



DRAFT

Town of Shandaken Flood Mitigation Plan

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Section 1 INTRODUCTION

1.1 WHY PREPARE THIS PLAN?

Flood hazard mitigation is a way to reduce or alleviate the loss of life, personal injury, and property damage that can result from flooding through long- and short-term strategies. It involves strategies such as planning, policy changes, programs, projects, and other activities that can mitigate the impacts of floods. The responsibility for flood hazard mitigation lies with many, including private property owners, business, industry, and local, state and federal government.

Numerous state and federal programs and regulations promote flood hazard mitigation planning. Notable among these are two programs of the Federal Emergency Management Agency (FEMA): The National Flood Insurance Program (NFIP) and the Community Rating System (CRS). These programs provide benefits in the form of reduced flood insurance costs for communities that meet minimum requirements for floodplain management. The Town of Shandaken participates in the NFIP and is preparing to participate in the CRS.

The Town of Shandaken participated in the 2017 Ulster County all-hazard mitigation plan and included an update of the Town of Shandaken 2013 mitigation plan strategy as an annex to the plan. In order to provide a comprehensive update of the 2013 Flood Mitigation Plan, the Town has supported the development of the update of this town-specific flood management plan to more clearly address reducing its current flood vulnerability. The town has prepared this new flood hazard mitigation plan as an up-to-date tool for flood preparedness and flood hazard mitigation. Elements and strategies in this plan were selected because they meet various state or federal program requirements as well as the needs of the Town of Shandaken and its citizens.

This plan identifies resources, information, and strategies for reducing risk from flood hazards. It will help guide and coordinate mitigation activities. The plan was developed to meet the following objectives:

- Meet the needs of the Town of Shandaken as well as state and federal requirements.
- Meet planning requirements allowing the Town of Shandaken to join CRS with an enhanced classification.
- Coordinate existing plans and programs so that high-priority initiatives and projects to mitigate possible disaster impacts are funded and implemented.
- Create a linkage between the flood hazard mitigation plan and established plans of the Town of Shandaken, Ulster County, and the Ashokan Stream Management Program to ensure they can work together in achieving successful mitigation.

All citizens, businesses, and visitors of the Town of Shandaken are the ultimate beneficiaries of this plan. Participation in development of the plan by key stakeholders helped ensure that outcomes will be mutually beneficial. The plan's goals and recommendations can lay groundwork for the development and implementation of local mitigation activities and partnerships.

1.2 GUIDELINES FOR FLOOD PLANNING

The priority for this plan is to benefit the citizens of the Town of Shandaken by providing the greatest possible protection against the hazard posed by potential flooding. In addition, the plan has been developed to follow as closely as feasible the guidelines for flood planning presented by FEMA for the CRS program.



1.2.1 CRS STEPS FOR COMPREHENSIVE FLOODPLAIN MANAGEMENT PLAN

Developing a comprehensive floodplain management plan is among the activities that earn CRS credits toward reduced flood insurance rates. To earn CRS credit for a floodplain management plan, the community's process for developing the plan must include at least one item from each of 10 steps (see Appendix B for details):

Planning process steps:

- Step 1. Organize
- Step 2. Involve the public
- Step 3. Coordinate

Risk assessment steps:

- Step 4. Assess the hazard
- Step 5. Assess the problem

Mitigation strategy steps:

- Step 6. Set goals
- Step 7. Review possible activities
- Step 8. Draft an action plan

Plan maintenance steps:

- Step 9. Adopt the plan
- Step 10. Implement, evaluate and revise.

1.3 BACKGROUND

The Town of Shandaken is vulnerable to flooding and has experienced devastating losses over the years. The Town has developed this Flood Mitigation Plan to identify the Town's known flood problem areas; establish goals, objectives, policies and implementation programs to reduce flooding and flood-related hazards; and to ensure the natural and beneficial functions of the floodplains are protected.

Since 1980 residents have received \$5,764,828.30 in flood insurance claims (FEMA NFIP Statistics, 2019).

The Town intends to apply for the National Flood Insurance (NFIP) Community Rating System (CRS) to help strengthen floodplain management in the Town and to reduce flood insurance premiums for residents

The Town has an approved hazard mitigation plan (2017 Ulster County Hazard Mitigation Plan) but recognizes that a more focused and detailed plan would benefit the community by having a focused mitigation strategy and to maximize CRS credits and provide discounts for flood insurance.

1.3.1 CRS Origins

The NFIP provides federally backed flood insurance to encourage communities to enact and enforce floodplain regulations. The NFIP's CRS was implemented in 1990 as a mechanism for recognizing and encouraging

Hazard Mitigation

is any sustained action taken to reduce or eliminate the long-term risk and effects that can result from specific hazards.

FEMA defines the Community Rating System as

A program developed by FEMA to provide incentives for those communities in the Regular Program that have gone beyond the minimum floodplain management requirements to develop extra measures to provide protection from flooding.

community floodplain management activities that exceed the minimum NFIP standards. The National Flood Insurance Reform Act of 1994 codified the CRS in the NFIP. Under the CRS, flood insurance premium rates are adjusted to reflect the reduced flood risk resulting from community activities that meet the three goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote the awareness of flood insurance.

There are 10 CRS classes: class 1 requires the most credit points and gives the largest premium reduction; class 10 receives no premium reduction. A community that does not apply for the CRS or that does not obtain the minimum number of credit points is a class 10 community. The CRS recognizes 18 creditable activities, organized under four categories numbered 300 through 600: Public Information, Mapping and Regulations, Flood Damage Reduction, and Flood Preparedness (An Evaluation of the National Flood Insurance Program's Community Rating System, Federal Emergency Management Agency, October 1998).

The Town of Shandaken is a Category "B" community (at least one but fewer than 50 properties on the updated list of repetitive loss properties). As a Category "B" community, in order for the Town of Shandaken to join the CRS program, must first adopt this Plan and then submit an application for the CRS program. Once the Town is accepted into the program, the Town will receive credit for this Plan.

At each verification visit, the town must:

- a) Prepare a map of the repetitive loss area(s),
- b) Review and describe its repetitive loss problem,
- c) Prepare a list of the addresses of all properties with insurable buildings in those areas, and
- d) Undertake an annual outreach project to those addresses. A copy of the outreach project is submitted with each year's recertification.

Enrolling in the CRS program will help the Town receive a reduction in flood insurance premium for performing activities that reduce the impacts of flooding. Joining the CRS program will also encourage the Town to carry out flood mitigation actions on a regular basis.

1.3.2 Organizations Involved in the Mitigation Planning Effort

The Town of Shandaken intends to implement this Plan with the participation of its various departments, organizations and governing body, as well as by coordinating with relevant Federal and state entities. Coordination helps to ensure that stakeholders have established communication channels and relationships necessary to support mitigation planning and mitigation actions included in Section 6.

1.3.3 Multiple Agency Support for Hazard Mitigation

Primary responsibility for the development and implementation of mitigation strategies and policies lies with local governments. However, local governments are not alone; various partners and resources at the regional, state and federal levels are available to assist communities in the development and implementation of mitigation strategies. Within New York State, the New York State Department of Environmental Protection, the Ulster County Department of the Environment, the Ulster County Soil and Water Conservation District, and the Ashokan Watershed Stream Management Program provided hazard mitigation planning assistance to the Town.



Additional input and support for this planning effort was obtained from a range of agencies and through public involvement (as discussed in Section 3). Oversight for the preparation of this plan was provided by the SAFARI Planning Committee (the Flood Management Planning (FMP) Committee), which includes representatives from:

- Town Supervisor's Office
- Town Board
- Town Highway Department
- Town Building Department
- The Town Planning Board
- Town Zoning Board of Appeals
- Town Clerk's Office
- Ulster County Department of the Environment
- Ulster County Department of Emergency Management
- NYC Department of Environmental Protection
- Catskill Watershed Corporation
- RCAP Solutions
- Cornell Cooperative Extension of Ulster County

The Shandaken Planning Board provides oversight on land use and comprehensive planning. Additionally, the Shandaken Building Inspector/Zoning and Code Enforcement Office is responsible for enforcing codes within the Town limits. Finally, the floodplain administrator is one and the same with the Town Code Officer in the Building Department and provides oversight for all floodplain related issues.

In addition, the New York State Department of Transportation, New York State Department of Environmental Conservation provided plan review and input/support.

This Flood Mitigation Plan was prepared in accordance with the following regulations and guidance:

- 44 Code of Federal Regulations part 78.5 - Flood Mitigation Plan Development in accordance with the National Flood Insurance Act of 1968 (42 U.S.C. 4104c et seq.
- CRS Coordinator's Manual (OMB No. 1660-0022, expires March 31, 2020)
- DMA 2000 (Public Law 106-390, October 30, 2000).
- 44 Code of Federal Regulations (CFR) Parts 201 and 206 (including: Feb. 26, 2002, Oct. 1, 2002, Oct. 28, 2003, and Sept. 13, 2004 Interim Final Rules).
- FEMA. 2004. "How-To Guide for Using HAZUS-MH for Risk Assessment." FEMA Document No. 433. February.
- FEMA Mitigation Planning How-to Series (FEMA 386-1 through 4, 2002), available at: <http://www.fema.gov/fima/planhowto.shtm>.

