Local Flood Analysis

Town of Halcott, Greene County, New York
November 2019

Prepared for:
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Conservation District
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ABBREVIATIONS/ACRONYMS

BCA	Benefit-Cost Analysis
BCR	Benefit-Cost Ratio
BFE	Base Flood Elevation
CFS	Cubic Feet per Second
CMP	Corrugated Metal Pipe
CR	County Route
CRRA	Community Risk and Resiliency Act
CTDOT	Connecticut Department of Transportation
CWC	Catskill Watershed Corporation
DCSWCD	Delaware County Soil and Water Conservation District
DEM	Digital Elevation Model
EWP	Emergency Watershed Protection
FAC	Flood Advisory Committee
FEMA	Federal Emergency Management Agency
FHM	Flood Hazard Mitigation (funding category in SMIP)
FHMIP	Flood Hazard Mitigation Implementation Program
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FPMS	Floodplain Management Services Program
GCSWCD	Greene County Soil and Water Conservation District
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
HSG	Hydrologic Soil Group
LFA	Local Flood Analysis
LiDAR	Light Detection and Ranging
MMI	Milone & MacBroom, Inc.
MWRRP	Municipal Waste Reduction and Recycling Program
NFIP	National Flood Insurance Program
NFIRA	National Flood Insurance Reform Act
NRCS	Natural Resources Conservation Service
NYC	New York City
NYCDEP	New York City Department of Environmental Protection
NYCFFBO	New York City Funded Flood Buyout
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
SFHA	Special Flood Hazard Area
SIR	Scientific Investigations Report
SMIP	Stream Management Implementation Program
SRL	Severe Repetitive Loss

TS	Trout Spawning
USACE	United States Army Corps of Engineers
US EPA	United States Environmental Protection Agency
USGS	United States Geological Survey

EXECUTIVE SUMMARY

The Delaware County Soil and Water Conservation District (DCSWCD) has retained Milone & MacBroom, Inc. (MMI) to complete a Local Flood Analysis (LFA) in the town of Halcott. An LFA is an engineering feasibility analysis that seeks to develop a range of hazard mitigation alternatives. Its primary purpose is to identify flood hazards and mitigation options for the community to implement. In the long term, these mitigation options are designed to reduce flooding and facilitate recovery from flood events. The flood analysis focuses on Vly Creek and several tributaries.

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. Major floods have occurred periodically over the last century with at least 11 major floods occurring since 1933. Floods can take place any time of the year but are commonly divided into those occurring in winter and spring and those occurring in summer and fall. Floods that take place in summer and fall are typically due to extreme rainfall events caused by hurricanes and tropical storms. Floods in winter and spring are associated with rain on snow events and spring snowmelt.

A public meeting was convened at the Halcott Grange Hall at the beginning of the LFA process. Attendees were provided with an overview of the project, the LFA process, and hydraulic modeling techniques. Large-format maps were provided, and attendees were asked to point out locations of flooding and flood damages during both Tropical Storm Irene and previous flood events. Information was collected on flood damages and potential flood mitigation alternatives. This information was used throughout the LFA process to verify flood damages, pinpoint problem areas, and develop flood mitigation alternatives.

A common concern expressed by the community is the issue of maintaining access into and out of Halcott, as well as within the town. The road network in Halcott has very few redundancies, several roads that are only seasonally maintained, and a large number of dead-end roads. During flood events, residents are frequently stranded due to roadway overtopping, culvert washouts, or other infrastructure damage, without a passable detour. Upgrading or replacing hydraulically deficient or problematic stream crossings may improve the resiliency of the transportation network and reduce the risk of damaging floods leaving members of the community cut off from assistance.

Hydraulic assessment was used to evaluate historical and predicted water surface elevations, to identify flood-prone areas, and to help develop mitigation strategies to minimize future flood damages and protect water quality. Specific locations were identified within the project area as being prone to flooding. Alternatives were developed and assessed at each area where flooding is known to have caused damage to infrastructure and properties.

One bridge and six culverts were evaluated using hydraulic modeling. Ursum Way is the primary access to the Halcott Town Highway Garage, and its embankment traverses the Vly Creek floodplain, where the road crosses Vly Creek with a bridge and, just to the southeast, Spring Brook with a culvert. Both the bridge and culvert were found to be undersized. The crossing is in

an extremely poor alignment with the watercourse, is a significant hydraulic constriction, and contributes to flooding of the Town Highway Garage.

The garage experiences flooding during events equal to or greater than the 10-year return period flood. In high flows, Ursum Way overtops, the culvert is frequently damaged, and the facility must be accessed via Fairbairn Drive, a private road that itself is vulnerable to flooding damage. Rather than improving the Ursum Way crossing, relocation of the facility to a new parcel outside of the Special Flood Hazard Area (SFHA) is recommended both for practical considerations as well as available programmatic funding. Replacement of the bridge and/or culvert with an appropriately sized structure is not feasible as the replacement structure and channel modifications required to significantly reduce flooding of the garage represent an order-of-magnitude increase in cost over relocation and construction of a new, upgraded highway facility. An alternative relocation scenario is also presented wherein the garage can be relocated out of the SFHA but on the existing parcel. In this case, upgrading the Fairbairn Drive culvert is recommended to provide reliable alternate emergency access in case of damage to Ursum Way in a flood.

The remaining five assessed culverts were found to be undersized as well, either acting as hydraulic constrictions or overtopping during flood events. Hydraulic modeling informed the recommended adequately sized replacement structures summarized in TABLE ES-1. Note that the Fairbairn Drive culvert crossing of Elk Creek was assessed to provide an alternative Town Garage relocation scenario that does not require acquisition of a new parcel. Several attributes were considered for relative prioritization of these culvert improvements, including roadway importance and functional classification, existing structure condition, available detours, number of properties serviced, and location relative to emergency response facilities. When any of these culverts are scheduled for replacement, it is recommended that a full hydraulic assessment be conducted to ensure that the new structures meet New York State Department of Transportation (NYSDOT) hydraulic design standards and New York State Department of Environmental Conservation (NYSDEC) stream crossing guidelines.

TABLE ES-1
Recommendations for Assessed Culverts in Halcott LFA Area
Priority rankings are relative to this group of structures alone.

Priority	Road	Stream Crossed	Existing		Recommended		Notes
			Description	Capacity	Description	Capacity	
1	County Route 3	Brownell Creek	12' x 5' concrete box, poor condition	520 cfs / 10-year flood	24' x 5' concrete box w/wingwalls	1,080 cfs / 100-year flood	Critical access route for emergency services; primary access to town; hydraulically and structurally deficient
2	Fairbairn Drive	Elk Creek	7.5' circular steel pipe, poor condition	350 cfs / 2-year flood	24' x 6' concrete box w/wingwalls	1,370 cfs / 100-year flood	Substantially upgrading this culvert is only recommended if the Town Garage is to remain on its current parcel.
3	Townsend Hollow Road	Elk Creek	6' circular corrugated metal pipe (CMP), deficient hydraulics	200 cfs / 1.5-year flood	18' x 5' concrete box w/wingwalls	910 cfs / 50-year flood	History of failure, extremely poor hydraulics; only detour is seasonal.
4	County Route 1	Brownell Creek	16' x 5' concrete box, poor alignment	370 cfs / 5-year flood	26' x 5' concrete box w/wingwalls; downstream channel work	1,020 cfs / 100-year flood	Frequently flanks on left side, overtops road; two available detours. Structure is in poor condition.
5	County Route 3	Unnamed Tributary to Vly Creek	7' x 4.5' elliptical CMP, good condition	270 cfs / ~100-year flood	maintain existing culvert	270 cfs / ~100-year flood	Structure is in good condition, with no reported issues. Maintain capacity with regular debris removal and address downstream scour hole.

cfs = cubic feet per second

During Tropical Storm Irene, a substantial section of the Elk Creek Road embankment collapsed into Elk Creek about 1,000 feet downstream from the Townsend Hollow Road culvert crossing. This bank failure presents a manifest threat to the stability and safety of the roadway as the active failure plane will intercept the road surface if its progress is not arrested. As of October 2019, the area of active failure was approximately 23 feet high and 110 feet long. Tension cracks alongside the roadway indicate imminent failure of the overhanging escarpment. A large debris jam has also formed just downstream, which is currently redirecting flows toward other sections of the Elk Creek Road embankment. Once the roadway embankment has been stabilized, flow deflection and energy diffusion at the toe of the embankment can be employed to prevent the slope failure from reactivating. This can be achieved with one or more J-hook vanes and toe logs; these are recommended along with stabilization of the failing slope, removal of the debris jam, and minor excavation of the left overbank area to promote floodplain activation and further alleviate the shear stresses along the slope.

Flooding of bridges, culverts, and roadways during flood events has been reported at several locations in Halcott. It is recommended that risks associated with the flooding of bridges and roadways be reduced by temporarily closing flood-prone roads during flooding events. This requires effective signage, road closure barriers, and consideration of alternative routes.

Critical facilities are public facilities that if destroyed or damaged would impair the health and/or safety of the community. The following recommendations are offered to reduce flooding at critical facilities:

- It is recommended that the Halcott Town Highway Garage and adjoining Transfer Station be relocated out of the SFHA.

For homes and properties located within the SFHA, it is recommended that the town work to relocate the most flood-vulnerable properties where there is owner interest and programmatic funding available through flood buyout, relocation, and structure elevation programs.

Some homes in the 100-year flood zone are rarely flooded. Residents and businesses may benefit from minor individual property improvements. Providing landowners with information regarding individual property protection is recommended. In areas where properties are vulnerable to flooding, improvements to individual properties and structures may be appropriate. Potential measures for property protection include the following:

- Elevation of the structure
- Construction of property improvements such as barriers, floodwalls, and earthen berms although little to no programmatic funding is available for these activities; see Section 5.7
- Dry floodproofing of commercial structures to keep floodwaters from entering
- Wet floodproofing of the structure to allow floodwaters to pass through the lower area of the structure unimpeded
- Performing other home improvements, such as elevating utilities, to mitigate damage from flooding
- Encouraging property owners to purchase flood insurance under the National Flood Insurance Program (NFIP) and to make claims when damage occurs

The Town of Halcott adopted a local Flood Damage Prevention Law as *Local Law No. 1* in 1992. The text of this law is currently available online here:
http://www.gdgbd.net/gb/HalCenArch/laws/1-1992.pdf
It is recommended that town government staff seek training regarding the content and implementation of the law. This will allow town officials to successfully disseminate information regarding the law to the public and to implement the law accurately.

It is recommended that sources of man-made pollution be reduced or eliminated through the relocation or securing of fuel oil and propane tanks, as well as any other stored chemicals. It is recommended that the town gather and file flood-related lost revenue information as provided by businesses and that the town record and compile municipal, county, and state costs related to cleanup and recovery. During and after future floods, it is recommended that high water marks be recorded if it is safe to do so.

A number of potential funding sources are identified in Section 5.7 of this report. As the recommendations of this LFA are implemented, the Town of Halcott should work closely with potential funders to ensure that the best combinations of funds are secured for the recommended flood mitigation alternatives. It would be advantageous for the town to identify combinations of funding sources in order to reduce its own requirement to provide matching funds.

1.0 INTRODUCTION

1.1 Project Background

Milone & MacBroom, Inc. (MMI) has been retained to conduct a Local Flood Analysis (LFA) in the Town of Halcott in Greene County, New York. The LFA has been undertaken with funding provided by the New York City Department of Environmental Protection (NYCDEP), administered through the Delaware County Soil and Water Conservation District (DCSWCD).

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. Tropical Storm Irene caused extensive flooding throughout the Catskills Region, including Halcott, on August 28, 2011.

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.

Project recommendations generated through an approved LFA may be eligible for Flood Hazard Mitigation funding available through the Stream Management Implementation Program (SMIP) administered by DCSWCD, the Catskill Watershed Corporation's (CWC) Flood Hazard Mitigation Implementation Program (FHMIP), or the New York City Department of Environmental Protection (NYCDEP)-funded Buyout Program. A more detailed list of potential funding sources is included in Section 5.7 of this LFA report.

1.2 Study Area

The Town of Halcott is a small, topographically isolated community bordered by mountain ridges to the west, north, and east. The town's population is 258 as of the 2010 U.S. census. The Halcott valley is only accessible year round by one maintained road, with seasonal access via three others. All of these routes have multiple stream crossings, and the towns of Fleischmanns and Margaretville are the primary providers of emergency services to Halcott. For these reasons, the community is especially susceptible to being cut off during damaging floods.

The subject LFA focuses on flooding mitigation and infrastructure improvements within the hamlet of Halcott although flooding hazards may exist elsewhere in the town. Road crossings of Elk Creek, Vly Creek and Spring Brook, Brownell Creek, and one unnamed tributary have been assessed, which include the following bridge and six culverts:

- Ursum Way bridge over Vly Creek (access to Town Highway Garage)
- Ursum Way culvert over Spring Brook tributary to Vly Creek (access to Town Highway Garage)
- Townsend Hollow Road culvert over Elk Creek
- Fairbairn Drive (private) culvert over Elk Creek
- County Route 3 culvert over unnamed tributary that parallels Turkey Ridge Road. This stream is identified as *Vly Creek Tributary 2* in Federal Emergency Management Agency (FEMA) products.

- West Settlement Road/County Route 1 culvert over Brownell Creek (West Settlement Creek)
- County Route 3 culvert over Brownell Creek (West Settlement Creek)

Ursum Way traverses the Vly Creek floodplain to access Halcott's Town Highway Garage. The garage has been flooded in the past, most recently in 2011 (Tropical Storm Irene), when the facility was heavily damaged. FEMA's SFHA includes the northwestern corner of the building. Ursum Way and its bridge and culvert were assessed in conjunction with flooding at the Highway Garage because the hydraulic control imposed by the roadway directly impacts floodwater elevations at the garage.

Erosion along the right bank of Elk Creek is threatening the stability of Elk Creek Road about 1,000 feet downstream from the Townsend Hollow Road culvert crossing. Town officials report that during Tropical Storm Irene this section of the Elk Creek channel initiated erosion of the roadway embankment toe and, subsequently, failure of the overlying slope. The failure plane of this slope intersects the roadway, which is just 30 feet from the channel margin. As of October 2019, the area of active failure was approximately 23 feet high and 110 feet long; this has reportedly been growing slowly since this 2011 flood.

1.3 Community Involvement

The LFA was undertaken in close consultation with the Halcott Flood Advisory Committee (FAC). The FAC is comprised of individuals with technical and nontechnical backgrounds and is meant to represent various interests and stakeholders at town and county levels as well as the DCSWCD, CWC, and NYCDEP. The FAC met regularly over the course of the LFA process to review results and provide input on flood mitigation alternatives. Minutes from the FAC meetings are included in Appendix A. FAC members include representatives from the following organizations and backgrounds:

- Halcott Town Board
- Halcott residents
- DCSWCD
- NYCDEP
- CWC
- MMI

The LFA process included two public meetings, as well as a public engagement effort at the Halcott Fair. The Halcott Fair and the first public meeting took place at the start of the LFA in order to inform the public about the LFA process and gather input about flood events and flood damages in Halcott. The second public meeting was held at the end of the LFA in order to share the findings of the analysis.

TABLE 1-1 summarizes FAC and public meetings that took place during the LFA process.

TABLE 1-1
LFA Meeting Schedule

Date	Type of Meeting	Topic
April 15, 2019	FAC (#1)	Introduction to and overview of LFA process; gathering of flood information from FAC members
July 20, 2019	Halcott Fair	Gather information, encourage public meeting attendance
July 22, 2019	Public (#1)	Introduction to and overview of LFA process; gathering of flood information from members of the public
August 19, 2019	FAC (#2)	Presentation of preliminary hydraulic modeling results; solicitation of feedback regarding proposed alternatives
September 16, 2019	FAC (#3)	Presentation of recommendations and solicitation of additional feedback for final report
October 19, 2019	Public (#2)	Presentation of recommendations and solicitation of additional feedback for final report

1.4 Nomenclature

In order to provide a common standard, FEMA's 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) is the water surface elevation of floodwaters. In this report, the 1 percent annual chance flood is referred to as the 100-year flood event. Other common recurrence probabilities referred to in this report include the 2-year flood event (50 percent annual chance flood), the 10-year flood event (10 percent annual chance flood), the 25-year flood event (4 percent annual chance flood), the 50-year flood event (2 percent annual chance flood), and the 500-year flood event (0.2 percent annual chance flood). The SFHA is the area inundated by flooding during the 100-year flood event.

It should be noted that over the time period of a standard 30-year property mortgage a property located within the SFHA will have a 26 percent chance of experiencing a 100-year flood event. Structures falling within the SFHA may be at an even greater risk of flooding if a house is low enough that it may be subject to flooding during the 25-year or 10-year flood events. In this case, during the period of a 30-year mortgage, the chance of being hit by a 25-year flood event is 71 percent, and the chance of being hit by a 10-year flood event is 96 percent, which is a near certainty.

The FEMA-designated floodway is defined as the stream channel and that portion of the adjacent floodplain that must remain open to permit passage of the base flood. Floodwaters are typically

deepest and swiftest in the floodway, and anything in this area is in the greatest danger during a flood. The portion of the floodplain that is outside the floodway is referred to as the flood fringe and is generally (but not in all cases) associated with less rapidly flowing water. Figure 1-1 illustrates the SFHA, floodway, and flood fringe on a typical channel cross section.

