. U.S. Geological Survey, Regionalization of Flood Discharges for Rural, Unregulated Streams in New York, Excluding Long Island. Water-Resources Investigations Report 90-4197.Albany, NY.

Lumia, R., D. Freehafer, and M. Smith, 2006. Magnitude and Frequency of Floods in New York. Scientific Investigations Report 2006–5112. U.S. Geological Survey, in Cooperation with the New York State Department of Transportation, Troy, NY.

Milone & MacBroom, Inc., 2019. Margaretville Gateway Implementation Project Recommended Improvements. Margaretville, NY.

Northeast Regional Climate Center, 2015. *NY Projected IDF Curves*. Cornell University. https://ny-idf-projections.nrcc.cornell.edu/ [ny-idf-pro...ornell.edu]

NYCDEP, 2014. NYC Watershed Stream Management Program Local Flood Analysis (LFA) Program Rules, Final Version.

Tetra Tech, 2013. Delaware County Multi-Jurisdictional Hazard Mitigation Plan Update. Delaware County, NY.

Tetra Tech, 2017. Margaretville Gateway Study. Margaretville, NY.

U.S. Fish & Wildlife Service, 2021. National Wetlands Inventory (NWI). U.S. Department of Interior, Fish and Wildlife Service, Washington D.C. https://www.fws.gov/wetlands/data/Mapper.html

U.S. Geological Survey, (n.d.). New York Geologic Map Data. USGS Mineral Resources Program. https://mrdata.usgs.gov/geology/state/state.php?state=NY

U.S. Geological Survey, 2016. National Land Cover Database (NLCD) Land Cover, New York. U.S. Department of Interior, Sioux, SD. https://cugir.library.cornell.edu/catalog/cugir-009031

Ver Straeten, C.H., 2013. Beneath it all: bedrock geology of the Catskill Mountains and implications of its weathering. Annals of the New York Academy of Sciences. Albany, NY.

# Appendix A Critical Facilities Map

## Village of Margaretville

Local Flood Analysis

**Delaware County S&WCD**

SLR Project No.: 142.15197.00023

October 27, 2025

# Appendix B Flood Notes from Public Meeting

## Village of Margaretville

Local Flood Analysis

**Delaware County S&WCD**

SLR Project No.: 142.15197.00023

October 27, 2025

# Appendix C Public Meeting Presentations

## Village of Margaretville

Local Flood Analysis

**Delaware County S&WCD**

SLR Project No.: 142.15197.00023

October 27, 2025

Making Sustainability Happen