1.3.4 IMPLEMENTATION OF THE PLANNING PROCESS

To support the planning process to develop this Flood Mitigation Plan (FMP), the Town of Shandaken has accomplished the following:

- Developed an FMP Committee

- Profiled the Flood Hazard
- Estimated the inventory at risk and potential losses from flood hazards
- Perform a comprehensive review of mitigation alternatives
- Developed mitigation actions and goals that address the various hazards that impact the area
- Developed mitigation plan maintenance procedures to be executed after adoption of plan.

To address the requirements of CRS and better understand their potential vulnerability to and losses associated with hazards of concern, the Town of Shandaken used the Hazards U.S. – Multi-Hazard (HAZUS-MH) software package (discussed in greater detail later in this Plan) supplemented by local data, as feasible, to support the risk assessment and vulnerability evaluation. HAZUS-MH assesses risk and estimates potential losses for natural hazards. It produces outputs that will assist state and local governments, communities, and the private sector in implementing emergency response, recovery, and mitigation programs, including the development of FMPs.

As required by CRS, the planning process has engaged the public throughout, providing opportunities for public comment and input. In addition, numerous agencies and stakeholders have participated as core or support members, providing input and expertise throughout the planning process.

This Flood Mitigation Plan documents the process and outcomes of the Town’s efforts. Additional information on the planning process is included in Section 3, Planning Process. Documentation that the prerequisites for plan approval have been met is included in Appendix E, Plan Adoption.

1.3.5 Benefits of Mitigation Planning

The planning process will help prepare citizens and government agencies to better respond when disasters occur. Also, mitigation planning allows the Town of Shandaken to remain eligible for mitigation grant funding for mitigation projects that will reduce the impact of future disaster events. The long-term benefits of mitigation planning include:

- An increased understanding of flood hazards faced by the Town of Shandaken
- A more sustainable and disaster-resistant community
- Financial savings through partnerships that support planning and mitigation efforts
- Focused use of limited resources on hazards that have the biggest impact on the community
- Reduced long-term impacts and damages to human health and structures and reduced repair costs

1.3.6 Benefits of Participating in the Community Rating System

The objective of the CRS is to support the goals of the NFIP. To do this, the CRS provides insurance premium rate discounts to policy holders in recognition that their communities implement activities that work toward its three goals of reducing flood damage, supporting the insurance part of the NFIP, and pursuing a broad approach to floodplain management.

In this process, the “community” part of the Community Rating System includes state and regional agencies and private organizations that support and assist city, county, and tribal governments that are participants in the NFIP. A closer look at how communities can implement these three goals is as follows:

1. Reduce flood damage to insurable property. Communities are encouraged to map and provide regulatory flood data for all their flood hazards. The data should be used in their regulatory programs and shared

with all users and inquirers. New buildings in mapped floodplains should be protected from the known local flood hazards, which may require setting standards higher than the minimum national criteria of the NFIP. Communities are encouraged to reduce the exposure of existing buildings to flood damage, especially repetitive loss properties.

2. Strengthen and support the insurance aspects of the NFIP. Communities should encourage their residents to be aware of their flood risk and to purchase and maintain a flood insurance policy to protect themselves from the financial impacts of flooding. Communities should also help make the program more financially sound by implementing mapping and information programs that help to evaluate accurately the individual property risk for flood insurance rating purposes, expand the policy base, and reduce repetitive losses.
3. Encourage a comprehensive approach to floodplain management. Insurable property is not the only floodplain management concern of communities, so the CRS recognizes efforts that protect lives; further public health, safety, and welfare; and protect natural floodplain functions.

A community's staff should understand the physical and biological processes that form and alter floodplains and watersheds and take steps to deal with flooding, erosion, habitat loss, water quality, and special flood-related hazards. A comprehensive approach includes planning, public information, regulations, financial support, open space protection, public works activities, emergency management, and other appropriate techniques. (CRS Coordinator's Manual, 2017).

1.3.7 How to Use this Plan

This flood hazard mitigation plan is organized into the following primary parts, which follow the organization of the CRS steps for floodplain planning.

Part 1—Planning Process and Project Background

Section 1, Introduction: Overview and summary of the Town of Shandaken Flood Mitigation Plan

Section 2, Planning Process: A description of the Plan methodology and development process, HMP Committee and stakeholder involvement efforts, and a description of how this Plan will be incorporated into existing programs.

Section 3, Town Profile: An overview of the Town of Shandaken, including: (1) general information, (2) population and demographics, (3) general building stock inventory, (4) land use trends, (5) future growth and development, and (6) critical facilities.

Section 4, Relevant Programs and Regulations

Part 2—Risk Assessment

Section 5, Flood Profile: Documentation of the hazard identification and ranking process, hazard profiles, and results of the vulnerability assessment (estimates of the impact of hazard events on life, safety and health, general building stock, critical facilities, the economy and future growth and development). Description of the status of local data and planned steps to improve local data to support mitigation planning.

Part 3—Mitigation Strategy

Section 6, Mitigation Strategies: Information regarding the mission statement, mitigation goals, objectives, capability assessment and mitigation action items identified by the Town in response to priority hazards of



concern. Also, under this section is a comprehensive review of alternatives considered with an emphasis on strengths, weaknesses, obstacles and opportunities within the community.

Part 4—Plan Maintenance

Section 7 Plan Maintenance Procedures: The system established by the Town of Shandaken to monitor, evaluate, maintain and update the Plan.

Each part includes elements identified in the CRS's 10 steps. These steps are often cited within each subsection to illustrate compliance with the requirement.

The following appendices provided at the end of the plan include information or explanations to support the main content of the plan:

- Appendix A—A glossary of acronyms and definitions
- Appendix B—Description of CRS Planning Requirements
- Appendix C—Public and Stakeholder Outreach Documentation
- Appendix D—Progress Report Template
- Appendix E—Plan Adoption Resolution
- Appendix F—Flood Management Committee Composition

Section 2 PLANNING PROCESS

2.1 INTRODUCTION

This section includes a description of the planning process used to develop the Plan, including how it was prepared, who was involved in the process, and how the public was involved.

The process followed to develop the Town of Shandaken Flood Mitigation Plan had the following primary objectives to ensure that the Plan met the requirements of the CRS:

- Form a planning team
- Define the planning area
- Establish a steering committee
- Coordinate with other agencies
- Review existing programs
- Engage the public.

These objectives are discussed in the following sections.

2.2 FORMATION OF A PLANNING TEAM-ORGANIZE THE RESOURCES

This planning project was initiated and overseen by the Town of Shandaken and the Shandaken Area Flood Assessment and Remediation Initiative (SAFARI) or the FMP Committee. SAFARI's mission is to reduce the flood hazard vulnerability in the planning area to ensure that residential and business communities can thrive within a healthy environment. SAFARI in conjunction with the Town of Shandaken represented by the Town Supervisor hired Tetra Tech, Inc. to assist with development and implementation of the plan. While SAFARI is an advisory committee, the Town Supervisor oversees the land use and planning in the town and is committed to supporting the committee's recommendations as appropriate. The Tetra Tech project manager assumed the role of the lead planner, reporting directly to the Town of Shandaken Supervisor. A planning team was formed to lead the planning effort, made up of the members shown in Table 2-1:

Table 2-1 Shandaken Area Flood Assessment and Remediation Initiative (SAFARI) - FMP Committee

Name	Title	Association
Robert Stanley	Town Supervisor	Town of Shandaken
Eric Hofmeister	Town Highway Superintendent	Town of Shandaken
Howard McGowan	Town Building Inspector/Code Enforcement Officer	Town of Shandaken
Faye Storms	Town Board Member	Town of Shandaken
Don Brewer	Planning Board, Chair	Town of Shandaken

Name	Title	Association
Mark Loete	ZBA Member	Town of Shandaken
Aaron Bennett	Environmental Planner	Ulster County Department of Environment (UCDOE)
Steve Peterson	Director of Emergency Services	Ulster County Emergency Service Department
Candace Balmer	Water Resource Specialist	RCAP Solutions
Leslie Zucker	Extension Issues Leader	Cornell Cooperative Extension of Ulster County (CCEUC)
Brent Gotsch	Watershed Educator	Cornell Cooperative Extension of Ulster County (CCEUC)
Adam Doan	Project Manager	Ulster County Soil and Water Conservation District (UCSWCD)
Phil Eskeli	Flood Hazard Mitigation Coordinator	NYC Department of Environmental Protection (NYCDEP)
Chris Tran	Project Manager	NYC Department of Environmental Protection (NYCDEP)
John Mathiesen	Environmental Engineering Specialist	Catskill Watershed Corporation (CWC)

This team provided input to the planning committee and established the guidelines for the planning process.