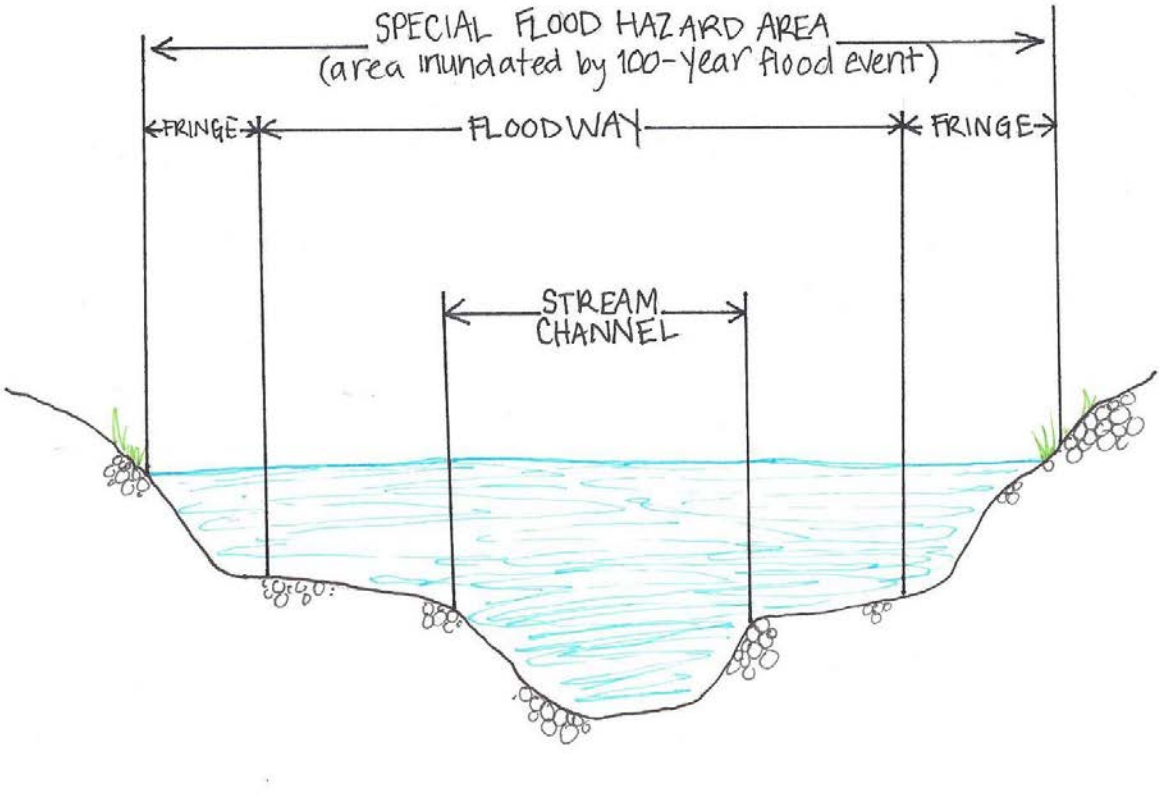

Figure 1-1: Special Flood Hazard Area (SFHA), Floodway, and Flood Fringe

The name of the tributary to Vly Creek that runs along Greene County Route 1 (West Settlement Road) may be a source of confusion. A historical map dated 1867 identifies this tributary as Brownell Creek as does the 1903 Phoenicia 15' United States Geological Survey (USGS) topographic quadrangle. However, this tributary is identified as West Settlement Creek on the 1945 West Kill 7.5' USGS topographical map and most (but not all) publications thereafter, including FEMA rate maps. Despite this revision, the watercourse is still known as Brownell Creek in the Halcott community and is referred to as such in this report.

NYSDOT classifies stream crossings as bridges or culverts based on their span length alone rather than their hydraulic design or construction. Any structure with a span greater than 20 feet is considered a bridge; spans shorter than 20 feet are considered culverts. For example, a 25-foot-span box culvert would be classified as a bridge, and a 15-foot-span bridge would be considered a culvert. NYSDOT enforces substantially different hydraulic design standards for bridges and culverts, which may have considerable implications for project cost.

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.

2.0 WATERSHED INFORMATION

2.1 Initial Data Collection

FEMA Flood Insurance Study (FIS)

The current FIS for Greene County has an effective date of May 16, 2008, with revisions to some areas of the county effective June 2, 2015. FEMA conducts these studies to identify flood hazards and establish flood insurance rates by determining potential floodwater elevations and delineating floodplains. Vly Creek within the town of Halcott is mapped with FEMA's approximate methods, meaning that flood extents are estimated, and BFEs are not computed.

Several homes and buildings are mapped as partially or wholly within the SFHA, or 100-year floodplain, defined in this FIS. Because this boundary has been approximated rather than calculated, it is possible that some areas in the SFHA are rarely flooded while others that are not in the SFHA may frequently experience flooding. One consequence of this discrepancy is that some property owners may be overinsured through the NFIP while others who should participate do not. Nevertheless, the approximately mapped floodplain extents provide a fairly reliable depiction of flood-prone areas and may be used to identify homes and property that may be at risk.

DCSWCD Stream Corridor Management Plan

DCSWCD undertook a stream corridor assessment of the East Branch of the Delaware River, including Vly Creek, in 2007. This evaluation identifies and assesses stream and basin geomorphic characteristics, land cover and hydrology, stream crossings, and floodplain modifications and encroachments. This report indicates that overall, Vly Creek is in good condition, excepting localized issues such as problematic erosion and roads impinging on the stream corridor. The report also mentions the unnatural location of Vly Creek within its floodplain that has resulted from historical modifications of the stream.

The relevant chapter from this plan can be accessed here:
https://www.dcswcd.org/Stream%20Program/East%20Branch/Volume%202/1b-Stream%20Corridor%20Assessment.pdf

Delaware Engineering Stormwater Assessment

In 2010, Delaware Engineering conducted a stormwater assessment of highway infrastructure for the Town of Halcott. This involved inspection of 23 locations throughout the town that had been identified for inadequate culvert or ditch sizing, bank failures, or other stormwater- or flooding-related concerns. After analysis of these sites, Delaware Engineering proposed and priority-ranked infrastructure improvements at each. The majority of these sites are situated outside of the bounds of the hamlet and were not assessed as part of this LFA as well. However, there is overlap with one culvert, the crossing of Townsend Hollow Road over Elk Creek, which Delaware Engineering determined to be significantly undersized.

Overall conclusions of this assessment were the following:

1. Five of the 23 sites require substantial improvements in order to correct the existing conditions and eliminate the repetitive damages.
2. County Route 1 has a severely deteriorated bridge structure, which should be addressed for safety concerns.
3. The majority of the areas contain hydraulically inadequate culvert pipes, which are not in need of immediate attention. However, in order to reduce the repetitive repair costs following large storm events, the subject culverts should be upgraded.
4. The five areas requiring substantial improvements may be eligible for funding through several local agencies. Where applicable, town records indicating the associated repetitive repair costs and frequency of repairs would be beneficial in seeking funding. Additionally, reducing and eliminating the repetitive repairs with new improved structures would reduce the associated decline in water quality during the repairs, a favorable and beneficial alternative.
5. The project also prioritized the 23 sites by urgency of work to be performed.

Recommendations were to do the following:

1. Seek funding through Greene County Soil and Water Conservation District (GCSWCD), DCSWCD, NYCDEP, and CWC to replace structures of concern.
2. Proceed with replacement of the five most critical structures.
3. Address other repair/replacement work in order of priority as funding becomes available.
4. Make repairs or improvements to structures that still provide ample service when possible.
5. Replace structures that are hydraulically inadequate with appropriately sized units.
6. Consult with Greene County Highway and GCSWCD to address the areas that are county owned.
7. Consult with landowners to address areas that have been created or are their responsibility.

Greene County Multijurisdictional 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).

In 2009, Greene County completed a multijurisdictional natural HMP. By participating in the plan, jurisdictions within the county comply with the Federal Disaster Mitigation Act of 2000. Compliance with this act allows jurisdictions to apply for federal aid for technical assistance and postdisaster mitigation project funding. A new HMP dated January 2016 is currently posted on the Greene County website. This new report has been finalized and accepted by FEMA. It has been adopted via resolution by Greene County and is in process for adoption by the towns. Both plans are available on the Greene County website.

2009 Plan: https://www.greenegovernment.com/wp-content/uploads/2015/01/HMP.pdf

2016 Plan: https://www.greenegovernment.com/wp-content/uploads/2016/02/hazplan2016.pdf

The 2009 HMP identifies flooding as a significant hazard in both Greene County and the town of Halcott. Hazards were ranked based on probability of occurrence and impact on the community. Flooding received the highest rating, which means that flooding is frequent and likely to occur within 25 years. The impact of a particular hazard was evaluated based on effect on the population, property, and the economy. Flooding was found to have a "high" impact on all these categories. Due to the probability of occurrence and impact on the community, flooding was assigned an overall risk of "high."

Water Quality Reports

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

The Delaware River Waterbody Inventory/Priority Waterbodies List provides water quality assessment data for waterbodies in the Delaware River Basin, which includes Vly Creek and its tributaries. These data can be accessed here:

http://www.dec.ny.gov/chemical/36745.html

Vly Creek and the town of Halcott are situated in the Upper East Branch of the Delaware River Basin; the specific document for this region can be accessed here:

http://www.dec.ny.gov/docs/water_pdf/widelawuppeast.pdf

Vly Creek and its tributaries are classified as B(TS) streams with no known impacts. Class B indicates that the waterbody is suitable for aquatic life, swimming, and other contact recreation activities but not for drinking water. The additional standard of TS (trout spawning) indicates that the watercourse may support a cold-water fishery; special NYSDEC requirements apply to these waters that support and sustain valuable and sensitive fisheries resources.

Local Flood Damage Prevention Codes

The Town of Halcott has adopted a local Flood Damage Prevention Law. The present code is authorized by the New York State Constitution and consistent with the federal guidelines, which are requirements for participation in the NFIP. The Town Code Enforcement Officer is empowered as the Local Administrator and is responsible for administering, implementing, and enforcing the local Flood Damage Prevention Law.

This law can be found on file with the Halcott Town Clerk or accessed online here:

http://www.gdgbd.net/gb/HalCenArch/laws/1-1992.pdf

The stated purposes of this local law are as follows:

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

The stated objectives of the local law are as follows:

1. To protect human life and health
2. To minimize the expenditure of public money for costly flood-control projects
3. To minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public
4. To minimize prolonged business interruptions
5. To minimize damage to public facilities and utilities such as water and gas mains; electric, telephone, and sewer lines; and streets and bridges located in areas of special flood hazard
6. To help maintain a stable tax base by providing for the sound use and development of areas of special flood hazard so as to minimize future flood blight areas
7. To provide that developers are notified that property is in an area of special flood hazard
8. To ensure that those who occupy the areas of special flood hazard assume responsibility for their actions

New York State Community Risk and Resiliency Act

The New York State Community Risk and Resiliency Act (CRRA) was adopted in 2014 for the purpose of ensuring that projects receiving state funding or requiring permits include consideration of the effects of climate risk and extreme-weather events.

To meet its obligation to develop guidance for the implementation of the CRRA, NYSDEC has proposed a new document, *State Flood Risk Management Guidance*, which is intended to inform state agencies as they develop program-specific guidance to require that applicants demonstrate consideration of sea-level rise, storm surge, and flooding as permitted by program-authorizing statutes and operating regulations. The guidance incorporates possible future conditions, including the greater risks of coastal flooding presented by sea-level rise and enhanced storm surge and of inland flooding expected to result from increasingly frequent extreme precipitation events.

NYSDEC is also proposing a new guidance document entitled *Guidance for Smart Growth Public Infrastructure Assessment*. This new document is intended to guide state agencies as they assess mitigation of sea-level rise, storm surge, and flooding in design of public-infrastructure projects as required by CRRA.

In response to CRRA, the NYSDOT has provided updates to its guidelines and manuals relating to the design of bridges and culverts, including a revision of Chapter 8 of the *Highway Design Manual* and a revised *Bridge Manual*. For new and replacement bridges and culverts, current peak flows are to be increased to account for future projected peak flows, which range from 10 to 20 percent. Bridges are required to pass the 50-year flow with a minimum of 2 feet of freeboard and must pass the 100-year flow without causing a rise in water surface elevations. Culverts must pass the 50-year flow and meet allowable headwater limits.

NYSDEC Stream Crossing Guidelines and Standards

The NYSDEC has developed stream crossing guidelines and standards aimed at protecting and restoring stream continuity. They provide minimum criteria to avoid fragmentation of streams. The objective is to maintain natural conditions that do not restrict the movement of fish and wildlife through the stream system.

These are summarized below and are available in more detail at:
https://www.dec.ny.gov/permits/49060.html
and:
https://www.dec.ny.gov/permits/49066.html

- Provide a minimum opening width of 1.25 times the bankfull width of the waterway in the vicinity of the culvert.
- Use open-bottom culverts or closed-bottom culverts that have the bottom slabs placed below the streambed elevation, which allows for installation of natural streambed material through the length of the culvert.
- Match the channel slope through the culvert to the natural channel slope upstream and downstream of the culvert.
- The culvert should not be skewed relative to the direction of flow of the stream.
- Install new or replacement structures so that no inlet or outlet drop would restrict aquatic organism passage.

2.2 Field Assessment

During the LFA process, MMI staff conducted several field visits to the project area in the winter, spring, and summer of 2019. During these visits, various data were collected on several culverts, bridges, and the streams they cross; channel morphology, configuration, and floodplain characteristics; and high-water marks and other evidence of past flooding extents. Culvert dimensions and downstream cross sections and profiles were measured for *HY-8* culvert hydraulics modeling. Bridge geometries and cross sections of the Vly Creek channel were measured for use in Hydrologic Engineering Center – *River Analysis System* (HEC-RAS) hydraulic modeling in the vicinity of Ursum Way and the Town Highway Garage. Cross sections were supplemented with a 2-meter resolution Light Detection and Ranging (LiDAR)-derived Digital

Elevation Model (DEM) available from the New York State Geographic Information System (NYS GIS) Clearinghouse.

2.3 Watershed Characteristics and Land Use

Vly Creek has an 18.2-square-mile watershed measured at the Greene/Delaware county line. This watershed includes almost the entire town of Halcott. Halcott is a rural community and is over 90 percent forested. Development is primarily agricultural; cropland and pasture make up about 7 percent of the watershed, and less than 2 percent is classified as urban development. Land use has changed in the years since Halcott was settled in the early 1800s. Most recently, the past several decades have seen gradual abandonment of agricultural activity, and forests are succeeding what had formerly been cultivated fields and pastures. Mean basin slope is steep at 1,230 feet per mile, or approximately 23 percent. Vly Creek runs through the center of this basin, collecting several tributaries along the way.

Surficial geology in the project watershed is dominated by glacial drift. Vly Creek and its tributaries run almost entirely through deposits of till and kame; alluvial substrate is encountered in the valley bottom, beginning at the confluence of Vly and Elk Creeks and continuing downstream through the terminus of the project area at the county line. Underlying bedrock geology is composed of two layers of the Upper Devonian Walton Formation, which consists of gray and green crossbedded sandstones, red and green shales, and round pebble quartz conglomerates. Higher elevations are mapped as the younger, upper Walton Formation of the West Falls Group, which overlies the older, lower Walton Formation of the Sonyea Group. Their interface is mapped at approximately 2,500 feet in elevation.

Soils are assigned a hydrologic soil group (HSG) identifier, which is a measure of the infiltration capacity of the soil. These are ranked A through D. An HSG A soil is often very sandy, with a high infiltration capacity and a low tendency for runoff except in the most intense rainfall events; a 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 run off 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. Over 80 percent of the mapped soils in the Vly Creek watershed are classified as HSG C or D, indicating a low capacity for infiltration and high tendency for runoff (Figure 2-1). This contributes to flash flooding in the watershed as rainfall runoff moves swiftly into streams rather than gradually seeping through the soils. This is mitigated to some degree by the large areas of forest in the watershed, which tend to encourage infiltration and reduce runoff.

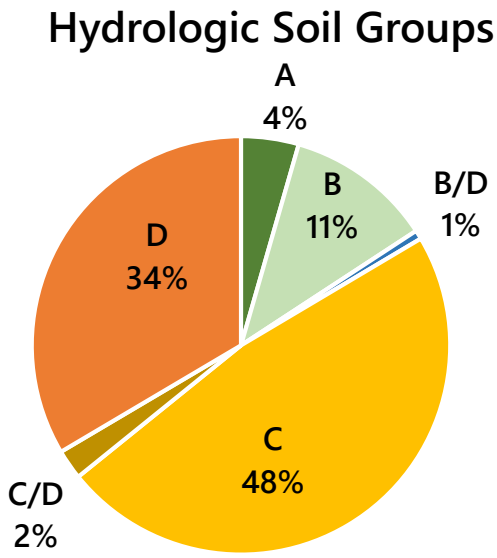

Figure 2-1: Distribution of hydrologic soil groups in Vly Creek watershed

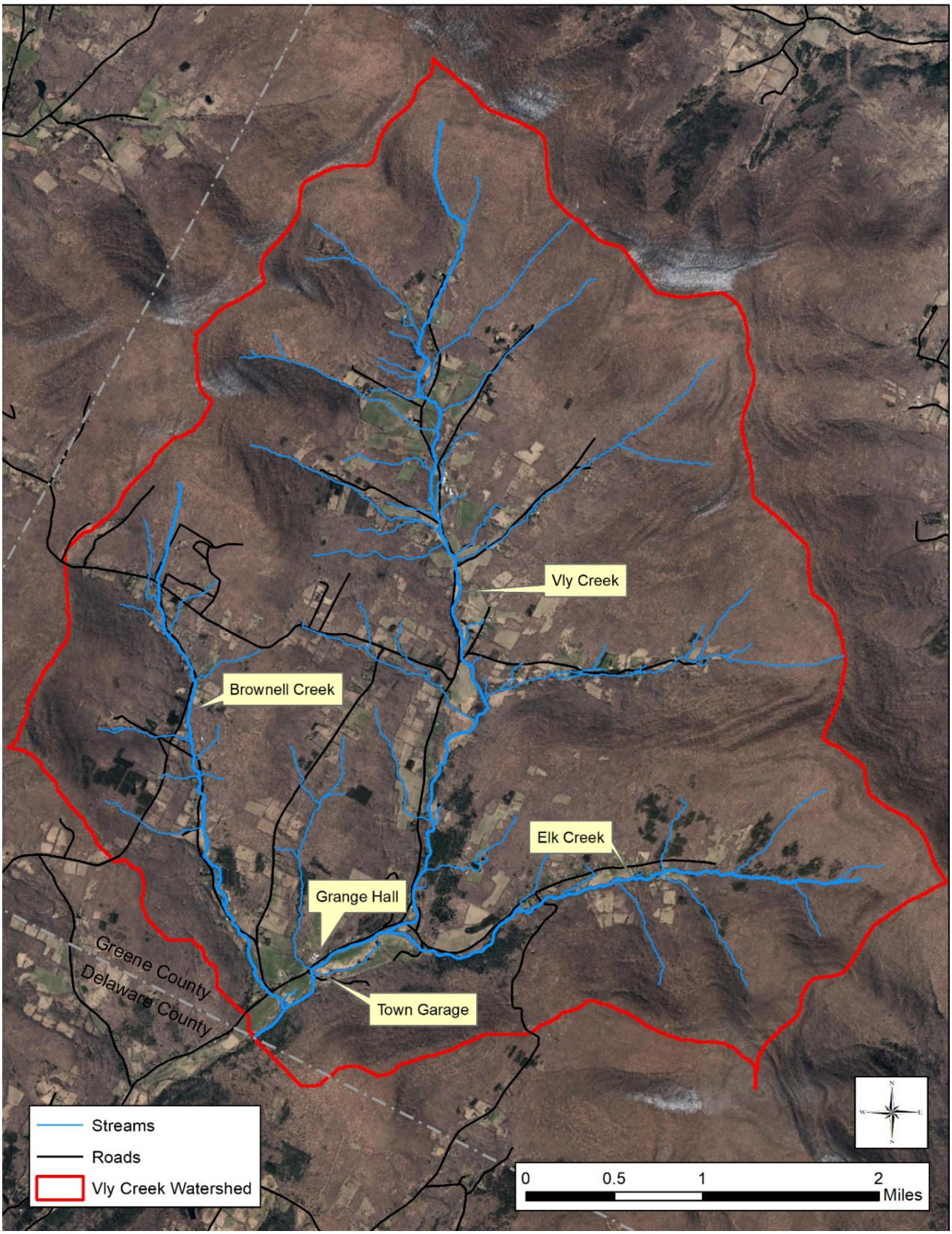

Figure 2-2: Vly Creek Watershed at the Greene/Delaware county line

2.4 Watercourse Characteristics

Vly Creek runs approximately 6.5 miles from its headwaters on the southern flank of Bearpen Mountain, through the town of Halcott, to the Greene/Delaware county line, with an average slope of 3 percent. Downstream of the county line, Vly Creek flows into the Bush Kill, on into Dry Brook, and thence into the East Branch of the Delaware River.

Within the town of Halcott, Vly Creek is met by Elk Creek and Brownell Creek (alternatively known as West Settlement Creek), as well as several smaller, unnamed tributaries. Greene County Route 3 (CR-3) follows Vly Creek for much of its length and in general is set back from the stream but is immediately adjacent along several reaches. Vly Creek is spanned by nine bridges as it flows to the county line; one of these is a private driveway. Dozens of culverts cross Brownell and Elk Creeks and the other tributaries to Vly Creek.

Vly Creek is impounded in a small artificial pond (~0.3 acre) near its headwaters and flows through a series of beaver ponds shortly downstream. Otherwise, the topography provides minimal floodwater storage until the stream reaches the valley bottom near Halcott Center. Here, the valley opens up into a floodplain, but the stream has experienced substantial historical modifications. Realignment, straightening, dredging, and berming of the channel have resulted in an unstable condition wherein the channel bottom is in fact at a higher elevation than the adjacent valley floor. When the stream spills its banks in flood stage, water flows laterally across the floodplain valley in the preferential flow path defined by the terrain. The Town Highway Garage is constructed on fill in this floodplain in this preferential flow path.

2.5 Critical Infrastructure and Anchor Businesses

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 follows: private gas stations, grocery stores, lumber yards, hardware stores, and medical doctor's office or pharmacy, which if destroyed or damaged would impair the health and/or safety of the community.

Critical facilities in the town of Halcott include the Town Highway Garage and the Town Grange Hall, which serves as an emergency shelter and meeting point but is not prone to flooding. However, the Highway Garage is partially in the SFHA delineated by FEMA. Presently, emergency services are provided primarily by the Towns of Fleischmanns and Margaretville. However, the Town of Halcott has recently acquired a parcel for a proposed satellite emergency facility on CR-3 near Brownell Creek.

No businesses were identified in the project area that meet the LFA definition of an anchor business. However, it should be noted that there are large farms in Halcott that if damaged, destroyed, or made inaccessible during a flood would seriously impair the economic health and well-being of the town.

2.6 Hydrology

Hydrologic studies are conducted to understand historical and potential future river flow rates. Stream flow rates are a critical input for hydraulic models such as *HY-8* and HEC-RAS. Stream flow is typically determined from USGS stream gauging stations or from regression equations based on region-specific variables such as precipitation and watershed area.

Peak discharges for selected recurrence intervals were calculated for Vly Creek at Ursum Way using a variety of estimation techniques. Regional runoff regressions have been developed by the USGS for ungauged watercourses. For New York State, these methods are described in USGS Scientific Investigations Report (SIR) 2006-5112 (Lumia et al., 2006). Additionally, this report provides several other estimation techniques, including transfer and scaling of flows from nearby gauged sites based on watershed area and hydrologic region. These and other methods described in the *Connecticut Drainage Manual* were used to estimate peak discharges in seven different ways (Connecticut Department of Transportation [CTDOT], 2000). Estimated 100-year discharges for Vly Creek at Ursum Way are presented in TABLE 2-1.

These estimates were fairly tightly clustered, with the *StreamStats* value near the center of the ranges for each specified recurrence interval. These were the peak discharges used for hydraulic analyses of Vly Creek in the vicinity of the Town Highway Garage, which is consistent with the hydrology implemented in culvert analyses. Note that with the current stream configuration, road crossings, and basin topography, calculated peak water surface elevations at critical locations vary only slightly over the ranges of computed flow estimates.

TABLE 2-1
100-Year Peak Flow Magnitude Estimates at Ursum Way Crossing of Vly Creek

Source	100-year Discharge (cfs)
StreamStats Estimate	4,830
Ratio Estimate East Branch of the Delaware River at Roxbury – Weighted 17B	4,440
Ratio Estimate Bush Kill at Arkville – 17B	6,620
Ratio Estimate Bush Kill at Arkville – Weighted 17B	4,565
Transfer Equation from Bush Kill at Arkville	5,510
Ratio Estimate West Kill at West Kill – 17B	5,460
Ratio Estimate West Kill at West Kill – Weighted 17B	4,930

cfs = cubic feet per second

2.6.1 *HY-8* Culvert Models

All culvert analyses use *StreamStats*' regional regressions to estimate peak flows in the relevant stream for common design floods. These peak flows are used as inputs to size replacement culverts with the *HY-8* culvert hydraulics software. This program uses several additional 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.

TABLE 2-2
Peak Flow Recurrence Intervals Estimated by *StreamStats* at LFA Bridge and Culvert Sites

Road	Stream Crossed	Drainage Area (mi^2)	Peak Discharge Estimate (cubic feet per second)						
			Flood Return Interval (years)						
			2	5	10	25	50	100	500
Townsend Hollow Road	Elk Creek	2.7	230	380	510	700	880	1,060	1,560
Fairbairn Drive	Elk Creek	3.5	300	490	650	900	1,120	1,360	1,980
County Route 3	Unnamed Tributary	0.7	60	95	130	180	220	270	400
County Route 1/ West Settlement Road	Brownell Creek	2.8	200	335	450	630	790	950	1,400
County Route 3	Brownell Creek	3.0	220	360	490	670	840	1,020	1,490
Ursum Way	Vly Creek	14.8	1,080	1,800	2,410	3,290	4,080	4,830	7,170

2.6.2 HEC-RAS Models

Two 2-Dimensional HEC-RAS models were developed; one larger model covers the area in the vicinity of Ursum Way and the Town Highway Garage. A smaller model was developed to assess the Elk Creek Road bank failure.

Unsteady flow hydrographs for Vly Creek and its tributaries were synthesized by applying gamma distributions to peak flow values estimated by *StreamStats*, with scaling factors derived from hydrologic characteristics of the watersheds. These are intended to approximate a transient flood hydrograph and demonstrate the progression of a flood wave through the valley for the purposes of determining locations where flow leaves the channel, the subsequent flow paths of floodwaters, and peak water surface elevations. They do not represent any actual storm event; however, peak water surfaces modeled in the synthetic 100-year storm at the Town Highway Garage are within inches of observed high-water marks in Tropical Storm Irene. This is not a rigorous validation but does indicate that modeled hydraulics are reasonably accurate and sufficient for these analyses.

3.0 EXISTING FLOOD HAZARDS

3.1 Flood History

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. An examination of stream flow gauges indicates that floods can take place any time of the year but are commonly divided into those occurring in winter and spring and those occurring in summer and fall. Floods that take place in summer and fall are typically due to extreme rainfall events caused by hurricanes and tropical storms. Floods in winter and spring are associated with rain on snow events and spring snowmelt (FEMA, 2015).

FEMA reports that significant flood events have occurred in the Greene County region in 1938, 1955, 1960, 1972, 1980, 1987, 1995, 1996, 1997, 1999, 2003, 2005, 2006, 2007, and 2011, among others. These floods were primarily triggered by rain-on-snow and snowmelt events in winter or spring, or hurricanes and tropical storms in the autumn. In recent memory, the floods of 1996, 1999, 2003, 2005, 2007, and 2011 were especially damaging to Halcott.

3.2 Tropical Storm Irene

The Town of Halcott experienced substantial damage in Tropical Storm Irene at the end of August 2011. Hydrologic analysis indicates that peak flows in Vly Creek were just under the estimated 100-year flood levels; by comparison, the 1996 flood was an approximately 10-year event. During flooding caused by Tropical Storm Irene, several important stream crossings were damaged or destroyed, including Elk Creek Road over Vly Creek, Townsend Hollow Road over Elk Creek, Turk Hollow Road over a tributary to Vly Creek, County Route 1 over Brownell Creek, and Ursum Way over Vly Creek and Spring Brook. Numerous additional small culverts were washed out, and several roads were heavily damaged by runoff as well. The Town Highway Garage was inundated by over 1 foot of water, causing extensive damage to the structure and destroying several valuable pieces of equipment.

3.3 FEMA Mapping

The town of Halcott and Vly Creek are mapped on FEMA Flood Insurance Rate Map (FIRM) number 36039C0330F, dated May 16, 2008 (see Figure 3-1). SFHA are indicated as Zone A, meaning that no BFEs have been determined and that these areas are identified by approximate methods. Minimal development is present in the SFHA overall although the Town Highway Garage and several homes are mapped as partially or completely within the 100-year floodplain. Some properties lie within Zone X, meaning that these areas may be within the inundation extents of the 500-year flood or that water depths of less than 1 foot are expected in the 100-year flood.

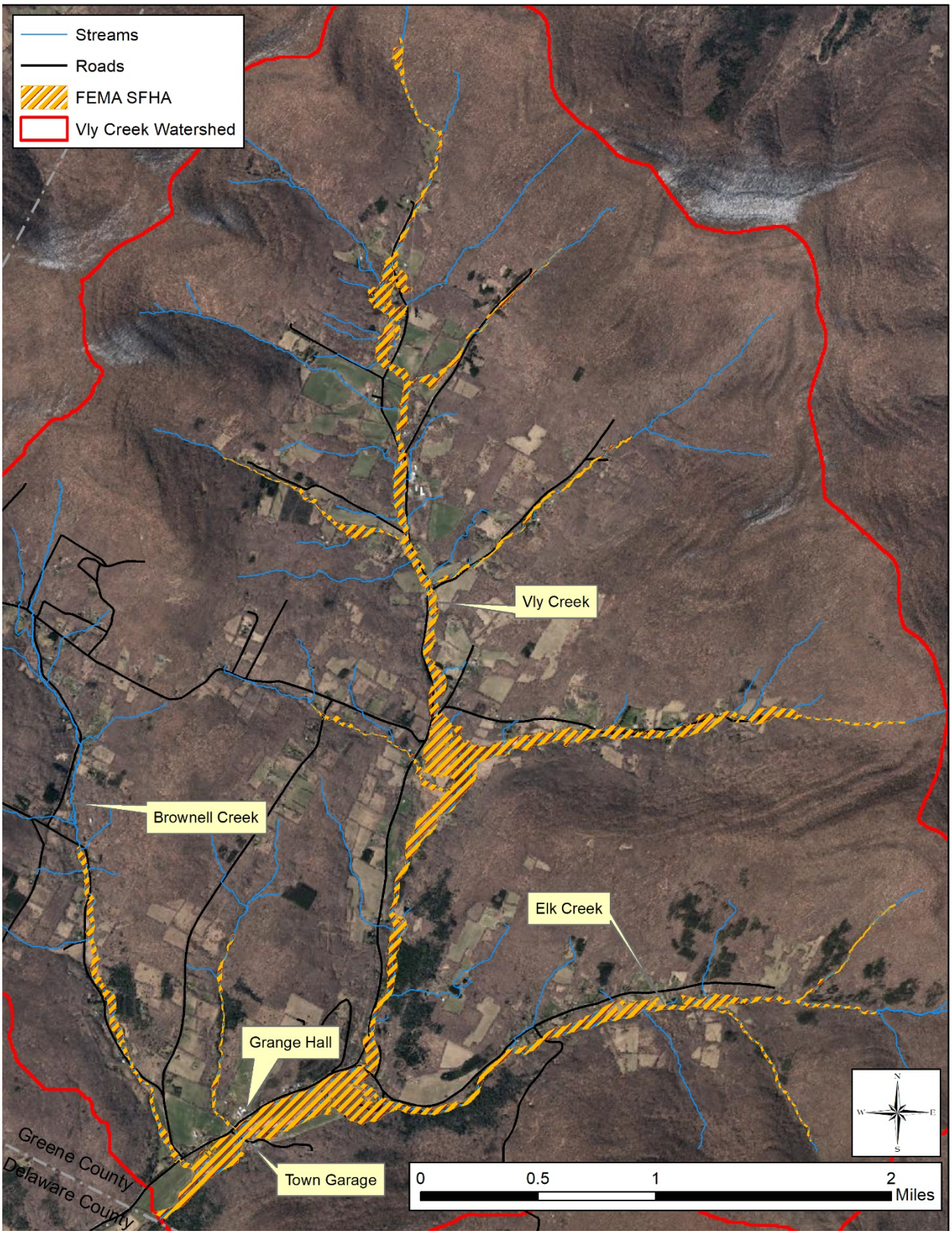

Figure 3-1: FEMA SFHA for the Vly Creek watershed in Town of Halcott (FIRM panel 36039C0330F)

4.0 FLOOD MITIGATION ANALYSIS

4.1 Analysis Approach

Culverts:

HY-8 culvert hydraulics models were developed to evaluate the following stream crossings:

- Townsend Hollow Road over Elk Creek
- Fairbairn Drive (private) over Elk Creek
- CR-3 over unnamed tributary that parallels Turkey Ridge Road
- West Settlement Road/CR-1 over Brownell Creek
- CR-3 over Brownell Creek

Alternatives target minimal alterations of roadway profiles and alignments unless necessary. Complete hydraulic assessments are recommended prior to any upgrades to ensure that replacement structures meet NYSDOT standards and NYSDEC guidelines.

Ursum Way and Highway Garage:

Due to the complex floodplain flow dynamics in the floodplain valley upstream of Ursum Way and the Town Highway Garage, a two-dimensional HEC-RAS model was developed to assess flooding at the garage and the two structures on Ursum Way:

- Ursum Way over Vly Creek (bridge, access to Town Highway Garage)
- Ursum Way over Spring Brook tributary to Vly Creek (culvert, access to Town Highway Garage)

Elk Creek Road Bank Failure:

A two-dimensional HEC-RAS model was developed to assess shear stresses, stream power, and flow depths and velocities along the failing slope between Elk Creek and Elk Creek Road.

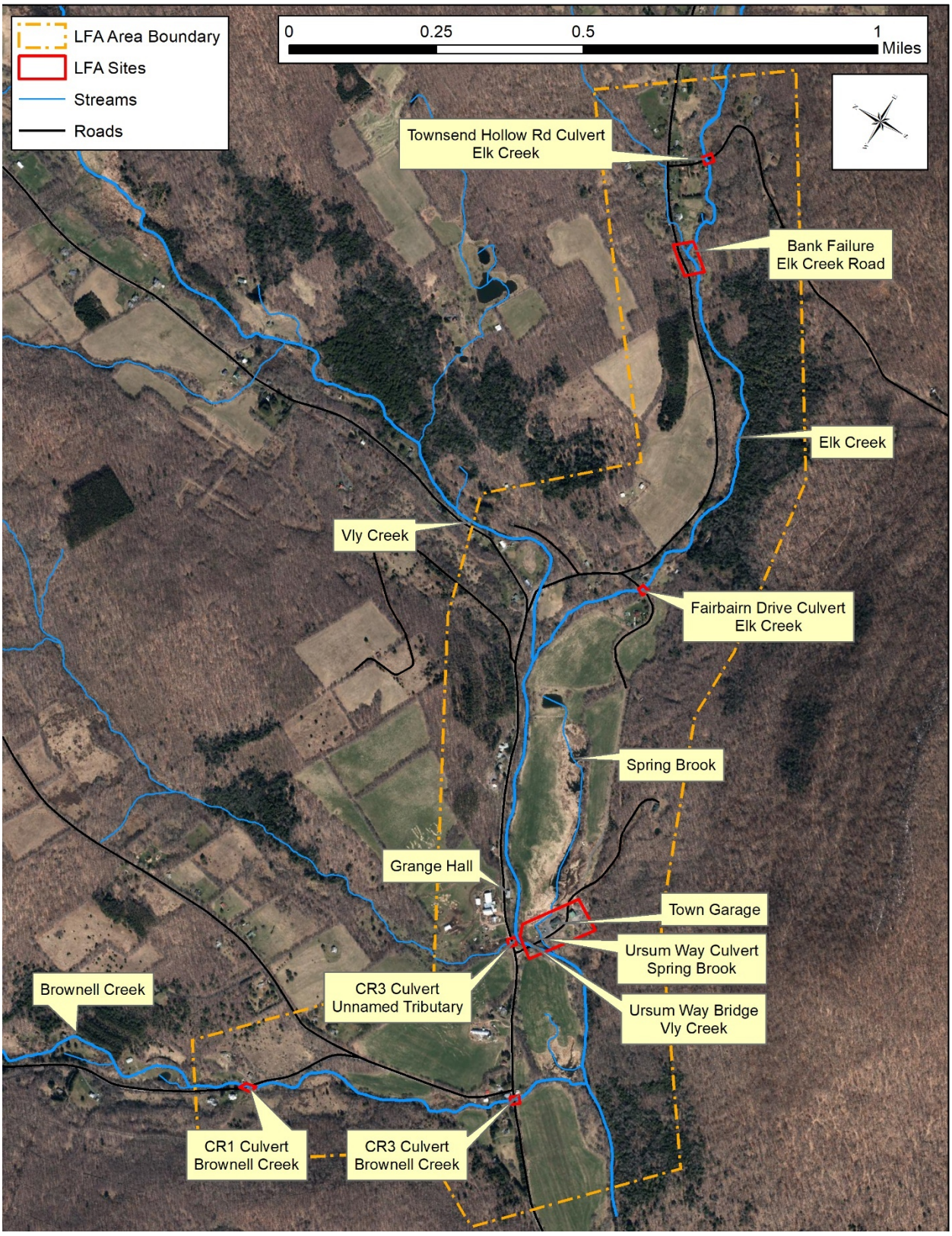

Figure 4-1: Town of Halcott LFA sites

5.0 FINDINGS AND RECOMMENDATIONS

5.1 Culverts

Overall, assessed culverts are not adequately sized in that they do not meet all NYSDOT standards and NYSDEC guidelines for new culverts in terms of hydraulic opening, permissible headwater depths, and/or aquatic organism passage. Replacing these culverts to meet these criteria represents a substantial capital investment, so upgrades must be prioritized in order 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.

Minimizing additional risk in the event of culvert failure is a key component of upgrade prioritization. A collapsed culvert may pose an immediate danger to those nearby, but the loss of a critical link in the road network can have further-reaching consequences. Structures that carry vital transportation routes are essential for safe passage of residents who may need to evacuate or obtain supplies, emergency responders to reach those in danger, and construction crews to access and repair damaged infrastructure elsewhere. Roadway functional classification, existence and length of available detours, average daily traffic, businesses and homes serviced, and proximity to emergency facilities and anchor businesses may be used to determine a structure's relative importance.

5.1.1 Townsend Hollow Road over Elk Creek

The existing structure is a circular, 6-foot-diameter corrugated metal pipe. The culvert has poorly aligned, stacked stone wingwalls and is covered by approximately 1 foot of fill. This road has washed out several times in the past when the stream flanks the culvert on either or both sides. This structure was also identified as being significantly undersized in the 2010 Stormwater Assessment conducted by Delaware Engineering.