The Town of Shandaken Flood Mitigation Plan (FMP) was written using the best available information obtained from a wide variety of sources. Throughout Plan development, a concerted effort was made to gather information from municipal and regional agencies and staff as well as stakeholders, federal and state agencies, and the residents of the Town (**CRS Step 1**). SAFARI solicited information from local agencies and individuals with specific knowledge of certain natural hazards and past historical events, as well as considering Planning and zoning codes, ordinances, and other recent Planning decisions. The natural hazard mitigation strategies identified in this Plan have been developed through an extensive Planning process involving local, county and regional agencies, and Town residents and stakeholders.

This section of the Plan describes the mitigation Planning process, including (1) Planning Committee involvement and efforts; (2) local involvement; (3) stakeholder and public involvement; and (4) integration of existing data, Plans, and information.

2.3 DEFINING THE PLANNING AREA

The planning area was defined as the Town of Shandaken with special emphasis on the hamlets of Phoenicia and Mt. Tremper.

2.3.1 Planning Committee and Other Stakeholder Support

Many entities supported preparation of this Plan; the Planning Committee and other stakeholders involved in the process are presented below.

2.3.2 Early Planning Efforts

This planning effort represents an update of the initial Town of Shandaken Floodplain Management Plan. The Town has worked to continue to enhance and maintain a CRS compliant local plan, and it represents the ongoing hazard risk management efforts in the Town. Various regional, county and local agencies and governments including the Ashokan Watershed Stream Management Program, the NYS Department of Environmental Conservation, NYC Department of Environmental Protection, Cornell Cooperative Extension of Ulster County, Ulster County Department of the Environment, and the Ulster County Soil and Water Conservation District have been involved in natural hazard risk assessment, mitigation planning and project activities, prior to and/or unrelated to the current planning effort. Such activities provide a strong foundation for subsequent efforts, and an awareness and understanding of the need for and benefits of mitigation planning across a broad range of regional, county and local governments and stakeholders.

2.3.3 Planning Committee Involvement and Efforts

The Town Board was of the opinion that SAFARI, comprised of appropriate municipal personnel, local emergency first responders, and other stakeholders would be an effective body to guide the overall process, provide significant input, and effectively partner with Tetra Tech to develop a successful Plan. Thus, the Board approved the SAFARI committee by resolution to guide and oversee all phases of the planning effort.

Leadership roles and ground rules were established during the meeting on August 14, 2018. SAFARI agreed to meet monthly or as needed throughout the course of the plan's development. The planning team facilitated each SAFARI meeting, which addressed a set of objectives based on the established scope. SAFARI met 8 times from 8/14/18 through x/xx/19 and will continue to meet on a quarterly basis throughout the plan performance period. Meeting agendas notes and attendance logs areas available are provided in Appendix C. Notes:

The Committee supported the following planning activities, under the guidance and direction of the contract consultant:

- Establish Plan development goals;
- Establish a timeline for completion of the Plan;
- Ensure that the Plan meets the requirements of CRS, FMA, and FEMA and NYSOEM guidance;
- Solicit and encourage the participation of regional agencies, a range of stakeholders, and citizens in the Plan development process;
- Assist in gathering information for inclusion in the Plan, including the use of previously developed reports and data;
- Organize and oversee the public involvement process;
- Consider a comprehensive range of alternatives;
- Review and prioritize actions;
- Develop, revise, adopt, and maintain the Plan.

Members of SAFARI (individually and as a whole), as well as key stakeholders, convened and/or communicated on an as-needed basis to share information and participate in workshops to identify hazards; assess risks; identify critical facilities; assist in developing mitigation goals, objectives and actions; and provide continuity through the Plan development process to ensure that natural hazards vulnerability information and appropriate mitigation strategies were incorporated into the Plan. Each member of SAFARI reviewed the Plan, supported interaction with other stakeholders and assisted with public involvement efforts.

Table 2.3 presents a summary of SAFARI and general project planning efforts implemented during the development process for this Plan. It also identifies which DMA 2000 requirements the activities satisfy. Meeting minutes and documentation are provided in Appendix C (Public and Stakeholder Outreach Documentation).8/14/2018

Table 2-2. Summary of Mitigation Planning Activities / Efforts

Date	Activity/ CRS Requirement	Description of Activity	Participants
8/14/2018		Pre-Kick Off Meeting.	Aaron Bennett, Ulster County DOE Phil Eskeli, NYCDEP Richard Frusciante, NYSDOT Brent Gotsch, AWSMP/ (CCEUC) Tim Koch, AWSMP Mark Loete, Town of Shandaken- ZBA John Mathiesen, CWC Howie McGowan, Town of Shandaken-Building/Zoning/Code Enforcement Officer Rob Stanley, Town of Shandaken- Supervisor Chris Tran, NYCDEP Leslie Zucker, CCEUC Cynthia Bianco, Tetra Tech, Inc.
9/11/2018		Data Collection, review goals and objectives, stakeholder engagement strategy.	Aaron Bennett, Ulster County DOE Amanda LaValle, Ulster County DOE Faye Storm, Shandaken Town Board Brent Gotsch, AWSMP/(CCEUC Candace Balmer, RCAP Solutions Justine Rutherford, CWC John Mathiesen CWC Howie McGowan, Town of Shandaken-Building/Zoning/Code Enforcement Officer Rob Stanley, Town of Shandaken-Supervisor Chris Tran, NYCDEP Cynthia Bianco, Tetra Tech, Inc.
10/9/2018		Review project status; continue discussion of goals and objectives update, SWOO/review of mitigation alternatives.	Candace Balmer, RCAP Solutions Aaron Bennett Ulster County DOE Cynthia Bianco, Tetra Tech, Inc. Adam Doan, UCSWCD, AWSMP Phil Eskeli, NYCDEP Brent Gotsch, AWSMP/CCEUC Eric Hofmeister, Town of Shandaken Highway Superintendent Tim Koch, CCEUC John Mathiesen, CWC Robert Stanley, Town of Shandaken Supervisor Chris Tran, NYC DEP Leslie Zucker, CCEUC



SECTION 2: PLANNING PROCESS

Date	Activity/ CRS Requirement	Description of Activity	Participants
11/13/2018		Review project status; finalize discussion of goals and objectives update; review of citizen survey responses; presentation of draft vulnerability assessment; discuss additional stakeholder outreach.	Candace Balmer, RCAP Solutions Aaron Bennett, UCDOE Cynthia Bianco, Tetra Tech, Inc. Phil Eskeli, NYCDEP Brent Gotsch, AWSMP/CCEUC Eric Hofmeister, Town of Shandaken Highway Department Mark Loete, Town of Shandaken ZBA Justine McNeilly, CWC Robert Stanley, Town of Shandaken Supervisor
12/11/2018		Review project status, review updates to draft vulnerability assessment; discuss additional stakeholder outreach.	Candace Balmer, RCAP Solutions Aaron Bennett, UCDOE Cynthia Bianco, Tetra Tech, Inc. Phil Eskeli, NYCDEP Brent Gotsch, AWSMP/CCEUC Eric Hofmeister, Town of Shandaken Highway Department Howie McGowan, Town of Shandaken-Building/Zoning/Code Justine McNeilly, CWC Robert Stanley, Town of Shandaken Supervisor Tim Koch, CCEUC Don Brewer, Town of Shandaken Planning Amanda Cabanillas, CCEUC
1/8/2019		Review project status; update mitigation action list to reflect progress.	Candace Balmer, RCAP Solutions Aaron Bennett, UCDOE Cynthia Bianco, Tetra Tech, Inc. Phil Eskeli, NYCDEP Brent Gotsch, AWSMP/CCEUC Eric Hofmeister, Town of Shandaken Highway Department Howie McGowan, Town of Shandaken-Building/Zoning/Code Justine McNeilly, CWC Robert Stanley, Town of Shandaken Supervisor Chris Tran, NYCDEP Adam Doan, UCSWCS/AWSMP Mark Loete, Trout Unlimited Leslie Zucker, CCEUC
3/13/2019		Review project status; review draft Sections 3 (Town Profile) and 6 (Mitigation Strategies) for feedback, review mitigation action list to update lead agencies and prioritization.	John Horn, Town of Shandaken Planning Board Aaron Bennett, UCDOE Cynthia Bianco, Tetra Tech, Inc. Phil Eskeli, NYCDEP Brent Gotsch, AWSMP/CCEUC Eric Hofmeister, Town of Shandaken Highway Department Justine McNeilly, CWC Robert Stanley, Town of Shandaken Supervisor Tim Koch, CCEUC Adam Doan, UCSWCS/AWSMP
4/9/2019	1b, 2, 3, 4, 5	Review of Maintenance Procedures; Draft Plan Review.	
?		Request for Stakeholder input	
?	1b, 2, 3, 4, 5	Draft Plan Presentation	