Figure 5-1: Townsend Hollow Road culvert carrying Elk Creek. View looking upstream at culvert outlet.

Figure 5-2: Townsend Hollow Road culvert carrying Elk Creek. View looking downstream through culvert.

Townsend Hollow Road is a seasonal route into and out of the Halcott valley, climbing through a gap in a steep ridge to the southeast and descending into the adjacent valley. A few homes are serviced by this road, between the culvert and the basin divide, and have a detour length of approximately 10 miles if the road is passable over the ridge. However, because the Townsend Hollow Road pass is only seasonally maintained and is a very rough and steep road anyway, it is possible for residents to become stranded between Elk Creek and the pass if this culvert is damaged. While the number of people potentially impacted is small, the magnitude of this impact may be quite severe.

The current structure has a capacity of about 200 cfs, which is sufficient to convey bankfull flows but is inadequate for the estimated 2-year flood and greater flows. Replacing this culvert with an 18-foot span, 5-foot rise would pass the 50-year flood. A structure capable of conveying the 50-year flood is recommended because the marginal benefits of a larger structure may not justify the additional expense. That being said, it is crucial to have an emergency plan in place for residents that are prone to being cut off by culvert failure not just on Townsend Hollow Road but in other cases of dead-end roads or unreliable detours as well.

Three homes are adjacent to Elk Creek at the Townsend Hollow Road crossing, one on the upstream side of the road and two downstream. One of these is mapped entirely within the SFHA; the other two are just a short distance outside. If these properties have a history of flooding damages and there is owner interest, it is recommended that the owners seek a buyout and relocation assistance from FEMA, New York City (NYC), and/or CWC, or consider elevating their homes above flood levels. The building in the SFHA downstream of the crossing would likely impact replacement culvert design; if the home is indeed frequently flooded, a buyout of this property may improve and expedite culvert replacement.

TABLE 5-1
Peak Discharge Estimates at Townsend Hollow Road Culvert Crossing of Elk Creek
Existing and Recommended Culvert Characteristics

Road	Stream Crossed	Peak Discharge Estimate (cubic feet per second)						
		Flood Return Interval						
		2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	500-Yr
Townsend Hollow Road	Elk Creek	230	380	510	700	880	1,060	1,560

Existing Structure:	200 cfs capacity (1.5-Year). 6-foot circular CMP; 5 percent slope; square edge with headwall
Recommended Structure:	910 cfs capacity (50-Year). 18-foot span x 5-foot rise concrete box; 5 percent slope; square edge with wingwalls; upstream invert lowered by 0.4 foot; roadway raised by 0.3 foot

5.1.2 Fairbairn Drive over Elk Creek

The Fairbairn Drive crossing of Elk Creek was assessed because this road is the only alternative access route to the Town Highway Garage in its current location. Relocating the Highway Garage is recommended although it is possible to move the facility to higher ground on its existing parcel rather than to elsewhere in town. To facilitate this alternative, improving Fairbairn Drive for suitability as a permanent alternate emergency access was assessed because this would be more practical and less expensive than upgrading Ursum Way to the point that an alternative access is not necessary.

Figure 5-3: Fairbairn Drive culvert carrying Elk Creek. View looking upstream at culvert outlet. Left wingwall (right side of photograph) has failed; right wingwall (left side of photograph) is in fair condition. Perched outlet is an impediment to aquatic organism passage and may contribute to headwall failure.

Figure 5-4: Fairbairn Drive culvert carrying Elk Creek. View looking downstream at culvert inlet. Right wingwall has failed and collapsed. Left wingwall is in poor condition. Tent frame and picnic bench cover collapsed portion of road embankment.

The existing culvert is a smooth, 7.5-foot-diameter riveted-steel pipe. Wingwalls are constructed of alternating layers of timber and stacked stone. On the upstream side, the right wingwall has failed and collapsed into Elk Creek while the left wingwall is in poor condition. On the

downstream side, the left wingwall has failed, and the right wingwall is in fair condition. This culvert has a perched outlet and a deep scour hole on the downstream side, which jeopardizes the stability of the downstream headwall.

In past floods, Fairbairn Drive, which is a private road, has been used for emergency access to the Town Highway Garage when the Ursum Way culvert has washed out. This is a critical alternative access in case of damage to Ursum Way even though it is not maintained by the town. If both Fairbairn Drive and Ursum Way are damaged in a flood, which is not unlikely given their history and condition, the Highway Garage would be completely inaccessible, which is an unacceptable scenario in terms of the town's capacity to respond to a damaging flood event.

The existing culvert has a capacity of approximately 350 cfs, which will pass the 2-year flood, but the 5-year flood and greater flows overwhelm the structure. A 20-foot-span, 6-foot-rise box culvert would pass the 50-year flood, and increasing the span to 24 feet would allow the culvert to pass the 100-year flood. A structure capable of conveying the 100-year flood is recommended if it will be relied upon for alternate emergency access to the Town Highway Garage. If the garage will be relocated elsewhere in Halcott, replacing this culvert is not a priority for the town.

Because Fairbairn Drive is a privately owned road, many public funding sources may not be available for improving this road and its culvert. If Halcott intends to keep the Highway Garage on its current parcel, the town should consider acquisition of the right-of-way so that public funding may become available for improvements of the road and culvert. Regardless of long-term plans, it is recommended that the town not hesitate to reach an agreement with the owners of Fairbairn Drive to secure interim alternate emergency access to the Town Highway Garage in case of flooding in the near future.

Two properties on Fairbairn Drive are mapped in the SFHA, one on each of the upstream and downstream sides of the road. It is recommended that these homeowners seek a buyout, relocation assistance, or structure elevation if their properties have a history of flood damage and they are interested in doing so.

TABLE 5-2
Peak Discharge Estimates at Fairbairn Drive Culvert Crossing of Elk Creek
Existing and Recommended Culvert Characteristics

Road	Stream Crossed	Peak Discharge Estimate (cubic feet per second)						
		Flood Return Interval (years)						
		2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	500-Yr
Fairbairn Drive	Elk Creek	300	490	650	900	1,120	1,360	1,980

Existing Structure:	350 cfs capacity (2-Year). 7.5-foot circular riveted steel pipe; 2.8 percent slope; square edge with headwall
Recommended Structure:	1,370 cfs capacity (100-year). 24-foot span x 6-foot rise concrete box; 2.8 percent slope; square edge with wingwalls

5.1.3 County Route 3 over Unnamed Tributary to Vly Creek

An elliptical, corrugated metal pipe with 83-inch span and 53-inch rise conveys an unnamed tributary under CR-3, which meets Vly Creek just upstream of Ursum Way. For reference, FEMA products identify this stream as *Vly Creek Tributary 2*. This culvert has stacked stone headwalls and a perched outlet and is partially occluded by aggraded sediments. While an impediment to aquatic organism passage, no problems have been reported with this culvert, and it is currently in good structural condition.

In its current configuration, this crossing has a capacity of approximately 270 cfs, which is hydraulically adequate. The culvert is able to pass the 50-year flood and may be capable of conveying the 100-year flood as well. However, this culvert is susceptible to further aggradation or obstruction by debris in floods and should be cleaned out on a routine basis, as well as following any high-flow events. Further, the perched outlet has contributed to formation of a downstream scour hole. This should be monitored and remediated as necessary as continued scour may destabilize the headwall and lead to collapse of the structure.

Figure 5-5: County Route 3 culvert carrying unnamed tributary. View inside culvert, looking downstream. Sediment aggradation has reduced the hydraulic capacity of the culvert.

Figure 5-6: County Route 3 culvert carrying unnamed tributary. View looking upstream at culvert. Perched outlet is an impediment to aquatic organism passage and contributes to development of downstream scour hole.

Retrofits to improve aquatic organism passage may be performed in conjunction with installation of downstream scour countermeasures. It is important that these modifications not impose a significant tailwater control on the culvert so that its capacity is not diminished. These and any other upgrades should include a full hydraulic analysis.

TABLE 5-3
Peak Discharge Estimates at CR-3 Culvert Crossing of Unnamed Tributary to Vly Creek
Existing and Recommended Culvert Characteristics

Road	Stream Crossed	Peak Discharge Estimate (cubic feet per second)						
		Flood Return Interval (years)						
		2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	500-Yr
County Route 3	Unnamed Tributary	60	95	130	180	220	270	400

Existing Structure:	270 cfs capacity (100-Year). 7-foot span x 4.5-foot rise elliptical CMP; 4.6 percent slope; square edge with headwall
Recommended Structure:	Maintain existing culvert.

5.1.4 County Route 1/West Settlement Road over Brownell Creek/West Settlement Creek

An open-bottom box culvert with 16-foot span and 5-foot rise carries CR-1, also known as West Settlement Road, over Brownell Creek upstream of its confluence with Vly Creek. This structure has a very poor alignment with the stream and frequently overtops and flanks on the left side.

Channel constrictions from historical modifications just downstream of the culvert impose a tailwater control on the structure, which reduces its capacity in flood events. This should be addressed prior to or concurrently with culvert replacement.

Figure 5-7: County Route 1 culvert over Brownell Creek. View inside culvert, looking downstream.

Figure 5-8: County Route 1 culvert over Brownell Creek. View from right bank, looking upstream. In floods, water flanks this culvert on the left side, flows across the driveway in the background of the image, and down the road.

Route 1 is an important access to western Halcott although there are two possible, seasonally passable detours of 5 to 6 miles if this culvert is damaged. It is also possible to travel out of the

Halcott valley to the west via this route although this too is a seasonally maintained road. The culvert is deteriorating as it is quite old and has incurred damage by numerous floods in the past. Some abutment scour is evident as well.

In its current configuration, this culvert has a capacity of 370 cfs, which will pass the 5-year flood but not the 10-year flood. Upgrading this culvert will have negligible impact unless done in conjunction with channel modifications downstream to remove the tailwater-inducing constriction. With this constriction removed, a 26-foot-span, 5-foot-rise box culvert will pass the 50-year flood. The same structure, but with the roadway elevation raised by 1 foot, would pass the 100-year flood. A culvert capable of passing the 100-year flow is recommended because it is not a substantial additional investment over the 50-year structure and because of the importance of this road in Halcott.

TABLE 5-4
Peak Discharge Estimates at CR-1 Culvert Crossing of Brownell Creek
Existing and Recommended Culvert Characteristics

Road	Stream Crossed	Peak Discharge Estimate (cubic feet per second)						
		Flood Return Interval (years)						
		2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	500-Yr
County Route 1 / West Settlement Road	Brownell Creek	200	335	450	630	790	950	1,400

Existing Structure:	370 cfs capacity (5-Year). 16-foot-span x 5-foot-rise open-bottom concrete box; 0.1 percent slope; square edge with headwall
Recommended Structure:	1,020 cfs capacity (100-year). 26-foot-span x 5-foot-rise concrete box; 2.9 percent slope; square edge with wingwalls; downstream invert lowered by 0.75 foot; roadway raised by 1.0 foot; eliminate downstream channel constriction.

5.1.5 County Route 3 over Brownell Creek/West Settlement Creek

County Route 3 crosses Brownell Creek with a 12.3-foot-span, 5.3-foot-rise, open-bottom box culvert. A placard on the guardrail dates the structure to 1914 although it appears as though the deck was widened by a few feet on the upstream side at a later date. CR-3 is the main access to the town of Halcott and is a critical asset in transportation, emergency response, and life safety networks. Annual average daily traffic is reported as 432 and 373 vehicles per day in 2002 and 2008, respectively, which is considerable for a town of 258 people. A 6-mile detour is possible though it includes the vulnerable CR-1 crossing of Brownell Creek and may not be available year round.

Figure 5-9: County Route 3 crossing of Brownell Creek. View looking upstream.

This culvert appears to be in very poor condition, and an inspection by a qualified structural engineer is highly recommended. The structure has deteriorated over a century of service, and a substantial volume of material from the substructure and underside of the superstructure and deck has been lost to the stream as the concrete spalls apart and the steel beams rust and exfoliate (Figure 5-14). Bisected corrugated metal pipes used as concrete forms in the superstructure were left in place, which hides the concrete from view. Where these forms have rusted away, the concrete appears in poor condition or has crumbled away as well (Figure 5-11). This is not uncommon with left-in-place forms, which can trap moisture against the concrete and accelerate decay. Roughly 8 to 10 linear feet of the left abutment has been undermined by scour (Figure 5-12), and the right upstream wingwall has cantilevered and separated from the rest of the structure (Figure 5-10). Significant spalling of the abutments reveals the extensive use of large cobbles as aggregate in the concrete (presumably mined directly from Brownell Creek), indicating that little or no reinforcing steel is incorporated into the abutments (Figure 5-11, Figure 5-13).

This stream crossing is just a few hundred feet from the parcel recently acquired by the Town of Halcott for a satellite emergency services facility. This culvert will gain additional importance when that facility is operational and should be considered for replacement as a high priority. A structural inspection of the culvert is recommended and may indicate that stabilizing countermeasures are necessary in the interim. At the request of the FAC, the Greene County Highway Engineer was contacted, who informed MMI that the structure has not been inspected by the county though it has repaired the guardrail in the recent past.

The current culvert has a capacity of 520 cfs, which is sufficient to convey the 10-year flood but not the 25-year flood. To pass the 50-year flow, increasing the span to 20 feet is necessary and

22 to 24 feet for the 100-year flow. Because the existing culvert is undersized, it is possible for water to back up, overtop the road, and flow across CR-3. A larger, hydraulically adequate structure could minimize this risk. Because of this road's importance, a robust structure capable of meeting the demands of the 100-year flood is recommended. A complete hydraulic analysis is recommended when this culvert is due for replacement.

Three buildings on the left bank of Brownell Creek are mapped as partially in the SFHA – two upstream and one downstream of CR-3. It is possible that an adequately sized replacement culvert at the CR-3 crossing of Brownell Creek may reduce flood extents enough that these buildings would no longer be prone to flooding. If this is not the case, or this culvert replacement is deferred, interested property owners should consider buyouts, relocation assistance, or elevating their buildings.

TABLE 5-5
Peak Discharge Estimates at CR-3 Culvert Crossing of Brownell Creek
Existing and Recommended Culvert Characteristics

Road	Stream Crossed	Peak Discharge Estimate (cubic feet per second)						
		Flood Return Interval (years)						
		2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	500-Yr
County Route 3	Brownell Creek	220	360	490	670	840	1,020	1,490

Existing Structure:	520 cfs capacity (10-Year). 12.3-foot-span x 5.3-foot- rise open-bottom concrete box; 8.9 percent slope; square edge with wingwalls
Recommended Structure:	1,080 cfs capacity (100-Year). 24-foot-span x 5-foot-rise concrete box; 9 percent slope; square edge with wingwalls; upstream invert lowered by 1.0 foot

Figure 5-10: Upstream right wingwall separated from structure

Figure 5-11: Deteriorated concrete and steel, looking at upstream left abutment. The half-pipes used as concrete forms hide the condition of the concrete where they have not yet rusted away. Note large cobbles used as aggregate in concrete abutment.

Figure 5-12: Scour has undermined several feet of the left abutment.

Figure 5-13: Deteriorating concrete abutment, downstream left. Note large cobbles used as aggregate in concrete.

Figure 5-14: Underside of deck, looking at downstream right corner. Steel beams are rusted and exfoliating. A large amount of concrete appears to be missing from between the two beams along the left side of the image.

5.2 Ursum Way and the Town Highway Garage

Ursum Way is a short road that accesses Halcott's Town Highway Garage and one residence on the opposite side of Vly Creek from CR-3, near the center of Halcott. A community garden sits between a 31-foot bridge that spans Vly Creek and a 5.5-foot-diameter culvert that conveys a small tributary under Ursum Way. This small tributary is known in Halcott as Spring Brook, and there are indications that it follows a channel formed by Vly Creek prior to its historical relocation to the right valley wall. Spring Brook originates in a wetland defined by several small beaver ponds in the valley upstream of Ursum Way and flows parallel to Vly Creek on the opposite side of the valley. As it approaches the Highway Garage, Spring Brook is channelized into a narrow ditch before flowing through the culvert at Ursum Way.

The Town Highway Garage also hosts Halcott's solid waste transfer station, which the town reports has been frequently flooded, resulting in recyclables and solid and potentially hazardous waste washing downstream and damage to the facility. Floodproofing retrofits were proposed in the Greene County HMP; MMI recommends relocating the transfer station out of the SFHA along with the Town Highway Garage.

Figure 5-15: Ursum Way bridge over Vly Creek. Looking upstream from left bank.

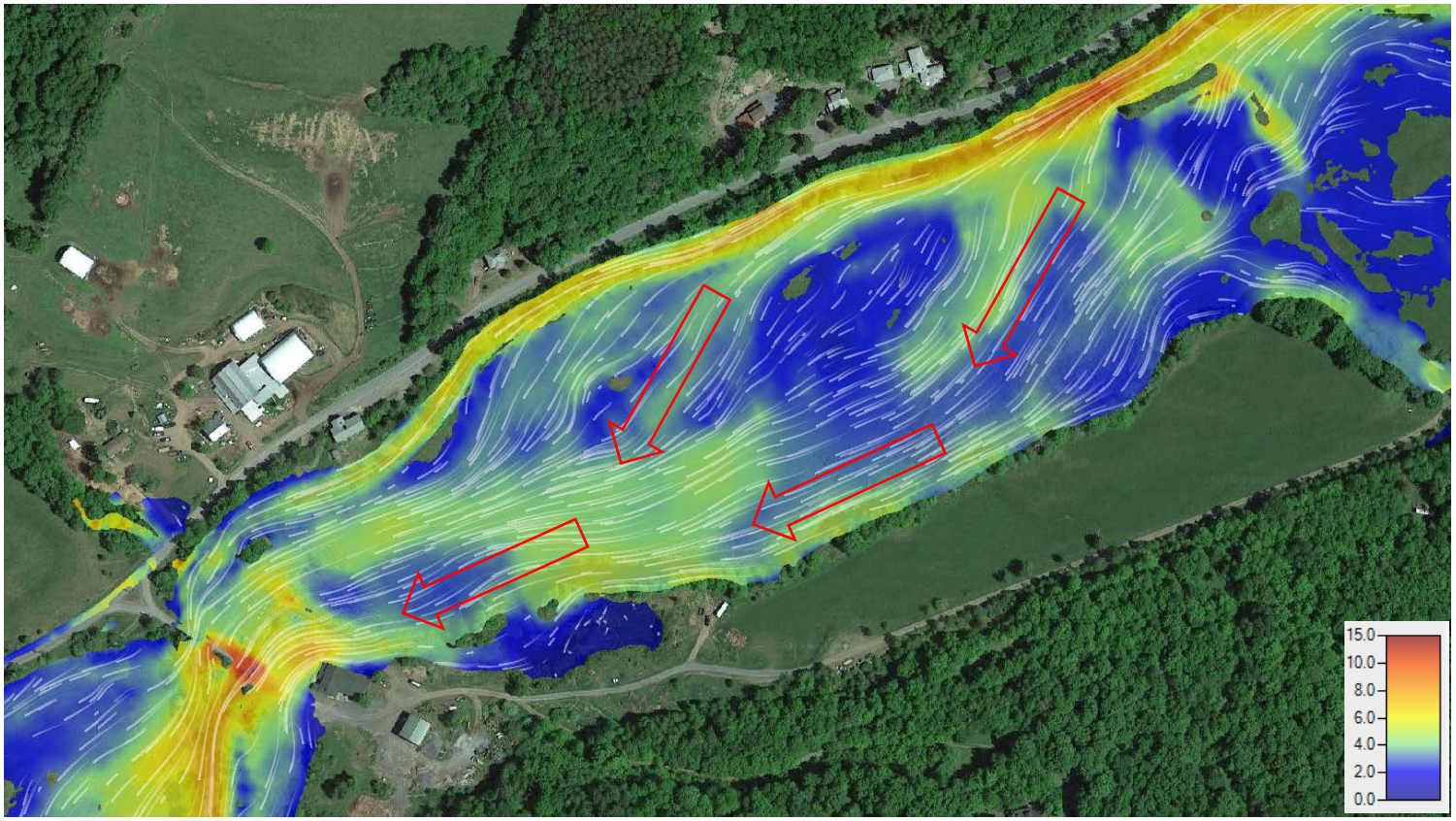

Figure 5-16: Two-dimensional HEC-RAS modeling at Ursum Way and the Highway Garage. Plotted colors indicate flow velocities in feet per second. White tracers indicate flow paths; these are highlighted with red arrows. During floods, Vly Creek fills its channel and spills onto the floodplain. Floodplain flow converges on the low terrain on the opposite valley wall and heads directly toward the Town Highway Garage and Ursum Way culvert. The floodplain constriction imposed by Ursum Way exacerbates flooding at the garage just upstream.

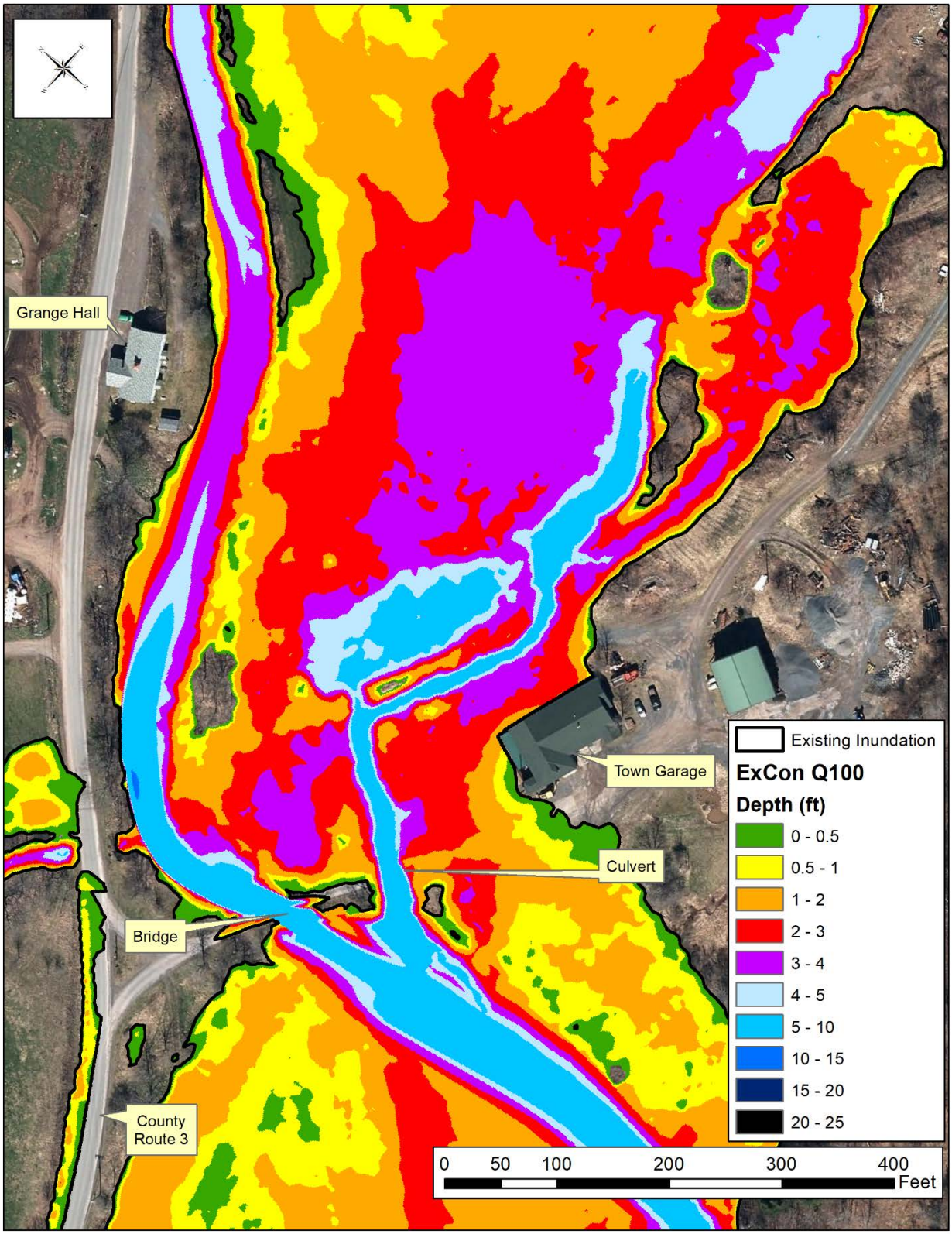

Figure 5-17: Map of flood depths near Town Highway Garage in estimated 100-year flood. 1-2 feet of water at the northwest corner of the garage.

It is important to note that Spring Brook and these wetlands lie at lower elevations than the bottom of Vly Creek's current channel on the other side of the valley. Because of this, Vly Creek is not in a stable alignment and is prone to avulsion since its channel is at a higher elevation than the adjacent land. When floodwater spills the banks of Vly Creek, it flows laterally across the valley to the low terrain and follows the path of Spring Brook toward the Highway Garage and the Ursum Way culvert (Figure 5-16).

It is for these same reasons that the Ursum Way bridge is less frequently damaged in floods than the culvert – valley topography does not direct floodplain flows toward the main channel and bridge but to Spring Brook and the culvert. Thus, the bridge has been spared the brunt of damaging flood flow at the expense of the culvert. This is not necessarily an issue in itself as culvert repairs are generally inexpensive compared to bridge repairs. However, in this case, the bridge and culvert are part of a system in series, and failure of either renders the Highway Garage inaccessible from CR-3 and Ursum Way.

The garage is constructed on fill that constricts the floodplain at this location, and the building sits almost directly in the path of floodplain flows that converge on the alignment of the Spring Brook channel. The bridge and culvert together are insufficient to convey Vly Creek in flood stage, so water backs up behind Ursum Way, leading to deeper flooding upstream and at the Highway Garage. If Ursum Way overtops, the road surface and culvert can be rapidly damaged. The bridge, even if hydraulically capable of conveying Vly Creek's flood flows, cannot do so because of its extremely poor alignment with the floodplain.

Figure 5-18: High-water mark on door inside Town Highway Garage (1.45 feet)

During Tropical Storm Irene, the Highway Garage was inundated by over a foot of water; high-water marks on an interior door show almost 1.5 feet of water inside the building (Figure 5-18). The garage was extensively damaged by floodwaters, and several pieces of equipment stored inside were destroyed. Labor and equipment resources expended at the garage and Ursum Way stream crossings in the aftermath of a flood could be diverted elsewhere if this critical facility was not in a flood-prone location. Flooding at the Highway Garage likely results in delayed response to damaged infrastructure elsewhere.

Community members report that the culvert crossing on Ursum Way has been damaged or destroyed by floods and repaired or replaced numerous times in the past. In Tropical Storm Irene, Fairbairn Drive, a private road, was used for emergency access to the Town Highway Garage when the Ursum Way culvert was washed out. Aside from the Highway Garage, Ursum Way services one residence, which is currently a second home and is also accessible via Fairbairn Drive.

Two objectives were identified for alternatives analysis:

1. Maintain access to Town Highway Garage during and after floods. The Highway Garage facility stores the materials, supplies, and equipment necessary for emergency road repairs and flood response and must be accessible to crews for these time-critical functions.
2. Reduce or eliminate flooding of the Town Highway Garage. If the garage is flooded, materials and equipment may be damaged or washed away, or the facility may not be reachable. Chemical storage and the municipal transfer station on site pose a risk to water quality when the garage floods.

The most effective solution is to relocate the Town Highway Garage either to high ground on the existing parcel or to a new parcel in a less flood-prone, more reliably accessible location. Floodplain enhancements are possible as well if the garage is relocated.

- Relocate the garage to higher ground on the same parcel. Ursum Way may receive upgrades and repairs as necessary but would be allowed and expected to flood during extreme storm events. Alternate access to the garage via Fairbairn Drive would need to be secured from its owners for use in emergencies. In this case, Fairbairn Drive and its culvert crossing of Elk Creek should be improved so that this access route is not overwhelmed and damaged in floods as well.
- Relocate the garage to a different parcel that is not flood prone. Ursum Way could then be considered for strategic disinvestment – the bridge may be left in place for access to the community garden, and the culvert may be removed or left in place but not repaired after future floods. In this case, the residence serviced by Ursum Way may secure permanent access by Fairbairn Drive.

A new parcel and building require initial investment but avoid long-term, repetitive flood damages and the hazards posed by an inaccessible critical facility. This solution may be eligible for a substantial amount of external funding as well. Additional funding sources are available to relocate and substantially upgrade the transfer station along with the garage.

Relocating the garage to high ground on the same parcel would ultimately require more maintenance as well as considerable investment in reliable alternate emergency access. Ursum Way would still be vulnerable to flooding damage, and the Fairbairn Drive culvert would need to be upgraded and the roadway improved as well. This would likely be most effectively accomplished if the town acquired the Fairbairn Drive right-of-way so that it becomes a public road. This solution is not as practical or effective as relocation to a new parcel but may be considered if other constraints preclude full relocation.

Alternatives to relocating the garage that both maintain access to it and prevent it from flooding would require substantial investments. Upgrading the Ursum Way crossing to the point that floodwaters no longer reach the Highway Garage in its current location would require one or more large bridges, extensive channel work (with significant regulatory challenges), and an order-of-magnitude increase in project cost over either garage relocation scenario.

It is also possible to floodproof the Highway Garage though this does not address the issue of access to the building during floods. Further, the garage is not just subjected to inundation flooding but also experiences high flow velocities, which undermined its northwest (upstream) corner in Tropical Storm Irene. Any floodproofing would need to withstand these kinetic forces. That being said, simple floodproofing measures may be employed immediately at minimal expense. Strategies include securing fuel tanks, elevating chemical storage above the BFE on shelves or racks, moving sand and gravel stockpiles to high ground, storing vehicles and equipment on high ground, and relocating the transfer station area to high ground. If flooding is forecasted, necessary or vulnerable equipment may be retrieved from the garage ahead of time, which is the Halcott Highway Department's current practice.

Figure 5-19: Contractors repairing Ursum Way and culvert following Tropical Storm Irene

5.3 Elk Creek Road Bank Failure

Approximately 1,000 feet downstream of the Townsend Hollow Road crossing, Elk Creek runs immediately adjacent to Elk Creek Road, which is cut into the hillside some 30 feet above and 30 feet away from the right bank of the channel. Elk Creek meets the road embankment on the outside of a meander bend, and approximately 110 linear feet of the failing embankment toe is in contact with the stream during normal flows. The failing portion of the bank was about 22 feet high as of October 2019 (Figure 5-20). Aggradation of a point bar on the opposite bank is continuing to force the channel into the roadway embankment. Town officials report that this slope was stable prior to the Tropical Storm Irene flood that triggered the failure in 2011; high-resolution aerial orthoimagery from 2001, 2004, and 2009 confirms that this slope was intact and well vegetated with mature trees in the years leading up to this storm. Coarser-resolution aerial photographs indicate that prior to Tropical Storm Irene the meander bend had been relatively stable in planform since at least 1960.

Figure 5-20: Bank failure along Elk Creek Road. Photo taken from opposite bank of Elk Creek.

Erosion of the embankment toe has led to slumping and cantilever failure of the overlying slope, which is currently excessively steep relative to the angle of repose of the substrate. The active failure plane will intercept the roadway surface if left unchecked. Continued erosion of the toe will accelerate and exacerbate this process. At the top of the bank, transverse tension cracks over 1 foot deep run parallel to the roadway, just 3 to 5 feet from the edge of pavement. Stormwater runoff from the roadway flows into these cracks, saturating the failure plane. The resulting increase in pore water pressure will accelerate the slumping and collapse of these escarpment blocks. Excavating a drainage swale on the uphill side of Elk Creek Road and pitching the road surface to slope away from the creek may help to mitigate additional erosion on the bank caused by stormwater runoff.

Two-dimensional hydraulic modeling indicates that the stream bank below the roadway experiences shear stresses of 3 to 4 pounds per square foot and velocities of 8 to 10 feet per second in the 10- and 100-year floods, respectively. This is sufficient to mobilize large cobbles

and small boulders, or particles up to about 6 to 8 inches in diameter. The potential for continued mass failure at this site in future floods is high, and collapse of this roadway would significantly impact the town and the many upstream residents who would be left stranded.

Several tree trunks and root wads are currently offering a moderate degree of toe protection during normal low flows, shown in Figure 5-21. However, much of this woody debris has apparently come directly from the failed bank and is susceptible to mobilization during excessive discharge events. Thus, while continuous creep of the substrate will slowly contribute to slope failure over time, a catastrophic collapse during a high-flow event is the more likely failure mechanism, especially given that very little stabilizing vegetation remains on the bank.

Figure 5-21: Tree trunks and debris from the failed embankment provide toe protection during normal low flows.

Remediation strategies include diffusing the energy acting on the bank and relocating the channel to direct flow away from the roadway. Riprapping the toe is not a suitable solution in itself as this kind of longitudinal hard armoring tends to deflect energy downstream rather than diffusing it, which often results in accelerated erosion and failure of nearby unarmored banks. Properly designed J-hook or lateral deflection vanes can substantially reduce friction slope, velocity, shear stress, and stream power in the near-bank region and would be appropriate for this site. Toe logs and root wads may also be installed in the embankment to further reduce erosive energy. These features can be extremely effective at diffusing stream power locally and can help to naturally heal the failing slope over time by inducing sediment deposition along the bank.

A stable embankment slope may require encroaching into the channel on the right side; a slight widening of the channel on the left bank would then be necessary to maintain an appropriate channel geometry. Excavation of the left overbank area to promote floodplain activation will also reduce forces acting on the embankment during high flows, when the slope is most susceptible to failure. These repairs and remediations should be accompanied by a complete hydraulic analysis to ensure the stability of the stream, countermeasures, and roadway embankment.

Straightening the stream channel to eliminate the meander bend that brings Elk Creek alongside the road is not recommended. Such a modification is likely to introduce additional instability to the stream, ultimately creating more problems than it solves.

Just downstream of the failing bank, a substantial debris jam has completely occluded the stream channel, which is actively flanking the jam on both sides, and a side channel has formed along the toe of the roadway embankment. Avulsion of the channel into this alignment would jeopardize Elk Creek Road at a new location. The debris jam includes a utility pole and associated communications cables, a long section of mesh fencing, and several tree trunks and root wads that may have come from the upstream bank failure (Figure 5-22). Removal of this jam is recommended both because of the hazard posed to the adjacent roadway and because the tangle of fencing and cables has made this jam unnaturally large and robust, and it is likely to continue to grow.

Figure 5-22: Large debris jam just downstream of Elk Creek Road bank failure.

5.4 Satellite Emergency Facility

Emergency services are provided to Halcott by the nearby Towns of Fleischmanns and Margaretville in Delaware County. However, Halcott is almost completely cut off from these towns when the Bush Kill floods in Fleischmanns. In the 2016 Greene County HMP, Halcott reported that the town had been isolated from emergency services due to flooding more than five times in the previous 15 years. To improve the flood resiliency of emergency response services, the Town of Halcott has recently acquired a parcel upon which a satellite emergency facility may be constructed, shown in Figure 5-23. This location, just east of the Route 3 – Route 1 junction, is centrally located and provides convenient access to the more distant parts of town via these main roads. At the same time, this location levies additional significance on the Route 1 and Route 3 crossings of Brownell Creek and the Route 3 crossing of the unnamed tributary to Vly Creek just to the east. Because reliable access to the community is contingent upon these stream crossings, locating the emergency facility here increases the replacement priority for the CR-1 and CR-3 culverts over Brownell Creek, as well as the importance of maintaining the CR-3 tributary crossing.

This parcel is not large enough to accommodate a new Highway Garage as well, but it may be more economical to incorporate the emergency facility into a new, relocated garage on a different, larger parcel.

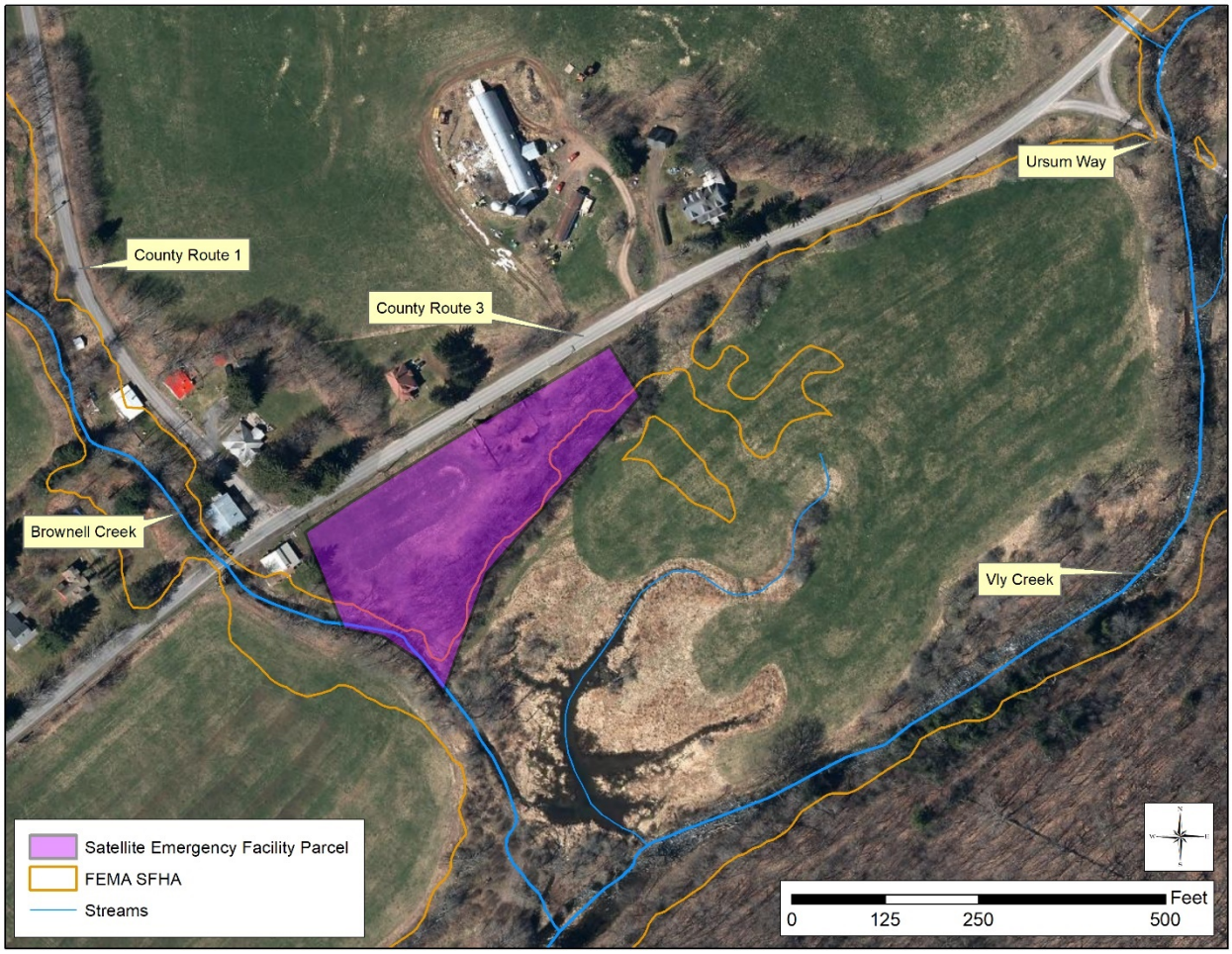

Figure 5-23: Parcel acquired for new satellite emergency facility in Halcott. FEMA SFHA is mapped for reference.