Each number in column 2 identifies specific DMA 2000 requirements, as follows:



- 1a – Prerequisite – Adoption by the Local Governing Body
 1b – Public Participation
 2 – Planning Process – Documentation of the Planning Process
 3a – Risk Assessment – Identifying Hazards
 3b – Risk Assessment – Profiling Hazard Events
 3c – Risk Assessment – Assessing Vulnerability: Identifying Assets
 3d – Risk Assessment – Assessing Vulnerability: Estimating Potential Losses
 3e – Risk Assessment – Assessing Vulnerability: Analyzing Development Trends
 4a – Mitigation Strategy – Local Hazard Mitigation Goals
 4b – Mitigation Strategy – Identification and Analysis of Mitigation Measures
 4c – Mitigation Strategy – Implementation of Mitigation Measures
 5a – Plan Maintenance Procedures – Monitoring, Evaluating, and Updating the Plan
 5b – Plan Maintenance Procedures – Implementation through Existing Programs
 5c – Plan Maintenance Procedures – Continued Public Involvement

NY DOT- New York State Department of Transportation
 NY DEP: New York City Department of Environmental Protection
 NYS DEC: New York State Department of Environmental Conservation
 USDA NRCS: United States Department of Agriculture-National Resources Conservation Service
 UCSWCD: Ulster County Soil and Water Conservation District
 Ulster County DOE: Ulster County Department of the Environment
 UCDPW: Ulster County Department of Public Works
 CCE: Cornell Cooperative Extension

2.3.4 Stakeholders Involved in Mitigation Planning

This section presents (1) Town involvement, (2) State and regional agency involvement, and (3) public participation – citizen involvement.

2.3.5 Municipal and Local Involvement

SAFARI and/or its members and contract consultant met and communicated with relevant representatives of the Town to obtain data and information, review existing Plans and capabilities, and facilitate the identification of appropriate mitigation initiatives. Further, these departments have reviewed the Draft Plan and provided direct input during its development.

The Town of Shandaken departments and agencies that have been involved in this effort include:

Town of Shandaken Department	
	Town Supervisor
	Town Board
	Building Department
	Clerk's Office
	Highway Department
	Zoning Board of Appeals
	Planning Board
	Code Official-Floodplain Administrator

Specifically the committee members provided input as detailed below.

- **Town of Shandaken Officials:** Town Supervisor responsible for project and grant contract management, Chair of Hazard Mitigation Planning Committee, provided administrative services, plan review, facilitation of meetings, assisted with public outreach; liaison for press releases, web postings, communications. Town clerk provided communication support. Planning Committee

members; provided data and information on hazards, inventory, vulnerabilities; developed goals and objectives; identified and developed potential mitigation actions; reviewed plan sections; assisted with public and stakeholder outreach.

- Town of Shandaken Highway Department: Planning Committee member; provided data and information on hazards, inventory, vulnerabilities; developed goals and objectives; identified and developed potential mitigation actions; reviewed plan sections; assisted with public and stakeholder outreach.
- Town of Shandaken Planning Board: Informed of planning process; provided data and input to plan to include identifying specific hazard areas that need to be addressed in the Plan; supported public outreach through local civic website coverage.
- Town of Shandaken Building Department-Code Official, Floodplain Administrator: Provided site visit to view flood-stricken areas, provided code enforcement data,

2.3.6 Coordination with Other Agencies- Federal, State, County, and Regional Agency Involvement

Opportunities for involvement in the planning process were provided to local and regional agencies involved in flood hazard mitigation, agencies with authority to regulate development, businesses, and other private and nonprofit interests (**CRS Step 3**). This task was accomplished by the planning team as follows:

- **Steering Committee Involvement**—Agency representatives were invited to participate on the Steering Committee.
- **Agency Notification**—The following agencies were invited to participate in the plan development from the beginning and were kept apprised of plan development milestones:
 - Ashokan Watershed Stream Management Program
 - NYS Department of Environmental Conservation
 - Ulster County Department of the Environment
 - Ulster County Soil and Water Conservation District
 - Cornell Cooperative Extension of Ulster County
 - Ulster County Emergency Services Department
 - NYC Department of Environmental Protection
 - Catskill Watershed Corporation
 - RCAP Solutions

These agencies received meeting announcements, meeting agendas, and meeting minutes by e-mail throughout the plan development process. These agencies supported the effort by participating on the committee, attending meetings, or providing feedback on issues.

- **Pre-Adoption Review**—All the agencies listed below were provided an opportunity to review and comment on this plan, primarily through the plan secure shared site and the plan website (see Section-PUBLIC INVOLVEMENT). Each agency was sent an e-mail message informing them that draft portions of the plan were available for review. In addition, the complete draft plan was sent to



the Insurance Services Office, FEMA's CRS contractor, for a pre-adoption review to ensure CRS program compliance.

Throughout this Planning process, the Town of Shandaken actively sought the involvement of a wide range of county, state and regional stakeholders, including:

Stakeholder
NYS Department of Transportation
NYD DHSES- Mitigation Unit
FEMA Region II – Mitigation Unit
NYS DEC- Bureau of Flood Protection and Dam Safety
Cornell University Climate Institute
NYS Climate Smart Communities Program
Village of Margaretville
Town of Olive
Ulster County Planning Department
Ulster County Emergency Services Department
Delaware County Department of Planning
Town of Middletown

At a minimum, these stakeholders were advised of the planning process and provided the opportunity to review and provide direct input to the Plan during its development. Further, SAFARI and/or its members and contract consultant, met and/or directly communicated with many of these stakeholders to obtain data and information, review existing plans, and facilitate the identification of appropriate mitigation initiatives. Specific information obtained from these stakeholder is cited and/or referenced throughout this Plan.

2.3.7 PUBLIC INVOLVEMENT

Broad public participation in the planning process helps ensure that diverse points of view about the planning area's needs are considered and addressed. CRS credits are available for providing opportunities to comment on disaster mitigation plans during the drafting stages and prior to plan approval, as well as for optional public involvement activities (**CRS Step 2**).

Strategy

The strategy for involving the public in this plan emphasized the following elements:

- Include non-government stakeholders and/or members of the public on the Steering Committee.
- Provide notice of meetings and minutes of meetings on the Town of Shandaken website
- Ensure all meetings open to the public.
- Use a questionnaire to determine the public's perception of flood risk and support of mitigation initiatives.
- Attempt to reach as many planning area citizens as possible using multiple media.
- Identify and involve planning area stakeholders.

Stakeholders and the Steering Committee

Stakeholders are the individuals, agencies and jurisdictions that have a vested interest in the recommendations of this plan. The effort to include stakeholders in this process included stakeholder participation on the Steering Committee. Stakeholders targeted for this process included:

- Property Owners
- Owners/operators of businesses within the floodplain
- Environmental advocacy groups/Citizen Action Groups

Questionnaire

An on-line natural hazards preparedness citizen survey was developed to gauge household preparedness that may impact the Town and to assess the level of knowledge of tools and techniques to assist in reducing risk and loss of those hazards. The questionnaire asked 29 quantifiable questions about citizen perception of risk, knowledge of mitigation, and support of community programs. The questionnaire also asked several demographic questions to help analyze trends.

The answers to its 29 questions helped guide the Steering Committee in selecting goals, objectives and mitigation initiatives. The questionnaire was also advertised in several public Town Board Meetings (televised) and posted on the town website.

Over 130 questionnaires were completed online and during this planning process. The responses provided SAFARI and planning team with feedback to use throughout the planning process. SAFARI used survey results to support the selection of guiding principles, goals and objectives discussed in Section 6. The survey results were also used in the review of alternatives and selection of mitigation initiatives. The complete questionnaire and a summary of its findings can be found in Appendix C.

Public Meetings

All SAFARI meetings were advertised and open to the public during the planning process. An open public meeting to present the planning process was held on August 14, 2018 at the Ashokan Watershed Stream Management Program (AWSMP) Offices located at 3130 State Route 28, Shokan, NY. During that meeting the planning process was presented including a description to flood mitigation planning, its benefits, and a description of the National Flood Insurance Program and the Community Rating System and how it can help reduce flood vulnerability in the town. A copy of the presentation is included in Appendix C. A second open public meeting to present the planning process and vulnerability assessment was held on November 13, 2018 at AWSMP Offices. The purpose of this meeting was to present the planning process status in addition to highlighting the vulnerability assessment. A copy of the presentation is included in Appendix C.

The final public meeting to present the draft plan was held on xx, 2019 at the Shandaken Town Hall. This meeting was advertised via a press release sent to all media outlets. This meeting was held at the beginning of the published public comment period, which ran until XX, 2019.