5.5 Flood-Prone Homes and Buildings

During the course of gathering information from Halcott residents, MMI was informed that several properties in town suffered considerable damages during Tropical Storm Irene. A number of homes are mapped within the SFHA demarcated around Vly Creek and its tributaries; other properties may not be included in these delineated floodplains but may incur flood damages nonetheless. It is recommended that property owners who have experienced flooding damage in the past seek appropriate flood mitigation strategies, whether through buyouts, relocation, or building elevation. A fairly comprehensive description of potential sources of funding for flood mitigation and damage reduction projects is included in Section 5.7 of this report. Residents may consult the current effective FEMA FIRM to determine the location of their home relative to the SFHA, which is the area inundated by flooding during the 100-year flood event.

The effective FIRM for the Town of Halcott at the time of this report is available here:
https://map1.msc.fema.gov/idms/IntraView.cgi?KEY=8563857&IFIT=1

Residents may also search for their home address directly by visiting:
https://msc.fema.gov/portal/home

- It is recommended that the town and village work to floodproof or relocate the most flood-vulnerable properties where there is owner interest and programmatic funding available through flood buyout and relocation programs. The two flow charts below provide decision-making guidance for nonresidential (Figure 5-24) and residential (Figure 5-25) properties.

- It is recommended that the town identify priority areas and structures that are prone to most frequent and deepest flooding. These areas should be considered the highest priority for individual flood protection measures.

Some of the homes in the SFHA are rarely flooded. Residents and businesses may benefit from minor individual property improvements. Providing landowners with information regarding individual property protection is recommended.

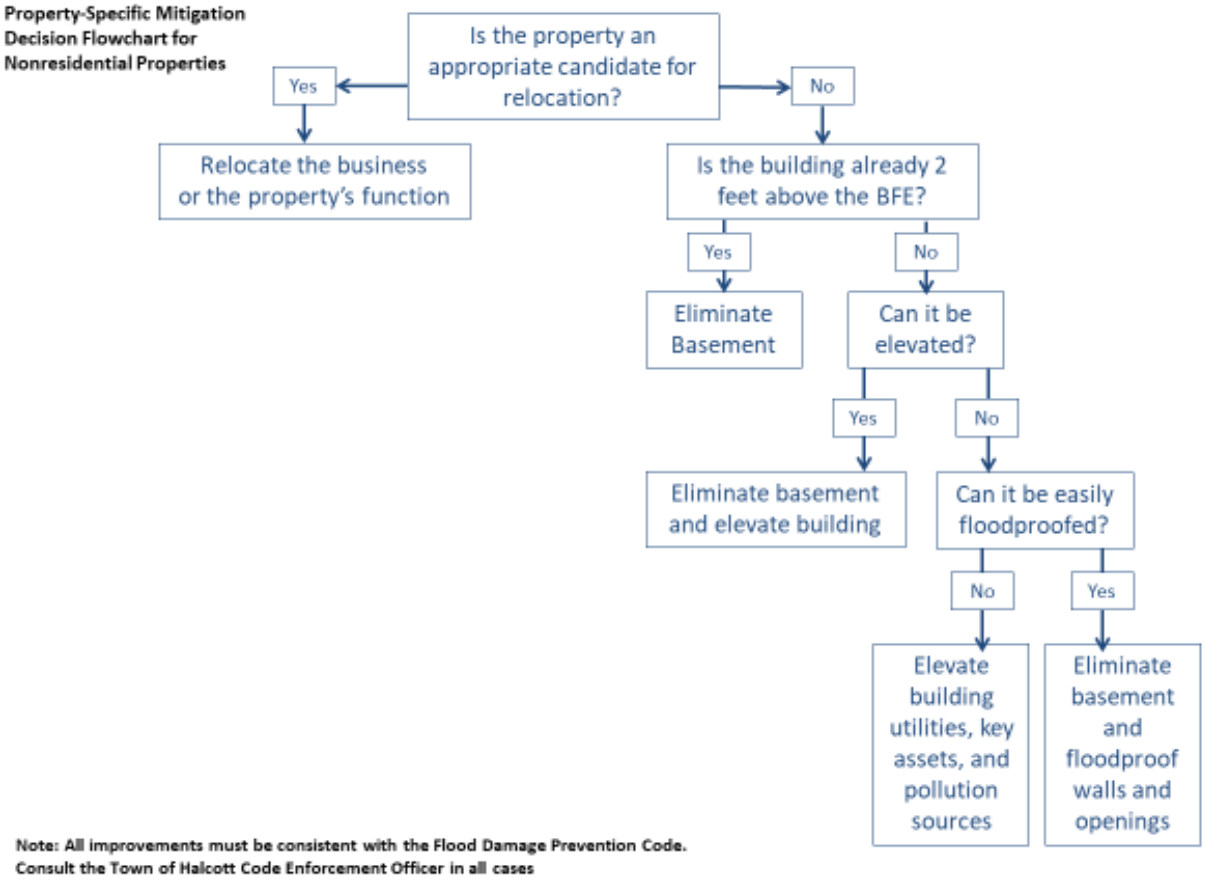

Figure 5-24: Property-Specific Mitigation for Nonresidential Properties

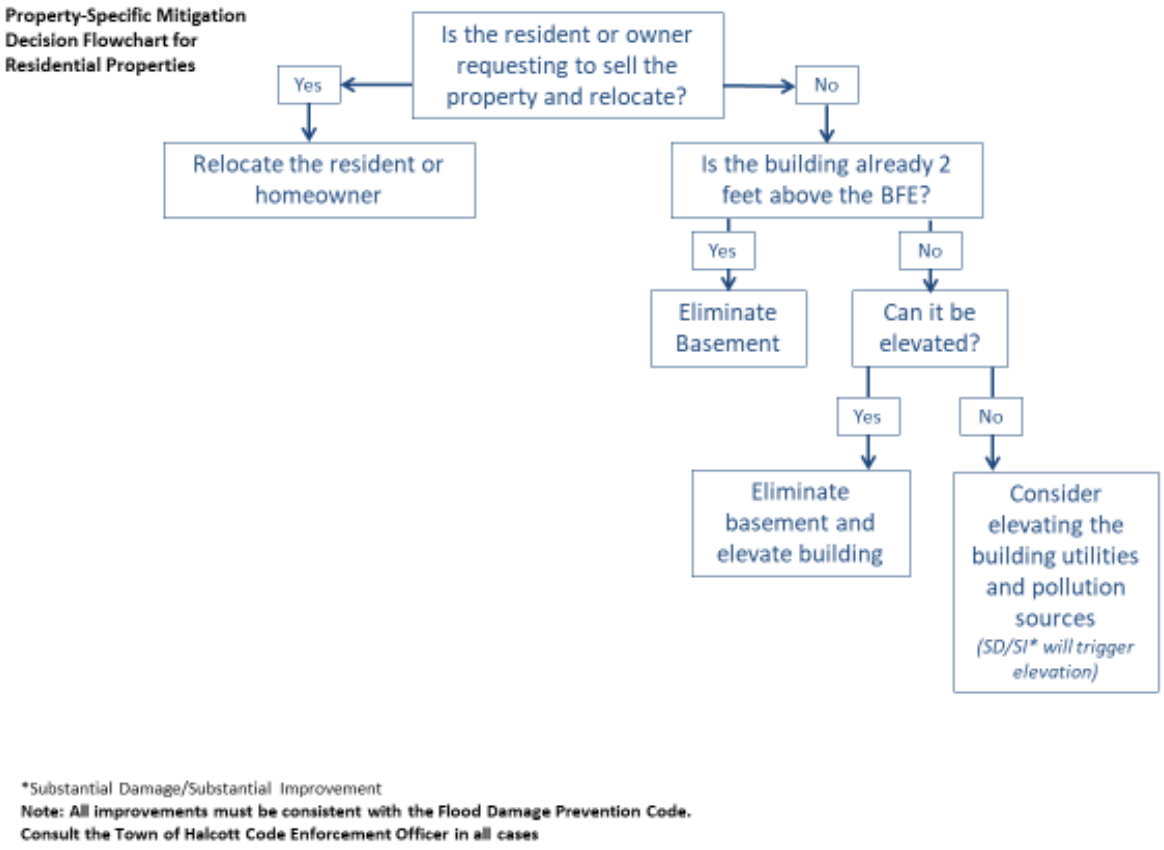

Figure 5-25: Property-Specific Mitigation for Residential Properties

In areas that are vulnerable to flooding, improvements of individual properties and structures may be appropriate. All practices to protect property within a floodplain must comply with local flood law and obtain the approval of the town floodplain administrator or code enforcement officer. Potential measures for property protection include the following:

Elevation of the structure – Home elevation entails the removal of the building structure from the basement and elevating it on piers to a height such that the first floor is located 2 feet or more above the level of the 100-year flood event. The basement area is abandoned and filled to be no higher than the existing grade. All utilities and appliances located within the basement must be relocated to the first-floor level or installed from basement joists or similar mechanism at an elevation no less than 2 feet above the BFE.

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

Wet floodproofing of the structure to allow floodwaters to pass through the lower area of the structure unimpeded – Wet floodproofing refers to intentionally letting floodwater into a building to equalize interior and exterior water pressures. Furniture and electrical appliances should be moved away or elevated above the 100-year flood elevation. Wet floodproofing should only be considered as a last resort.

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

- Relocate valuable belongings above the 100-year flood elevation to reduce the amount of damage caused during a flood event.
- Relocate or elevate water heaters, heating systems, washers, and dryers to a higher floor or to at least 12 inches above the BFE.
- Anchor fuel tanks to the wall or floor with noncorrosive metal strapping and lag bolts.
- Install a backflow valve to prevent sewer or septic backup into the home.
- Install a floating floor drain plug at the lowest point of the lowest finished floor.
- Elevate the electrical box or relocate it to a higher floor and elevate electric outlets to at least 12 inches above the high-water mark.

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

Construction of property improvements such as barriers, floodwalls, and earthen berms – Such structural projects can be used to prevent shallow flooding. There may be properties within the town where implementation of such measures will serve to protect structures. Such barriers must not be permitted unless designed by a qualified engineer and shown to comply with NFIP and local floodplain laws. These improvements are not eligible for funding under CWC or SMP-FHM grant programs.

5.6 General Recommendations

Flooding of, and damage to, bridges, culverts, and roadways during flood events have been reported at numerous locations in Halcott. 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 Town of Halcott 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. These data may be extremely valuable when seeking funding for flood mitigation assistance.

During the LFA process, it was mentioned that the town is somewhat hesitant to improve fish passage at certain culverts because of the supposition that these barriers help to insulate native brook trout populations from incursions of nonnative brown and rainbow trout from downstream waters. Downstream of Halcott, the Lake Switzerland Dam on Vly Creek imposed this barrier before its removal. It is recommended that the town consult with the NYSDEC Fisheries Biologist for Region 4 for guidance regarding this concern.

Public welfare depends on awareness and proper enforcement of Halcott's local Flood Prevention Law. It is recommended that town government staff seek training regarding the content and implementation of this law, especially the Town Code Enforcement Officer. As the Local Administrator, this individual is responsible for administering, implementing, and enforcing the local Flood Damage Prevention Code. This will allow town officials to successfully disseminate important information regarding the law to the public and to implement the law accurately to meet its stated purposes (Section 2.1).

Because the Town of Halcott can only be reliably accessed year round by CR-3, it is recommended that the town consider seeking to improve one of the three seasonally maintained routes into the valley. These roads may serve as critical detours if they are passable; as it is, these roads can be problematic for low-clearance vehicles even in the summer months and best conditions. Rainfall intense enough to generate damaging floods is likely to leave these roads impassable as well. Flooding in the Catskills is often associated with rain-on-snow and snowmelt events in the winter and spring, so the ability to maintain an alternate route into and out of the community, especially during these months, represents a substantial improvement in the town's resiliency to flooding and other hazards.

5.7 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 (NYS Comptroller, 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 5-6. 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 5-6
Potential Funding Sources for Flood Mitigation Alternatives

Recommendation	Potential Eligibility		
	Federal	State	Other
Replace undersized culverts	FEMA	Bridge NY Program	SMIP-FHM
Debris removal following floods	USACE		CWC
Relocate Town Highway Garage out of SFHA	FEMA		CWC; NYCFFBO
Relocate transfer station	US EPA	NYS Dept. of State; NYSDEC-MWRRP	CWC
Floodplain enhancements at Garage site			SMIP-FHM
Elk Creek Road bank failure mitigation	EWP; USACE		SMIP-FHM
Install floodproofing at critical facilities	FEMA		CWC
Floodproof or relocate the most flood-vulnerable properties where there is owner interest	FEMA	Empire State Development	CWC; NYCFFBO
Anchor fuel tanks			CWC

USACE = United States Army Corps of Engineers
US EPA = United States Environmental Protection Agency
FHM = Flood Hazard Mitigation
EWP = Emergency Watershed Protection Program
SMIP = Stream Management Implementation Program

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

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

Ineligible projects include construction of floodwalls, berms, or levees; stream dredging; routine annual maintenance; or replacement of privately owned bridges, culverts, or roads. Municipalities must apply to the Stream Management Program responsible for their respective watersheds. Although Halcott is in Greene County, it is within the Delaware River watershed and falls under the jurisdiction of the DCSWCD:

Delaware County Soil and Water Conservation District
44 West Street, Suite 1
Walton, NY 13865
(607) 865-7161

New York City Funded Flood Buyout Program

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

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

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

As this applies to Halcott's Town Highway Garage, once an appropriate property – approximately equivalent in size to the existing parcel – and willing seller have been located, CWC will fund 100 percent of the purchase cost with no cap although construction must begin within 5 years of this acquisition. Further, CWC will buy out the current garage site at 100 percent of its appraised value with no cap and contribute up to $50,000 (with 25 percent matching funds) toward a wastewater system for the new facility.

Sustainable Community Planning Program

This CWC program is for municipalities that have prepared LFAs. It is intended to fund revisions to local zoning codes or zoning maps or to upgrade comprehensive plans in order to identify areas within those municipalities that can serve as new locations for residences and/or businesses to be moved after purchase under the voluntary NYCFFBO. Grants of up to $20,000 are available through this program, part of the CWC's Local Technical Assistance Program. The CWC program rules can be accessed by clicking the 'Flood Hazard Mitigation Program Rules' link found here: http://cwconline.org/fhmi-program-overview

Emergency Watershed Protection Program (EWP)

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

FEMA Pre-Disaster Mitigation (PDM) Program

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

New York State (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.

NYS DEC - Municipal Waste Reduction and Recycling Program (MWRRP)
The NYS DEC administers MWRR funding to local government entities for waste reduction and recycling projects. The overall goal of this funding program is to assist municipalities in expanding or improving local waste reduction and recycling programs and to increase participation in those programs.

The MWRR state assistance program can help fund the costs of the following:

- Capital investment in facilities and equipment

Eligible projects are expected to enhance municipal capacity to collect, aggregate, sort, and process recyclable materials. Recycling equipment includes structures, machinery, or devices providing for the environmentally sound recovery of recyclables including source separation equipment and recyclables recovery equipment.

United States 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 the 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 postflood response. USACE assistance is limited to the preservation of life and improved property; direct assistance to individual homeowners or businesses is not permitted. In addition, the USACE can loan or issue supplies and equipment once local sources are exhausted during emergencies.

Other Potential Sources of Funding

New York State Grants

All New York State grants are now announced on the NYS Grants Gateway. The Grants Gateway is designed to allow grant applicants to browse all NYS agency anticipated and available grant opportunities, providing a one-stop location that streamlines the way grants are administered by the State of New York.
https://grantsmanagement.ny.gov/

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.

Empire State Development

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

Private Foundations

Private entities such as foundations are potential funding sources in many communities. The Town of Halcott and FAC 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 Town of Halcott 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 (BCA)

A BCA is used to validate the cost effectiveness of a proposed hazard mitigation project. A BCA is a method by which the future benefits of a project are estimated and compared to its cost. The end result is a benefit-cost ratio (BCR), which is derived from a project's total net benefits divided by its total project cost. The BCR is a numerical expression of the cost effectiveness of a project. A project is considered to be cost effective by FEMA when the BCR is 1.0 or greater, indicating that the benefits of the project are sufficient to justify the costs. The BCA does not include benefits that could have been generated for avoiding future street cleanup, avoided detours, avoided emergency response, etc.

6.1 Ursum Way and Town Highway Garage

Using FEMA's *BCA Calculator* software (Version 6.0), a BCR was calculated for proposed alternatives that would result in reduced flooding at the Halcott Highway Garage.

A BCA was conducted for acquisition and relocation of the garage. The standard BCR for a critical facility in this location ranges from 1.06 to 1.39. However, when the additional environmental benefits of garage relocation are included, the BCR increases to from 4.19 to 4.52. The value of environmental benefits depends on location, summarized in Table 6-1; the Town Garage parcel is predominantly riparian. The benefits of this project certainly justify the costs.

Factors and assumptions for the BCA include the following:

- Benefits for the acquired/relocated property were determined as acquisitions.
- A highway garage, though considered a critical facility, is not available as a selectable building type in FEMA's BCA software package, so ranges were developed based on all available critical facility types.
- Default depth-damage curves were used in the program.
- Water surface elevations were determined from the HEC-RAS model developed for the relevant reach of Vly Creek.
- First-floor elevations were estimated using LiDAR topographic mapping.
- Building replacement value was based on the estimated cost of $600,000 for a new Highway Garage facility; this figure was provided by the Halcott Town Board.