Internet

At the beginning of the plan development process, a website (<http://www.shandaken.us/flood-mitigation-plan/flood-mitigation-plan-post/>) was created to keep the public posted on plan development milestones and to solicit relevant input (see Figure 2.1):

Figure 2-1. Screenshot of Town website



The site's address was publicized in all press releases and public meetings. Information on the plan development process, SAFARI, the questionnaire and draft of the plan was made available to the public on the site throughout the process. The Town intends to keep a website active after the plan's completion to keep the public informed about successful mitigation projects and future plan updates. The Draft Plan was posted to the public website on May xx, 2019.

2.4 INTEGRATION OF EXISTING DATA AND PLANS INTO MITIGATION PLAN

Existing laws, ordinances and plans at the federal, state and local level can support or impact flood hazard mitigation actions identified in this plan. Flood hazard mitigation planning typically includes review and incorporation as appropriate of existing plans, studies, and technical information. This section provides a review of laws and ordinances that can affect flood hazard mitigation in the planning area. Some laws and programs have emergency protocols that go into effect during emergency situations to waive or expedite requirements or procedures. These modifications are limited in scope and duration, and all mitigation and recovery projects should be planned for and implemented in ways that they meet all federal, state and local laws. The following federal, state and local programs have been identified as being related to the goals and objectives to this plan.

The Mitigation Plan integrates relevant local, state and federal data and plans as discussed below.

Local Regulations, Codes, Ordinances and Plans

The following local regulations, codes, ordinances and plans were reviewed during this planning process in an effort to develop mitigation planning goals, objectives and mitigation strategies that are consistent across local and regional planning and regulatory mechanisms; and thus, develop complementary and mutually supportive plans.

The “Legal and Regulatory” capability assessment, included as Table 6-1 in Section 6, provides a listing of the local codes, ordinances, regulations and planning mechanisms available in the Town, and reviewed during this planning process.

2.4.1 Local Data

SAFARI and the contract consultant reviewed and incorporated existing data and plans to support the Mitigation Plan. A number of electronic and hard copy documents were made available to support the planning process. These documents are too numerous to list below; therefore, a summary is provided. A complete listing is included in the references section of this document.

- Local and regional Geographic Information System (GIS) data
- Documentation of past mitigation actions and grant applications
- Historic maps
- FEMA Flood Insurance Study and Flood Insurance Rate Maps
- Town and Regional Emergency Management Plans
- Watershed and Hydrologic Reports, Studies, and Analyses
- State, County, and Town Land Use Planning Codes, Regulations, and Ordinances
- Town Budget Summaries
- Articles from Local News and Media Outlets

Cross-referencing this Plan with documents like those above as they are updated will need to occur and has been included in Section 6 as mitigation activities.

2.4.2 Federal and State Data

Federal and State data was collected and used throughout the mitigation process including:

- US Census data
- HAZUS-MH provided data
- FEMA “How To” Series (386-1 to 386-4, and 386-7)

2.4.3 Other Plans, Reports, and Data

A summary of the reports and plans provided by the Town of Shandaken and reviewed in the preparation of this plan is included in the following Record of Review Matrix.

Record of the review of existing programs, policies, and technical documents



Existing Program/Policy/Technical Documents
Town of Shandaken Flood Mitigation Plan (2013)
New York State Hazard Mitigation Plan (2014)
Ulster County Hazard Mitigation Plan (2017)
Woodland Creek Stream Management Plan (2018)
Beaver Kill Stream Management Plan (2015)
Climate Smart Communities Program (2018)
Shandaken-Hardenburgh NYRCR Plan (2014)
Shandaken-Allaben Local Flood Analysis (2017)
Phoenicia-Mt. Tremper Local Flood Analysis (2015)
Comprehensive Plan-Town of Shandaken, (2005)
Upper Esopus Stream Management Plan (Cornell Cooperative Extension, January 2007)
Stony Clove Stream Management Plan (Greene County Soil and Water Conservation District and NYCDEP, March 2005)
Broadstreet Hollow Stream Management Plan (2003)
Ulster County, New York, Flood Insurance Study (FEMA JULY 30, 2018)
Town of Shandaken Flood Damage Prevention Ordinance – Chapter 77, Adopted October 3, 2016
Ulster County Comprehensive Emergency Management Plan, 2014
Ulster County – Emergency Evacuation / Detour Route Annex, November 2005
Ulster County Transportation Council Rethinking Transportation: Plan 2040 - Year 2040 Long Range Transportation Plan, September 29, 2015
Ulster County Subdivision Requirements. Ulster County DPW. November 2008
Town of Shandaken Fire Prevention and Building Code Administration – Chapter 74, Adopted April 7, 2008
Subdivision Ordinance – Chapter 105, Adopted December 11, 1971
Zoning Ordinance – Chapter 116, Adopted December 9, 1987

A complete list of the existing data and plans used to support this HMP is included in the references section of this document. By incorporating data from existing programs into this Plan, the Town also was able to identify the relevance of mitigation planning to these existing programs. Implementation of this Plan through these existing plans is identified as a specific mitigation action in several areas in Section 6 of this Plan.



2.5 CONTINUED PUBLIC INVOLVEMENT

The Town of Shandaken is committed to the continued involvement of the public. Therefore, copies of the Plan are available for review on their public website (<http://www.shandaken.us/disaster-prep-response/flood-mitigation-plan/>), as well as at the Town Clerks Office at 7209 NY-28, Shandaken, NY 12480 .

After completion of the Plan, implementation and ongoing maintenance will become a function of the HMP Committee. SAFARI will review the Plan and accept public comment as part of an annual review and as part of five-year mitigation Plan updates.

A notice regarding annual updates of the Plan and the location of Plan copies will be publicized annually after the HMP Committee's annual evaluation and posted on the public web site.

Mr. Robert Stanley , has been identified as the ongoing Town Flood Mitigation Plan Coordinator (see Section 7), and is responsible for receiving, tracking, and filing public comments regarding this Plan. Contact information is:

Rob Stanley, Town Supervisor
Town Hall
7209 NY-28
Shandaken, NY 12480
Phone: (845) 688-7165

The public will have an opportunity to comment on the Plan as a part of the annual mitigation planning evaluation process and the five-year mitigation Plan update. The Flood Mitigation Coordinator is responsible for coordinating the plan evaluation portion of the meeting, soliciting feedback, collecting and reviewing the comments, and ensuring their incorporation in the five-year Plan update as appropriate; however, members of SAFARI will assist the Coordinator. Additional meetings may also be held as deemed necessary by SAFARI. The purpose of these meetings would be to provide the public an opportunity to express concerns, opinions, and ideas about the Plan.

Section 3 TOWN PROFILE

The Town of Shandaken profile information is presented in the plan and analyzed to develop an understanding of the floodplain management plan study area, including the economic, structural, and population assets at risk and the particular concerns that may be present related to hazards analyzed later in this plan (e.g., low lying areas prone to flooding or a high percentage of vulnerable persons in an area). This profile provides general information for the Town of Shandaken (physical setting, population and demographics, general building stock, and land use and population trends) and critical facilities located within the town.

3.1 GENERAL INFORMATION

The Town of Shandaken is located in the Catskill Mountains, in the northwest corner of Ulster County. The Town's name is of Native American origin and means 'land of rapid waters'. The town is located along the Route 28 corridor within the Catskill Park and State Forest Preserve. The Town lands are over two-thirds state-owned and include Slide Mountain which is the highest peak in the Catskill range at 4,180 feet. The Town was originally settled around the Revolutionary War period and was formally established on April 9, 1804 (Town of Shandaken, Date Unknown) (<http://www.shandaken.us/about-2/>).

3.1.1 Physical Setting

This section presents the physical setting of the town, including: location, hydrography and hydrology, topography and geology, climate, and land use/land cover.

Location

The Town of Shandaken is one of the 24 municipalities that make up Ulster County. Ulster County is located in southeast New York State, in the Mid-Hudson Region of the Hudson Valley. It has a total area of 1,161 square miles. Ulster County is bordered to the north by Greene County, to the northeast by Columbia County, to the east by Dutchess County, to the south by Orange County and to the west by Sullivan and Delaware Counties (Ulster County Hazard Mitigation Plan, 2009). Figure 3-1 illustrates the location of the Town of Shandaken within Ulster County.

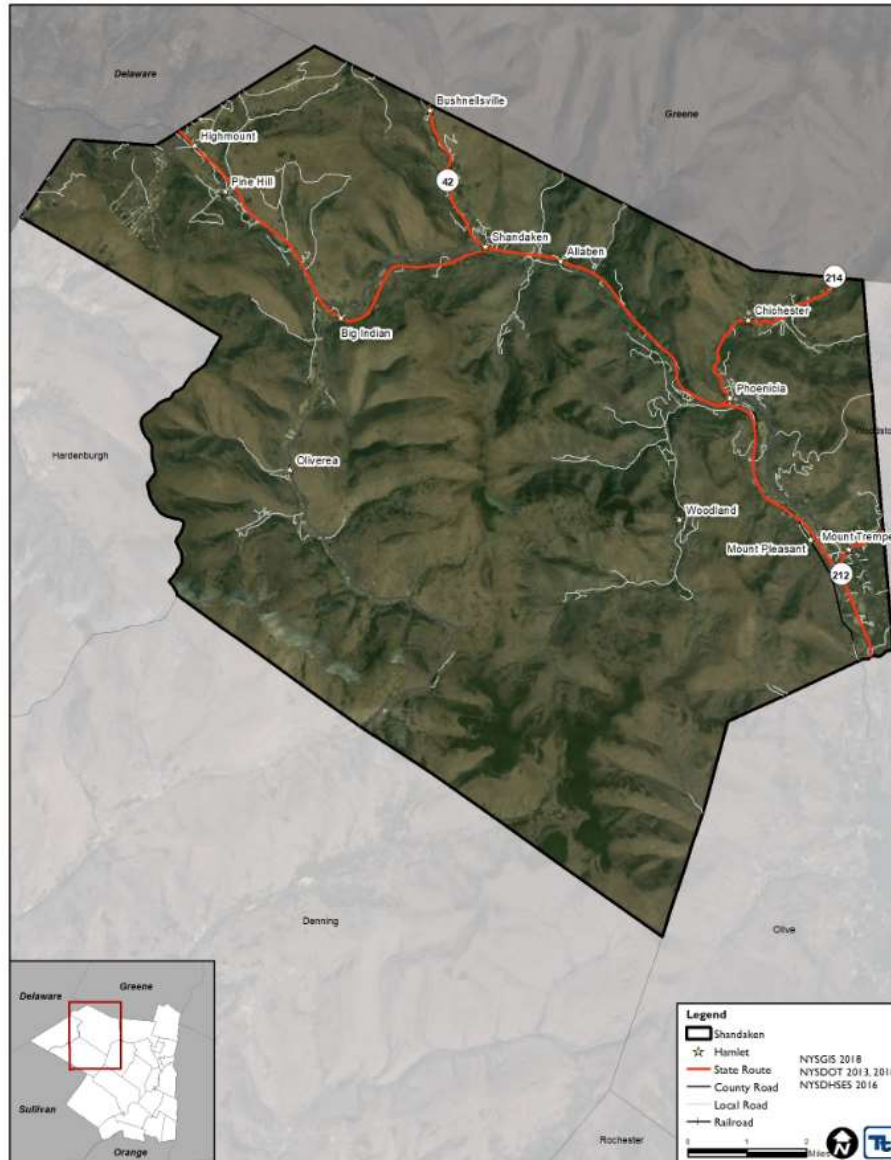
Figure 3-1. Ulster County and the Town of Shandaken, New York



Source: Ulster County, 2012; ESRI Ocean Map

The Town of Shandaken is located within the Central Catskill region of New York State (Town of Shandaken Comprehensive Plan, 2005). The Town is found in the northwestern portion of Ulster County. The Town of Shandaken is bordered to the east by the Town of Woodstock, to the south by the Towns of Denning and Olive, to the west by the Town of Hardenburgh, to the west and north by the Town of Middletown, and to the north by the Towns of Hunter and Lexington (FEMA, 1989). The Town is made up of 12 hamlets: Woodland Valley, Oliverea, Chichester, Bushnellsville, Mt. Pleasant, Mt. Tremper, Phoenicia, Shandaken, Allaben, Big Indian, Pine Hill and Highmount (Town of Shandaken Comprehensive Plan, 2005). **Figure 3-1** illustrates the location of the hamlets of Shandaken, Phoenicia, and Mt. Tremper.

Figure 3-2. Township of Shandaken

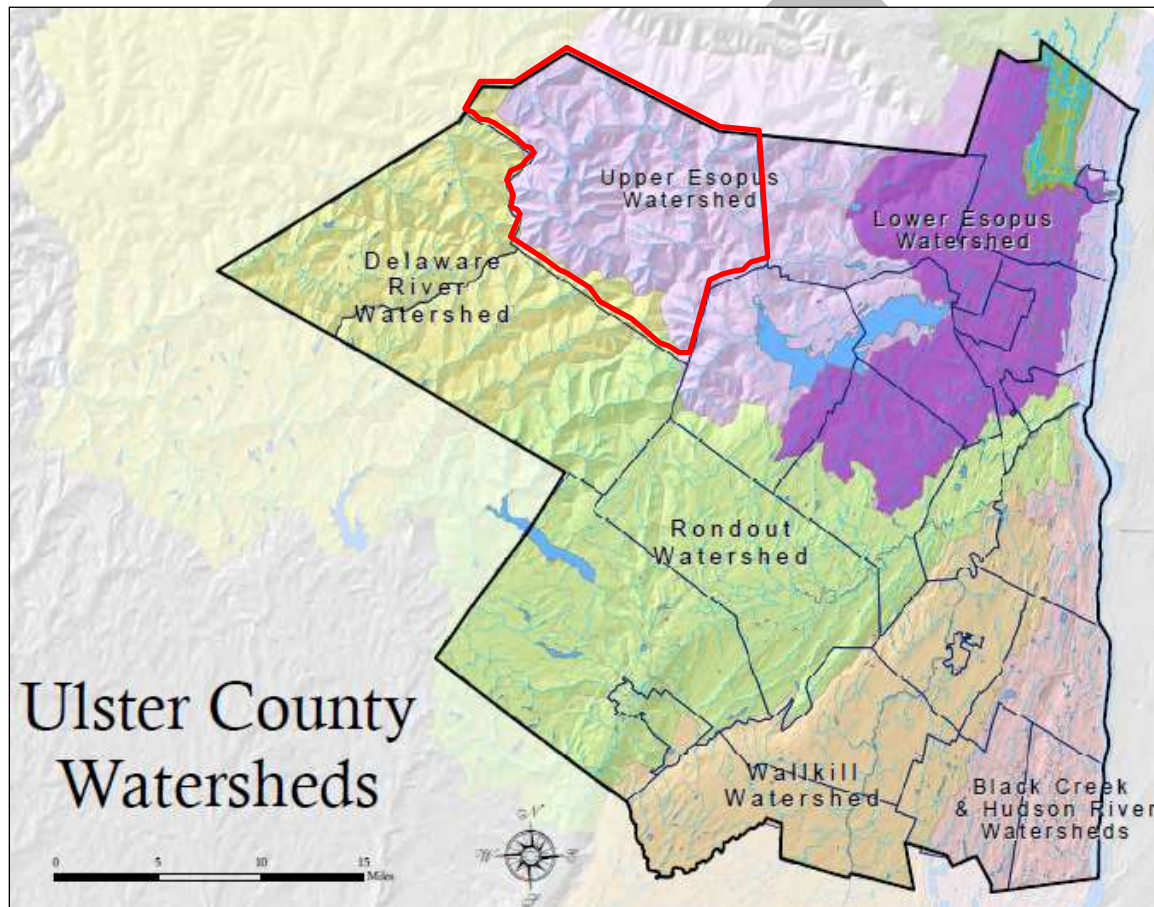


Hydrography and Hydrology

A watershed is the land area that drains water into a particular waterbody, such as a stream or wetland. All land and water areas are part of a watershed. The Town of Shandaken is located within the Upper Esopus and Delaware River Watersheds (Town of Shandaken, 2012; Ulster County, Date Unknown).

The Town of Shandaken is located within the 425-square mile Esopus Creek Watershed in the Catskill Mountains shown in Figure 3-3. The watershed is divided into two parts by the Ashokan Reservoir; the area above the dam is referred to as the Upper Esopus Watershed and the area below the dam is the Lower Esopus Watershed. The Town of Shandaken is located in the Upper Esopus Watershed.