Water quality benefits may be significant but are not directly accounted for in FEMA's BCA Toolkit. In the case of the Highway Garage, storage of fuel, oil, and other chemicals as well as solid waste at the adjoining transfer station may cause a detriment to water quality in flood events. Benefits to water quality by removing this material from the floodplain are difficult to quantify but may be substantial.

TABLE 6-1
FEMA Standard Values for Environmental Benefits

Type of Space	FEMA Standard Value
Green Open Space	$8,308/acre/year
Riparian	$39,545/acre/year
Wetlands	$6,010/acre/year
Forest	$554/acre/year
Marine and Estuary	$1,799/acre/year

The BCR for upgrading the Ursum Way crossing with a large bridge and restoration or relocation of the Vly Creek channel was determined to range from 0.17 to 0.27. The benefits of reduced flooding at the highway garage are overwhelmed by the $4.5M estimated to design, permit, and construct a 110-foot span bridge and the channel work required to realign the stream. Further, the environmental benefits of relocation are nullified. This is not cost effective, and funding for this alternative would be considerably more challenging to secure.

6.2 Culverts

It is difficult to perform an accurate BCA on a bridge or culvert crossing replacement in isolation without information regarding multiple historical damages. Sufficient data are not available for these small rural crossings. The BCR calculations also require a daily traffic input; this is available for County Route 3 but not the other roads assessed.

Critical contingencies such as the potential unavailability of detours are not considered in the BCR calculations. Nor is a structure's importance considered as part of a detour route in the event of another crossing's failure. Likewise, the consequences of loss of access for emergency responders are not accounted for either. These are vital considerations in the Town of Halcott, which has minimal redundancy in its road network, leaving many areas highly 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 hazards that are faced by a small number of individuals. Economic losses due to the interruption of traffic are the primary considerations in the BCR for roads and bridges, not life safety.

Table 6-2 illustrates some of these culvert and roadway characteristics that are difficult to quantify but help to justify the need for replacement.

TABLE 6-2
Crossing Characteristics that are Difficult to Quantify in a BCA
Replacement costs are presented as estimates only.

Road	County Route 3	Fairbairn Drive	Townsend Hollow Road	County Route 1	County Route 3
Stream Crossed	**Brownell Creek**	**Elk Creek**	**Elk Creek**	**Brownell Creek**	**Unnamed Tributary to Vly Creek**
Area Normally Serviced	Entire Town	< 5 homes	5 - 10 homes	30 - 40 homes	Most of Town
Estimated Replacement Cost	$430,000	$380,000	$300,000	$410,000	Not Recommended
Residents Stranded if Crossing Damaged?	Yes	No	Yes	No	No
Detour Length: Year Round	None	< 1 mile	None	5 miles	5 miles
Detour Length: Seasonal/4x4	6 or 15 miles	Same as Year Round	> 10 miles	6 miles	Same as Year Round
Detour Includes Other At-Risk Structure(s)?	Yes	Yes	Yes	Yes	Yes
Crossing is Critical Structure as Part of Another Detour?	Yes	Highway Garage	Seasonal	Yes	Yes
Critical Crossing for Emergency Response?	Yes	Highway Garage	Locally	Yes	Yes
Estimated AADT (year measured)	373 (2008); 432 (2002)	Not Available	Not Available	Not Available	373 (2008); 432 (2002)

AADT = Annual Average Daily Traffic

Improving the dependability and flood resiliency of the transportation network in Halcott can be achieved by upgrading these culverts. Hazards to life safety can be reduced, emergency response can be made more reliable, and the overall community can be strengthened. Although the economics of these culvert replacements are difficult to reconcile, the societal benefits to the Town of Halcott are tremendous and unambiguous.

6.3 Other Homes and Properties

For repetitive loss homes in the LFA area where the Town 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 $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 Flood Insurance Rate Map (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 Hazard Mitigation Assistance (HMA) grant programs.

This dramatically simplifies the BCA process for homeowners in the SFHA floodplain if relocation or elevation 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 Town of Halcott that identifies the property as an inundation or erosion hazard.

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Benefit-Cost Calculator

v6.0.0 (Build 20191101.1446)

Benefit-Cost Analysis

Project Name: Halcott Town Highway Garage

	Mitigation Title	Property Type	Hazard	Benefits (B)	Costs (C)	BCR (B/C)
	Acquisition @ 42.1894670; -74.4858540	Town Highway Garage	Riverine Flood	$2,709,241	$600,000	4.52
Totals				$2,709,241	$600,000	4.52

Property Configuration

Property Title	Acquisition @ 42.1894670; -74.4858540
Property Location	12430, Greene, New York
Property Coordinates	42.189467, -74.485854
Hazard Type	Riverine Flood
Mitigation Action Type	Acquisition
Property Type	Critical Facility Building
Analysis Method Type	Modeled Damages

Cost Estimation

Project Useful Life	100		
Project Cost	$600,000		
Number of Maintenance Years	100	Use Default	Yes
Annual Maintenance Cost	$0		

Hazard Probabilities Parameters - Flood

Lowest Floor Elevation of the Property (ft)	1742
Streambed Elevation at the Property Location (ft)	1735

Discharge

Before Mitigation

Recurrence Interval (years)	Surface Elevation (ft)	Discharge (cfs)
10	1743.5	2410
50	1744.5	4080
100	1745	4830
500	1746	7200

After Mitigation

Recurrence Interval (years)	Surface Elevation (ft)	Discharge (cfs)
10	1743.5	2410
50	1744.5	4080
100	1745	4830
500	1746	7200

Building Information

Critical Facility Type	Town Highway Garage
Building Is Engineered	No

Standard Benefits - Building

Building Size (sq.ft)	6,000

Building Replacement Value ($/sq.ft)	$100Use Default	Yes
Demolition Threshold (%)	%50.00 Use Default	Yes
Expected Annual Losses due to Building Damages before Mitigation	$33,120.00	
Expected Annual Losses due to Building Damages after Mitigation	$0.00	
Expected Annual Benefits - Building	$33,120.00	

Depth Damage Curve - Building

Depth Damage Curve
Selected:Use Default:Yes

	Before Mitigation				After Mitigation			
Flood Depth (ft)	Percent (%)	Damage Value ($)	NFIP ($)	ICC Fees ($)	Percent (%)	Damage Value ($)	NFIP ($)	ICC Fees ($)
-2	0.6	3,600	0	0	0	3,600	0	0
-1	0.6	3,600	0	0	0	3,600	0	0
0	1.1	6,600.00	0	0	0	6,600.00	0	0
1	10.5	63,000	0	0	0	63,000	0	0
2	17.3	103,800	0	0	0	103,800	0	0
3	22.3	133,800	0	0	0	133,800	0	0
4	28.2	169,200	0	0	0	169,200	0	0
5	32.1	192,600	0	0	0	192,600	0	0
6	35.5	213,000	0	0	0	213,000	0	0
7	38.9	233,400	0	0	0	233,400	0	0
8	42.7	256,200.00	0	0	0	256,200.00	0	0
9	45.7	274,200	0	0	0	274,200	0	0
10	47.1	282,600	0	0	0	282,600	0	0
11	47.1	282,600	0	0	0	282,600	0	0
12	47.1	282,600	0	0	0	282,600	0	0
13	47.1	282,600	0	0	0	282,600	0	0
14	47.1	282,600	0	0	0	282,600	0	0
15	47.1	282,600	0	0	0	282,600	0	0
16	47.1	282,600	0	0	0	282,600	0	0

Standard Benefits - Contents

Contents Value in Dollars	$0 Use Default	Yes
Expected Annual Losses due to Content Damages before Mitigation	$22,879.00	
Expected Annual Losses due to Content Damages after Mitigation	$0.00	
Expected Annual Benefits - Content	$22,879.00	

Depth Damage Curve - Contents

Depth Damage Curve
Selected:Use Default:Yes

	Before Mitigation		After Mitigation	
Flood Depth (ft)	Percent (%)	Damage Value ($)	Percent (%)	Damage Value ($)
-2	0	0	0	0
-1	0	0	0	0
0	0	0	0	0
1	14	0	0	0
2	25	0	0	0
3	37	0	0	0
4	47	0	0	0
5	55	0	0	0
6	63	0	0	0
7	74	0	0	0
8	83	0	0	0

9	84	0	0	0
10	86	0	0	0
11	86	0	0	0
12	86	0	0	0
13	86	0	0	0
14	86	0	0	0
15	86	0	0	0
16	86	0	0	0

Standard Benefits - Displacement

Expected Annual Losses due to Displacement Damages before mitigation:$0.00
Expected Annual Losses due to Displacement Damages after Mitigation:$0.00
Expected Annual Losses - Displacement:$0.00

Depth Damage Curve - Displacement

Depth Damage Curve
Selected:Use Default:Yes

	Before Mitigation		After Mitigation	
Flood Depth (ft)	Days	Damage Value ($)	Days	Damage Value ($)
-2	0	0	0	0
-1	0.6	0	0	0
0	0	0	0	0
1	45	0	0	0
2	90	0	0	0
3	135	0	0	0
4	180	0	0	0
5	225	0	0	0
6	270	0	0	0
7	315	0	0	0
8	360	0	0	0
9	405	0	0	0
10	450	0	0	0
11	450	0	0	0
12	450	0	0	0
13	450	0	0	0
14	450	0	0	0
15	450	0	0	0
16	450	0	0	0

Critical Facilities Properties

Critical Facility Type	Highway Garage
Number of people are served by Highway Garage	250
Type of Area served by this highway garage	Rural
Distance in miles between this highway garage and the highway garage that would provide maintenance and repairs for the geographical area normally served	12

Standard Benefits - Loss of Function/Loss of Income

Expected Annual Losses due to Loss of Function/Loss of Income before mitigation	$1,777.00
Expected Annual Losses due to Loss of Function/Loss of Income after mitigation	$0.00
Expected Annual Benefits - Expected Annual Benefits - Loss of Function/Loss of Income	$1,777.00

Depth Damage Curve - Loss of Function/Loss of Income

Depth Damage Curve
Selected:Use Default:Yes

	Before Mitigation		After Mitigation	
Flood Depth (ft)	Days	Damage Value ($)	Days	Damage Value ($)
-2	0	0	0	0
-1	0	0	0	0
0	0	0	0	0
1	45	0	0	0
2	90	0	0	0
3	135	0	0	0
4	180	0	0	0
5	225	0	0	0
6	270	0	0	0
7	315	0	0	0
8	360	0	0	0
9	405	0	0	0
10	450	0	0	0
11	450	0	0	0
12	450	0	0	0
13	450	0	0	0
14	450	0	0	0
15	450	0	0	0
16	450	0	0	0

Additional Benefits - Volunteer

Number of Volunteers (volunteers/event)	0
Number of Days of Lodging	0
Expected Annual Volunteer Benefits	$0

Additional Benefits - Environmental

Total Project Area (acres)	5
Percentage of Green Open Space	20.00%
Percentage of Riparian	60.00%
Percentage of Wetlands	15.00%
Percentage of Forests	5.00%
Percentage of Marine Estuary	0.00%
Expected Annual Environmental Benefits	$131,589

Benefits-Costs Summary

Total Standard Mitigation Benefits	$58,276.68
Total Additional Benefits - Social	$0
Total Additional Benefits - Environmental	$1,877,676
Total Mitigation Project Benefits	$2,709,241
Total Mitigation Project Cost	$600,000
Benefit Cost Ratio - Standard	1.39
Benefit Cost Ratio - Standard + Additional	4.52

MILONE & MACBROOM

MEMORANDUM

TO:	Halcott Flood Advisory Committee
FROM:	Milone & MacBroom, Inc.
RE:	Halcott LFA FAC Kick-Off Meeting
DATE:	April 15, 2019
MMI #:	5197-16

A kick-off meeting for the Halcott Local Flood Analysis (LFA) was held on the evening of April 15, 2019 at the Grange Hall. In attendance were Mark Carabetta, Miguel Castellanos and Ethan Ely from Milone and MacBroom (MMI), as well as members of the Halcott Flood Advisory Committee (FAC). FAC members included representatives from the Halcott, the New York City Department of Environmental Protection (NYCDEP), the Delaware County Soil and Water Conservation District (DCSWCD), and Catskill Watershed Corporation (CWC). A sign-in sheet and the presentation slides are appended.

The purpose of the meeting was to:

- Review the study area
- Recap the LFA process and intended outcomes
- Collect information about flooding and flood damages
- Discuss next steps in the LFA process and plan for the first public meeting

The meeting began with introductions and a presentation by MMI about the LFA process and intended outcomes. During the presentation, MMI discussed what is known about the flood history in Halcott, steps involved in an LFA, and potential flood mitigation strategies.

Following the presentation, members of the committee discussed their thoughts and experiences with flooding. MMI provided large scale maps so that flood advisory members could identify areas where flood damage occurred and where bridges and culverts have overtopped or washed out. MMI staff collected information and took detailed notes, which are summarized below.

Flood damages and observations:

- It was emphasized that all of the town's emergency services are provided from surrounding towns, primarily Fleischmanns and Margaretville. Halcott is cut off from these towns when the Bush Kill is flooded in Fleischmanns. Many of the other roads leading in and out of town are seasonal and not always passable. Also, the bridge over West Settlement Creek at Route 1 is a key bridge for emergency vehicles, and access to the town would be cut off if this bridge were to be damaged or washed out.
- There was discussion of the potential to locate a satellite emergency facility in Halcott, which would be available even if roads to surrounding communities were to be cut off in a flood. The town has personnel capable of operating a fire truck or emergency vehicle, but does not have the resources to own one.
- The Route 1 and Route 3 bridges are county-owned and in poor condition. Any crossings with a span greater than 20 feet are considered to be bridges, and are county owned. The bridge over Vly Creek at Elk Creek Road was damaged in Irene and was replaced by the county two years ago. DCSWCD constructed stacked rock walls where erosion had occurred after Irene.

- The Turk Hollow Road culvert (not within LFA study area) was lost in Irene and a plan is in place for the state to replace it, in order to provide access to DEC property. The State will provide the culvert for town to install with its own forces.
- The Halcott town highway department (which is also the site of the transfer station) has flood insurance and was evacuated prior to T.S. Irene. Vly Creek spills onto the floodplain upstream of the highway garage, bypasses the bridge (which becomes clogged with debris) and washes out the smaller culvert under Ursum Way. This has happened numerous times.
- At the Townsend Hollow Road crossing, the road has washed out (usually on the side towards Elk Creek Road, but sometimes on both sides), although the culvert has remained in place.
- In Irene, a stream avulsion occurred along Elk Creek resulting in bank toe erosion that threatens Elk Creek Road. The creek needs to be returned to its original channel and the slope stabilized to prevent road washout. Application was made to FEMA, but was unsuccessful.
- Underground culvert that crosses Elk Creek Road and runs along Townsend Hollow Road did not wash out in Irene and has not been a problem.
- Fairbairn Road culvert crossing along Elk Creek is private. This road has been used as a detour during past flood events.

Reports and other information:

- In 2010, Delaware Engineering completed a stormwater assessment project for the town, which includes important information on the town's bridges and culverts. A paper copy of this report was provided to MMI.
- Town has FEMA damage survey reports that can be shared with MMI.
- Critical facilities include the town hall and highway garage.
- There are two active dairy farms in town, which are very important town businesses. Following washouts in Irene, culverts were borrowed from Belleayre Mountain in order to get milk trucks out of town for delivery.
- Highway garage and transfer station are sites of potential water quality impairment.
- Suggestion that MMI staff meet separately with town highway superintendent and others to discuss history of damages and other information at each culvert and bridge.
- Town provided MMI with flood-related files on a portable drive, which MMI will review.

There was a discussion of next steps for the first public meeting, where more information on flooding will be gathered:

- It was mentioned that approximately 75% of property owners are second home owners who live elsewhere.
- Suggestion was made that public meeting should be held on a Saturday when more people are available to attend.
- Suggestion that MMI provide town with wording to include in town newsletter to invite people to public meeting.
- Town also has email list and town website.
- Idea that people can provide input via email if they are unable to attend public meeting.
- MMI will provide Patty with a list of names and addresses of residents living along streams within project area, who would receive mailed invitations to public meeting.
- MMI will provide Patty with an example of mailing that was used to invite residents to a public meeting for a previous LFA.

The following immediate action items were identified:

- MMI to provide list of addresses for invitations to public meeting.
- MMI to provide example invitation from previous LFA.
- MMI to schedule meeting with highway superintendent to discuss flood damages at culverts.
- MMI to provide wording to include in town newsletter to invite people to public meeting.
- Town to provide MMI with list of possible dates for public meeting, including potential Saturday dates.

MEETING SIGN-IN SHEET

MILONE & MACBROOM		**Meeting Date:**	7:15PM
Project:	#5197-16 Halcott LFA	**Place/Room:**	~~Roxbury Town Hall~~ Halcott Grange Hall

Name	Company	Phone	E-Mail
Mark Carabetta	Milone & MacBroom, Inc	(845) 633-8153	mcarabetta@mminc.com
Ethan Ely	Milone & MacBroom, Inc	(845) 633-8153	eely@mminc.com
Miguel Castellanos	Milone & MacBroom, Inc	(845) 633-8153	mcastellanos@mminc.com
Judy DiBenedetto	Town Board Town of Halcott	845-254-4009	cdiben62@gmail.com
Inues Kasan	Town Board Town of Halcott	845-254-9920	inneskas70@gmail.com
Alan Reynolds	TOWN OF HALCOTT	845-254-4522	ALAN@HALCOTT.ORG TOWN OF
Russell Boulton	Highway Super Town of Halcott	845 399 4833	Rundy 9 at yahoo.com
Alan White	Town Supervisor	607-201-3649	supervisor@ ~~townofhalcott~~ .org
Patti Warfield	Town Clerk / Halcott	845-254-4833	Clerk@townofhalcott.org
Robert VanValkenburgh	Fleischmanns Fire	845-254-5839	bobbyvan49@gmail.com
Gale A Neale, PE	DCSWCD	607-437-9863	gale-neale@dcswcd.org
John Mathiesen	CWC / Town of Halcott Code Enforcement	845 586-1400	jmathiesen@cwconline.org
Phillip Eskeli	NYC DEP	845 340-7853	peskeli@dep.nyc.gov
Greg Beechler	neighbor	845-254-6110	webmaster@townofhalcott.org
Yuka Day	Town Board Town of Halcott	845 417 5432	day.yuka@yahoo.com

MILONE & MACBROOM

MEMORANDUM

TO: Halcott Flood Advisory Committee
FROM: Milone & MacBroom, Inc.
RE: Halcott Fair
DATE: July 20, 2019
MMI #: 5197-16

The 2019 Halcott Fair was held on Saturday, July 20 at the Grange Hall. Mark Carabetta from Milone and MacBroom (MMI) attended the fair for the purpose of gathering information for the Halcott Local Flood Analysis (LFA). A large format map of the LFA area was made available. Mark also encourage fairgoers to attend the public meeting scheduled for July 22, 2019 at 7pm.