Figure 3-3. Watersheds of Ulster County, New York

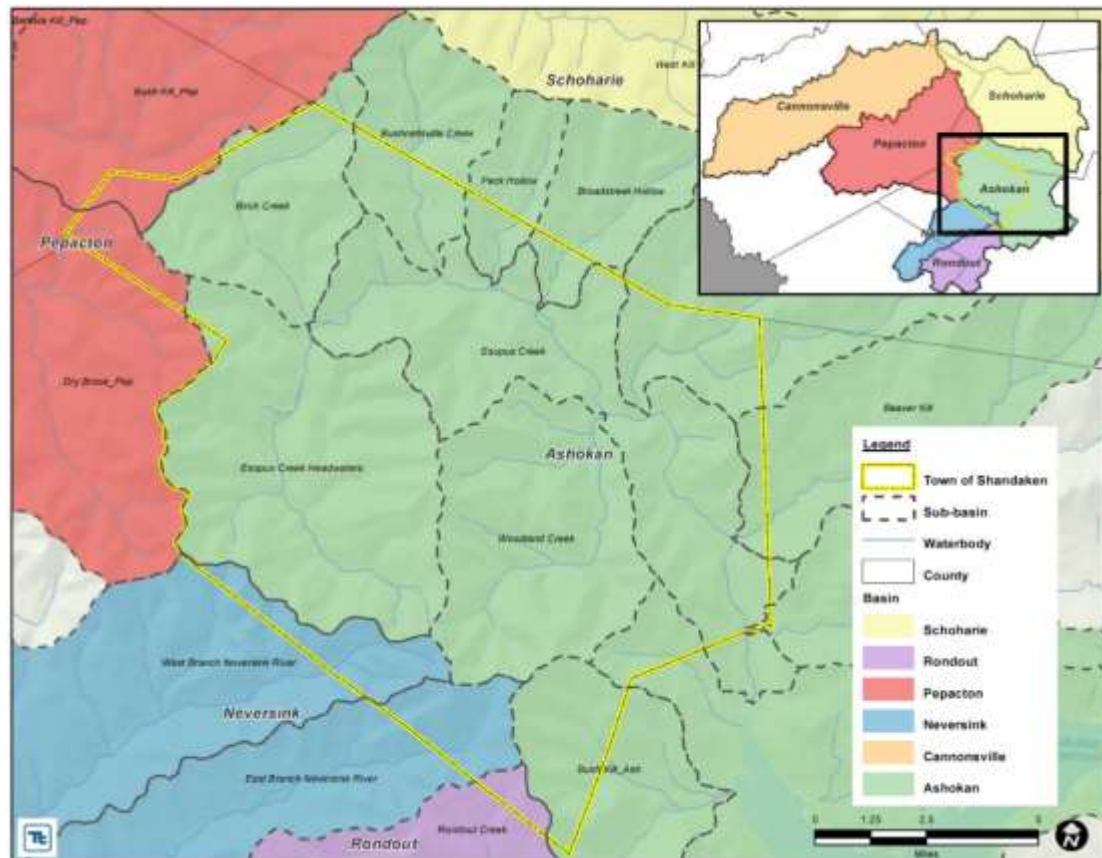


Source: Ulster County Environmental, Date Unknown (http://www.co.ulster.ny.us/environment/docs/county_watersheds.pdf)

Note: Red highlight added to outline the approximate boundary of the Town of Shandaken.

The Town of Shandaken is in the Ashokan, Neversink, Pepacton and Rondout basins shown in **Figure 3-4** (NYCDEP, 2012). The Town is within 17 sub-basins as detailed in **Table 3-1**.

Figure 3-4. Basins and Subbasins of the Town of Shandaken, New York



Source: NYCDEP, 2012

Table 3-1. Basins and Subbasins of the Town of Shandaken, New York

Basin	Sub-Basin
Ashokan	Bushnellsville Creek
	Birch Creek
	Peck Hollow
	Broadstreet Hollow
	Stony Clove Creek
	Beaver Kill
	Esopus Creek
	Esopus Creek Headwaters
	Woodland Creek
	Little Beaverkill
	Ashokan Reservoir
	Bushkill
Neversink	West Branch Neversink River
	East Branch Neversink River
Pepacton	Bush Kill
	Dry Brook
Rondout	Rondout Creek



The Upper Esopus Creek runs mostly through the Town of Shandaken and crosses the Town of Olive for approximately one mile before reaching the Ashokan Reservoir. The Upper Esopus Creek Watershed covers approximately 192 square miles in the south-central Catskill Mountain Region of southeast New York State.

The Esopus Creek Watershed is an important source of water for the City of New York. According to the Upper Esopus Creek Management Plan, the water supply of the Catskill District System is summarized as the following: ‘The Upper Esopus Creek is a regulated river by inter-basin transfer of water. The Shandaken Tunnel, and its outfall – often referred to as the “Portal,” is a handmade 18-mile aqueduct that connects the Schoharie Reservoir to the Upper Esopus. The Catskill District of New York City’s West-of-Hudson water supply system is one of three systems that supply water to New York City, and it includes the Schoharie Reservoir, Shandaken Tunnel, Ashokan Reservoir and the Catskill Aqueduct west of the Hudson River. Approximately 40% of the City’s average water supply demand is provided by the Catskill System. Figure 3-5 displays the water supply system of New York City and Figure 3-6 displays the water supply system from the Catskill District.

New York City must abide by two regulatory documents administered by the New York State Department of Environmental Conservation (DEC) when operating the Shandaken Tunnel: Title 6 NYCRR Part 670 “Reservoir Release Regulations: Schoharie Reservoir - Shandaken Tunnel – Esopus Creek” and a State Pollution Discharge Elimination System or “SPDES” permit. Together, these two regulations provide for flow, temperature, and turbidity thresholds to protect aquatic biota. Also, Part 670 allows up to four recreational releases for whitewater recreation to be granted per year by the NYSDEC (Cornell Cooperative Extension – Ulster County, 2007).

It is important to note that a separate “Catskill Turbidity Control Study” has been conducted in parallel with this effort. The recently concluded Phase II of that study has outlined structural and operational modification options for controlling turbidity releases from the Shandaken Tunnel that are currently being considered by Federal, State, and local authorities’ (Cornell Cooperative Extension, January 2007)

Figure 3-5. New York City's Water Supply System



Source: NYCEDP, 2007 (http://www.nyc.gov/html/dep/html/drinking_water/wsmaps_wide.shtml)

Figure 3-6. Catskill District Water Supply System



Source: Cornell Cooperative Extension – Ulster County, 2007

Note: Red circle indicates the approximate location of the Town of Shandaken.

Flow from the Upper Esopus Watershed has been regulated by the Ashokan Reservoir since 1913. Additional water enters the Esopus Creek through the Shandaken Tunnel, approximately 12 miles upstream of the Ashokan Reservoir (Lower Esopus Watershed Partnership, Date Unknown) (<http://www.loweresopus.org/watershed/overview/>).

Approximately 95% of the total Upper Esopus Watershed consists of forested land. Historical practices of logging and bark peeling activities have altered the stream flow. The watershed receives approximately 50 to 60 inches of precipitation each year (From Section 905(b) Reconnaissance Study – Esopus and Plattekill Creeks Watershed, Ulster and Greene Counties, New York (August 2008).

According to the Stony Clove Creek Stream Management Plan, the Stony Clove Creek watershed is also partially located in the Town of Shandaken. It is located in the central Catskill Mountain region of southeast New York State and drains an area of 32.3 square miles. The Stony Clove Creek flows from its headwaters at Notch Lake to its confluence with the Esopus Creek in the hamlet of Phoenicia. Approximately 80% of the watershed is in Greene County and the remainder of it is in Ulster County. The Stony Clove Creek watershed is bounded by some of the highest peaks in the Catskills, ranging in altitude from 2,220 to 4,040 feet (Greene County Soil and Water Conservation District, 2005).

Topography

Mountaintops and valleys wooded and steep hillsides, and natural communities of beech, maple, hemlock, ash, oak, and other northern hardwood and conifer forests, all makeup the landscape of the Town of Shandaken. There are few relatively flat plateaus in the town and many streams that feed the main watercourse, Esopus Creek. There are also expanses of relatively flat land and open fields along the Esopus Valley (Route 28 Corridor). Interspersed throughout the natural land features are the town's hamlets, developed over the years where the terrain was accessible and conducive, mainly in the valleys and along major streams, such as the Esopus Creek, Woodland Valley, Birch Creek, and the Stony Clove.

Many of the mountaintops in the Town of Shandaken are protected under the New York State Constitution Forest Preserve and are to be kept "Forever Wild". There are portions of several significant mountains in the town that are not included in the Forest Preserve and include Belleayre and Rose Mountain (Shandaken Comprehensive Plan, 2005; Town of Shandaken, 2012).

Climate

The climate of New York State is very similar to most of the Northeast U.S. and is classified as Humid Continental. Differences in latitude, character of topography, and proximity to large bodies of water all have an effect on the climate across New York State. Precipitation during the warm, growing season (April through September) is characterized by convective storms that generally form in advance of an eastward moving cold front or during periods of local atmospheric instability. Occasionally, tropical cyclones will move up from southern coastal areas and produce large quantities of rain. Both types of storms typically are characterized by relatively short periods of intense precipitation that produce large amounts of surface runoff and little recharge (Cornell, Date Unknown).

The cool season (October through March) is characterized by large, low-pressure systems that move northeastward along the Atlantic coast or the western side of the Appalachian Mountains. Storms that form in these systems are characterized by long periods of steady precipitation in the form of rain, snow, or ice, and tend to produce less surface runoff and more recharge than the summer storms because they have a longer duration and occasionally result in snowmelt (Cornell, Date Unknown).