Following is a summary of flood damages and observations reported:

- Several people mentioned that the town's emergency services are provided from surrounding towns, primarily Fleischmanns and Margaretville. Many of the roads leading in and out of town are vulnerable to washout, or are seasonal and not always passable. LFA should seek a solution to this problem.

- Several people inquired about areas that are not within the hamlet boundary and are therefore not part of this LFA study. Map should indicate location of hamlet boundary.

- It was noted that prior to Tropical Storm Irene in August, 2011, the largest flood was a rain on snow event in January, 1996.

- At location "A" on map, residents of a double-wide modular home at this location needed to be rescued during the Irene flood in August, 2011. They have subsequently moved back in.

- At location "B" flow path through secondary side channel is activated quite regularly during regular spring flood events. This still occurs, even after replacement of bridge. MMI field crew noted that there is remnants of a former bridge abutment remain in place along the channel and may warrant removal.

- At location "C" a swimming pool adjacent to a residence was washed out during Irene. It had not ever flooded previously. It has not been replaced. The home itself did not flood.

- The large flat fields along Vly Creek upstream of the highway garage were once impounded and used as an ice pond. Remnants of an old ice house foundation still remain along the creek.

- At location "E", off map, Turk Hollow bridge washed out in 1996 flood, came close in Irene but did not wash out.

- A recommendation was made that updates and information on the LFA be posted in the Times of Halcott.

MILONE & MACBROOM

MEMORANDUM

TO:	Halcott Flood Advisory Committee
FROM:	Milone & MacBroom, Inc.
RE:	Halcott LFA Public Meeting #1
DATE:	July 26, 2019
MMI #:	5197-16

A first public meeting for the Halcott Local Flood Analysis (LFA) was held on the evening of July 22, 2019 at the Grange Hall. In attendance were Mark Carabetta and Ethan Ely from Milone and MacBroom (MMI), several members of the Halcott Flood Advisory Committee (FAC), and a number of Halcott residents. A sign-in sheet and the presentation slides are appended.

The purpose of the meeting was to:

- Review the study area
- Recap the LFA process and intended outcomes
- Discuss flooding history in Halcott
- Collect information about flooding and flood damages

The meeting began with introductions and a presentation by MMI about the LFA process and intended outcomes. During the presentation, MMI discussed what is known about the flood history in Halcott, steps involved in an LFA, and potential flood mitigation strategies.

Through the presentation, community members discussed their thoughts and experiences with flooding. MMI provided a large scale map so that those in attendance could identify areas where flood damage occurred and where bridges and culverts have overtopped or washed out. MMI staff collected information and took detailed notes, which are summarized below.

Flood damages and observations:

- Several stream crossings along Vly Creek, upstream of the Elk Creek bridge, were identified as having overtoped and/or experienced structural failure during Tropical Storm Irene. Some of these culverts are outside the boundary of the hamlet, which was established by NYCDEP and DCSWCD as the limit of the LFA study area.

- During Irene a private bridge on the property of Bill and Elizabeth Bernhardt washed out and has since been replaced. While the property owners were not present for the meeting, other community members stated that the bridge appears to have been replaced in-kind.

- Community members expressed their desire to have any flood mitigation recommendations incorporate stream habitat restoration.

- Upstream of Elk Creek bridge, within the property of Halcott resident Dan Chesire, Vly Creek evulsed during Irene, shifting the primary channel approximately 100'-150' to the east. The evulsion downed numerous large Hemlock trees. Residents expressed concern that these trees may travel downstream and block a stream crossing during the next major flood event.

- A stream crossing over Brownell Creek along Country Road 1 was identified as being frequently overtopped during large storm events. The culvert was outside the bounds of the map provided by MMI.

Reports and other information:

- Halcott residents Paul and Sybil Margolis provided MMI with photos and videos of the flooding during Tropic Storm Irene on a portable drive, which MMI will review.

The following tasks will be performed in moving forward with the LFA:

- The Town of Halcott will provide MMI with list of possible dates in August for the second FAC meeting.

- MMI will perform hydrologic and hydraulic analyses of various flood prone structures identified during the public meeting and kick-off FAC meeting. The capacities of these structures and potential flood mitigation scenarios will be evaluated.

MEETING SIGN-IN SHEET

MILONE & MACBROOM		**Meeting Date:**	July 22, 2019, 7:00PM
Project:	#5197-16 Halcott LFA	**Place/Room:**	Halcott Grange Hall

Name	Company	Phone	E-Mail
Mark Carabetta	Milone & MacBroom, Inc	(845) 633-8153	mcarabetta@mminc.com
Ethan Ely	Milone & MacBroom, Inc	(845) 633-8153	eely@mminc.com
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Innes Kasanof	Town of Halcott	518-265-4581	inneskas70@gmail.com
Pattie Warfield	Town of Halcott	845-254-4833	Clerk@townofhalcott.org.
Paul Sybil Maya P.S	- Self	845 254 5374	PJMARGARITIS@GMAIL.Com
Peg DiBenedetto	Town of Halcott	845-254-6508	pegdib@gmail.com
Monica Cristofemano	Manhattan NY	(646 5058547	VIVIAFERN@AOL.COM
Luis Fernandez		(646)245-5975	LFernand@conncoll.edu
ROBERT VANVALKENBURGH	HALCOTT	845-254-5879	babbyVAN49@GMAIL.com
DAN CHESIRE	TOWN OF HALCOTT	845 254 4310	CHESIRE22000@GMAIL.COM
SCOTT MOROFF	HALCOTT	516-449-2278	smoroff@me.com

MILONE & MACBROOM

MEMORANDUM

TO: Halcott Flood Advisory Committee
FROM: Milone & MacBroom, Inc.
RE: Halcott LFA FAC Meeting #2
DATE: August 21, 2019
MMI #: 5197-16

A second meeting for the Halcott Local Flood Analysis (LFA) was held on the evening of August 19, 2019 at the Grange Hall. In attendance were Mark Carabetta and Matt Trueheart from Milone and MacBroom (MMI), as well as members of the Halcott Flood Advisory Committee (FAC). FAC members included representatives from the Halcott, the New York City Department of Environmental Protection (NYCDEP) and the Delaware County Soil and Water Conservation District (DCSWCD). A sign-in sheet and the presentation slides are appended.

The purpose of the meeting was to:

- Review the study area and project objectives
- Present preliminary hydraulic modeling results
- Solicit feedback regarding proposed alternatives
- Discuss next steps in the LFA process

The meeting began with introductions and MMI's presentation of the results from modeling of several culverts using HY8 hydraulic modeling software, and 2-dimensional HEC-RAS modeling of the complex flow dynamics in Vly Creek at the Ursum Way crossing and upstream floodplain.

Following the presentation, members of the committee discussed their thoughts and local knowledge regarding the viability of proposed alternatives, suggested additional possible solutions, and requested additional analysis. MMI staff collected information and took detailed notes, which are summarized below.

- A request was made for a structural inspection of the CR3 culvert over Brownell Creek.
- A request was made to expand the project scope to encompass additional structures outside the hamlet boundary; this cannot be accommodated as part of the LFA but may be possible in the future.
- A request was made for a representative of the Greene County Highway Dept. to attend the next FAC meeting. Alan Reynolds will make contact with Greene County and extend an invitation.
- Several questions were asked, and a discussion ensued regarding securing funding for culvert replacements and a means by which to prioritize replacements or upgrades. These shall be addressed in the LFA Report.
- Culverts conveying Brownell Creek, Elk Creek, and an unnamed tributary were evaluated for their capacity, and more hydraulically adequate crossings were outlined as necessary.
- The following alternatives were presented by MMI for discussion, for the Ursum Way crossing of Vly Creek:
    - Replace existing bridge and culvert with one large bridge
    - Secure alternate access via Fairbairn Drive (private road)
        - If Ursum Way culvert washes out, do not replace
        - Widening channel at culvert would reduce flooding
        - Access to community gardens can be maintained
        - May require improvements along Fairbairn Drive

    - Implement floodproofing of highway garage building
        - Barriers, elevate utilities, chemical storage, etc.
    - Relocate highway garage building on same parcel
    - Relocate highway garage to new parcel
- In discussing alternatives for the town highway garage and access via Ursum Way, the following information was gleaned:
    - Permanent access via Fairbairn Drive is not practical due to the tight, steep, sharp intersection with Elk Creek Road (difficult or impossible for tractor-trailers). Also, a right turn from Elk Creek Road headed west to Route 3 headed north is very sharp.
    - The parcel acquired by the town for an emergency services facility is likely not large enough to accommodate a relocated highway garage as well.
- Regardless of proposed alternatives at Ursum Way, it was suggested that the town of Halcott secure access to the town garage via Fairbairn Drive for use in future emergency situations.
- Additional alternatives were suggested and discussed:
    - Relocation of the highway garage to higher ground, and reclamation of the parcel for use as a floodplain.
    - Relocation of both the highway garage and salt shed off-site, and strategic abandonment of the Ursum Way crossing.
    - Lowering the grade of Ursum Way to provide additional overtopping relief in flood flows and reduce backwater inundation flooding.
    - Relocating the Vly Creek channel to a more natural position in the floodplain, thus improving alignment with the Ursum Way crossing. This would also require replacement of the Spring Brook culvert with a larger structure.
- The Town Clerk will provide MMI with the parcel number for the property that is being considered for siting of a satellite emergency facility.

The next FAC meeting date was set for **Monday, September 16 at 6:00 pm**. At that meeting MMI will run through its LFA recommendations for consideration and discussion by FAC members.

MEETING SIGN-IN SHEET

MILONE & MACBROOM		**Meeting Date:**	August 19, 2019, 7:15PM
Project:	#5197-16 Halcott LFA	**Place/Room:**	~~Roxbury Town Hall~~ HALCOT GRANGE HALL

Name	Company	Phone	E-Mail
Mark Carabetta	Milone & MacBroom, Inc	(845) 633-8153	mcarabetta@mminc.com
Matt Trueheart	Milone & MacBroom, Inc	(845) 633-8153	mtrueheart@mminc.com
GALE NEALE	DCSWCD	607-865-5223	gale-neale@dcswcd.org
Pattie Warfield	Town of Halcott	518-610-1214	Clerk@townofhalcott.org.
Russell Bouton	Town of Halcott Highway	845 399 4835	Rundy9 @yahoo.com
Judy DiBenedetto	Town of Halcott, Council	845-254-4009	cdiben620@gmail.com
ALAN Reynolds	TOWN OF HALCOTT	845-254-4522	ALANREYNOLDS95@GMAIL
PHILIP ESKOL	NYC DEP	845-340-7853	peskel@dep.nyc.gov
Innes Kasanof	Town of Halcott	518-265-4581 845-254-9920	inneskas70@gmail.com
PAUL MARGARIS	PRIVATE CITIZEN	2816776735	PJMARGARIS@
VIC PAGANO	Halcott	845-254-5263	VICPAGANO@GMAIL.COM
Yuka Day	Town of Halcott Council	845 417 5432	day.yuka@yahoo.com

MILONE & MACBROOM

MEMORANDUM

TO:	Halcott Flood Advisory Committee
FROM:	Milone & MacBroom, Inc.
RE:	Halcott LFA FAC Meeting #3
DATE:	September 18, 2019
MMI #:	5197-16

A third meeting for the Halcott Local Flood Analysis (LFA) was held on the evening of September 16, 2019 at the Grange Hall. In attendance were Mark Carabetta and Matt Trueheart from Milone and MacBroom (MMI), as well as members of the Halcott Flood Advisory Committee (FAC). FAC members included representatives from the Halcott, the New York City Department of Environmental Protection (NYCDEP), Catskill Watershed Corporation (CWC) and the Delaware County Soil and Water Conservation District (DCSWCD). A sign-in sheet and the presentation slides are appended.

The purpose of the meeting was to:

- Review the LFA study area and project objectives
- Present alternatives and recommendations
- Solicit feedback regarding proposed alternatives
- Discuss final steps in the LFA process

The meeting began with MMI's presentation of recommendations for five culverts in the LFA area, how to prioritize upgrades, and potential funding sources for culvert replacements; valuable feedback was gleaned from the FAC. Following this discussion, MMI presented alternatives and recommendations for the Town Highway Garage on Ursum Way. Discussions were largely focused on the best approach to funding these recommendations, as the need to address flooding at the Highway Garage is well-recognized. MMI staff collected information and took detailed notes, which are summarized below.

While presenting and discussing culvert upgrades, the FAC made the following observations:

- Seasonal maintenance of Townsend Hollow Road levies additional importance on this road's crossing of Elk Creek, since it is essentially a dead end road in the winter months.
- While the CR3 crossing of an unnamed tributary to Vly Creek is in good condition, the downstream scour hole may destabilize the headwall if it continues to grow.
- Detour routes often include inadequate stream crossings.
- Upgrades to the Fairbairn Drive culvert are contingent upon the future of the Town Garage.
- It was suggested that barriers to fish passage may insulate local native brook trout populations from incursions of brown and rainbow trout from downstream rivers, and may therefore be desirable.

MMI's recommendation is to relocate the Town Highway Garage, either to higher ground on its existing parcel, or to a new parcel that is not within or accessed through flood-prone areas. These two approaches have different requirements, advantages, and disadvantages, which were discussed in detail. Relocating to a new parcel is the preferred solution, as it avoids the long-term costs of maintaining the vulnerable Ursum Way and Fairbairn Drive access routes.

- Historically, a creamery was located near the current site of the Town Highway Garage
- Floodproofing the Highway Garage is not a viable alternative because the facility needs to be operational in a flood, which floodproofing measures often preclude.

- Cost estimates for constructing a new highway facility assumed in-kind replacement. However, this is not realistic, and Town Board members informed MMI that the cost for a new, upgraded highway facility has been estimated at approximately $600,000 or possibly more.
    - Several nearby towns have recently replaced their garages that may be comparable: Ashland, Andies, Bovina, Thompkins, Roxbury, Lexington
- Potential funding sources were presented, and are detailed in the LFA report, although CWC funding opportunities were discussed in detail:
    - CWC will fund up to $50,000 for wastewater at a 25% cost share.
    - CWC will fund 100% of the purchase of a new parcel, which must be built upon within 5 years of acquisition.
    - CWC will buy out the existing property at 100% of the appraised value with no cap.
    - CWC will fund 100% of a feasibility study, up to $10,000.
    - Additional funding sources would be necessary.

Town Board members stated that they do not have enough staff to dedicate resources to seeking grants.

Looking forward, the final public meeting date was set for **Saturday, October 19, 2019, at 10am**. MMI will provide Greg Beechler, the Halcott webmaster, with a draft report to post on the Halcott web page prior to the public meeting. Following a brief comment period, MMI will issue its final LFA report.

MEETING SIGN-IN SHEET

MILONE & MACBROOM		**Meeting Date:**	September 16, 2019, 6:00PM
Project:	#5197-16 Halcott LFA	**Place/Room:**	Halcott Grange Hall

Name	Company	Phone	E-Mail
Mark Carabetta	Milone & MacBroom, Inc	(845) 633-8153	mcarabetta@mminc.com
Matt Trueheart	Milone & MacBroom, Inc	(845) 633-8153	mtrueheart@mminc.com
GALE NEALE	Del. Co. SWCD	607-437-9863	gale-neale@dcswcd.org
PHIL ESKELI	NYC DEP	845 340-7853	peskeli@dep.nyc.gov
ALBERT DOUBRAVA - RESIDENT		845-254-4324	
Pattie Warfield	Clerk-T of H.	845-254-4838	Clerk@townofhalcott.org
Judy DiBenedetto	Town of Halcott Town Board	845-254-4009	cdiben62@gmail.com
Russell Conto	Town of Halcott Highway	845 254 5736	Rundy 9 at yahoo.com
ALAN REYNOLDS	TOWN BOARD	845-254-4522	ALANREYNOLDS05 @ GMAIL.COM
John Mathiesen	CWC	845 586-1400	jmathiesen@cwconline.org
Inmes Kasanof	Town Board	845 254-9920	inneskas70@gmail.com
Yuka Day	Town Board	845 254-6136	day.yuka@yahoo.com

MILONE & MACBROOM

MEMORANDUM

TO:	Halcott Flood Advisory Committee
FROM:	Milone & MacBroom, Inc.
RE:	Halcott LFA Public Meeting #2
DATE:	October 21, 2019
MMI #:	5197-16

A final meeting for the Halcott Local Flood Analysis (LFA) was held on the morning of Saturday, October 19, 2019 at the Grange Hall. In attendance were Mark Carabetta and Matt Trueheart from Milone and MacBroom (MMI), as well as members of the Halcott Flood Advisory Committee (FAC) and several members of the public. FAC members in attendance included representatives from the Halcott Town Board, and the Catskill Watershed Corporation (CWC). A sign-in sheet and the presentation slides are appended.

The purpose of the meeting was to:

- Review the LFA process
- Present recommendations for upgrading several culverts and the Town Highway Garage
- Solicit feedback and answer questions from members of the public
- Outline the next steps for Halcott to implement LFA recommendations

The meeting began with a recapitulation of the LFA process, and its application to Halcott. The Town's experiences with recent flood events were discussed, followed by MMI's presentation of recommendations for the five culverts assessed in the LFA area. Afterwards, MMI presented alternatives and recommendations for the Town Highway Garage on Ursum Way. Finally, MMI provided general recommendations regarding community flood resiliency.

The Draft LFA Report will be posted to Halcott's web page when Greg Beechler, the Halcott webmaster, returns from vacation. Members of the FAC and Halcott residents are encouraged to read this draft, and will have the opportunity to provide input before it is finalized. Comments from the public should be directed to the Halcott Town Board for synthesis and transmission to MMI. Those who wish to comment are asked to please do so by no later than November 11.

MEETING SIGN-IN SHEET

MILONE & MACBROOM

Project:	#5197-16 Halcott LFA	**Meeting Date:**	October 19, 2019, 10:00AM
		Place/Room:	Halcott Grange Hall

Name	Address/Company	Phone	E-Mail
Mark Carabetta	Milone & MacBroom, Inc.	(845) 633-8153	mcarabetta@mminc.com
Matt Trueheart	Milone & MacBroom, Inc.	(845) 633-8153	mtrueheart@mminc.com
Dan Chesire	648 RT 3 Halcott	254-4310	
Paul & Sybil Margaritis	513 Rt 3	254-5374	E224356SC@COMAIL.COM
Karen Rayter	741 Route 3 Halcott	2544180	jjkrayter@gmail.com
John Mathiesen	905 Main St. Margaretville	586-1400	jmathiesen@catskillonline.org
Yuka Day	932 Route 1 Halcott	417-5432 254-6136	day.yuka@yahoo.com
Alan Reynolds	Town Board	845-254-4522	AREYNOLDS05@GMAIL.COM
Russell Burton	Highway Superintendent	845 4833	flundy@atsplo.com
Innes Kasanof	Town Board	845-254-9920	inneskas70@gmail.com
Stephen Kozuch	281 Johnson Hollow Rd	917-952-0095	stephen.kozuch@araadvisors.com