The climate of the Town of Shandaken features substantial precipitation, with cold, snowy winters and short, cool summers. The annual precipitation averages 46 inches in the valleys and up to 60 inches in the mountains, and is evenly distributed throughout the year (FEMA FIS, 1989). Mean annual precipitation in the Upper Esopus watershed ranges from approximately 52 inches at Ashokan Reservoir and approximately 63.5 inches at Slide Mountain (Cornell Cooperative Extension – Ulster County, 2007). The average annual high temperature is approximately 57°F and average annual low temperature is approximately 35°F, with a minimum temperature in January averaging 11°F and a maximum July temperature averaging 81°F (The Weather Channel, 2012).

Land Use and Land Cover

The land use pattern of the Town of Shandaken has been influenced by the historic pattern of hamlet development, highway-oriented transportation, and state land ownership. Roadside development includes older dwellings and tourist-oriented businesses. Areas of resource-related industries, such as sawmills and bluestone, still exist but are not considered an economic factor that they were a century ago. Other factors such as floodplains, environmental legislations, and land acquisitions by the NYCDEP, in addition to the scenic natural terrain characteristics, have affected and limited land use and development. As per the 2005 Comprehensive Plan for the Town of Shandaken, 94% of the Town is developed, has significant development limitations or is highly regulated. The Town is comprised of approximately 79,200 acres with 66% of its land under public ownership and designated as public open space; 14% is residential land use; 9% private open space; 7% vacant land; and 4% miscellaneous (Shandaken Comprehensive Plan, 2005).

Between the last plan and this update, there has been little change in land use and land cover. Comparing the USGS National Land Cover Databases (NLCD) from 2006 and 2011 show a minor change in developed and forested land. There was a 4.6-percent decrease in farmland since the last plan, as well as a 74.3-percent decrease in barren land; there was a small area of barren land in the 2006 NLCD, so the change did not have as great of an impacted extent as the percent change shows. There was an increase of 12.5-percent in wetlands. Comparing the changes in area between both datasets, it is possible that much of the reduced barren land was recategorized as wetlands in the updated dataset. Figure 3-7 illustrates land use throughout the Town of Shandaken. Table 3-2 below shows the land use categories and their total square miles and percentages in the town.

Figure 3-7 Town of Shandaken Land Use



Source: USGS, 2011 (2011 National Land Cover Database)

**Table 3-2. Land Use (2011) in the Town of Shandaken**

Land Use	Total Area (sq. mi.)	Percent of Town (%)
Open Water	0.1	0.11
Developed	2.9	2.32
Barren	<1	0.01
Forested	118.7	96.31
Farmland	0.4	0.32
Wetlands	1.3	0.93
Total	123.3	100

Source: USGS, 2011 (2011 National Land Cover Database)

Note: sq. mi. = square miles

3.2 POPULATION AND DEMOGRAPHICS

According to the 2010 U.S. Census, the Town of Shandaken had a population of 3,085 people, which is the default demographic data in HAZUS-MH v4.2. Table 3-3 and Table 3-4 present the population statistics for the Town of Shandaken based on the 2010 U.S. Census data and 2013-2017 American Community Survey 5-year Estimates. Figure 3-8 shows the distribution of the general population density (persons per square mile) by Census block. For the purposes of this plan, U.S. Census 2010 data was used for the exposure and HAZUS-MH v4.2 analyses conducted for this plan.

The Disaster Mitigation Act of 2000 (DMA 2000) requires that hazard mitigation plans (HMPs) consider socially vulnerable populations. These populations can be more susceptible to hazard events, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. For the purposes of this study, vulnerable populations shall include (1) the elderly (persons aged 65 and over) and (2) those living in low-income households.

Table 3-3. Town of Shandaken Population Statistics (2010 U.S. Census)

Total	Pop. 65+	% Pop. 65+	Population Under 5	% Under 5	Low-Income Pop. *	% Low-Income Pop.
3,085	608	19.7%	110	3.6%	786	25.5%

Source: Census 2010 (U.S. Census Bureau); HAZUS-MH v4.2

Note: Pop. = population

*Individuals below poverty level - Census poverty threshold for a 3-person family unit is approximately \$19,730. Low-income population calculated by summing household income less than \$20,000 from HAZUS-MH v4.2 and multiplying by 2.32 (Broome County Average Household Size) to get a population count.

Table 3-4. Town of Shandaken Population Statistics (2013-2017 American Community Survey)

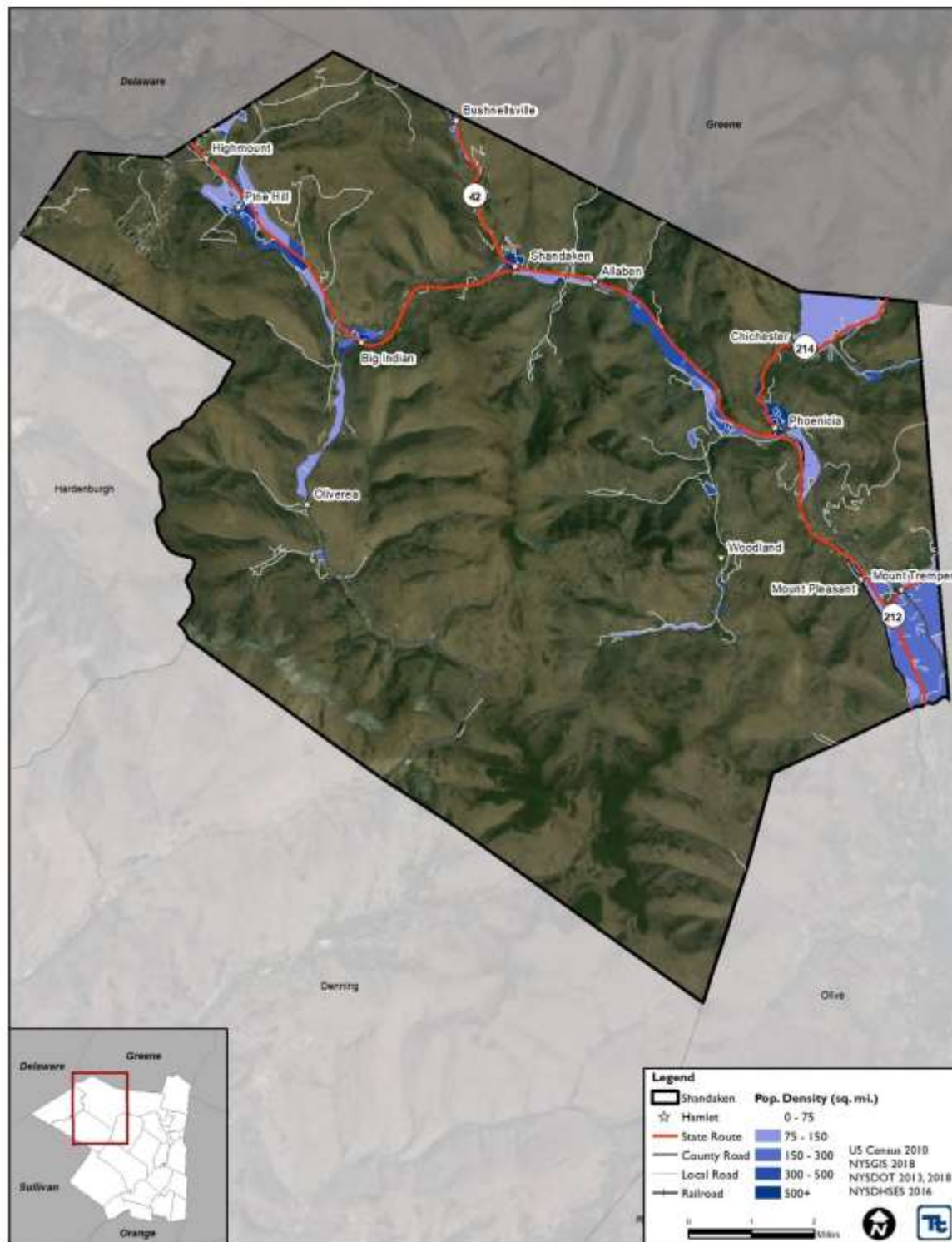
Total*	Pop. 65+*	% Pop. 65+	Population Under 5	% Under 5	Population Below the Poverty Level*	% Below Poverty Level*
2,847	859	30.1%	42	1.5%	407	14.3%

Source: 2013-2017 American Community Survey 5-year Estimates (U.S. Census Bureau)

Note: Pop. = population

* % Below Poverty Level = Percentage of Families and People Whose Income in The Past 12 Months Is Below the Poverty Level; population counts were calculated by multiplying the % Below Poverty Level by the municipal population estimate.

Figure 3-8. Distribution of General Population for the Town of Shandaken, New York



Source: U.S. Census, 2010

Table 3-5 presents a summary of the 2010 U.S. Census general population statistics for the Town of Shandaken by zip code. Census blocks do not follow the boundaries of each zip code. The Census blocks with their centroid in the zip code boundary was used to calculate the population within the zip code. Figure 3-9 displays

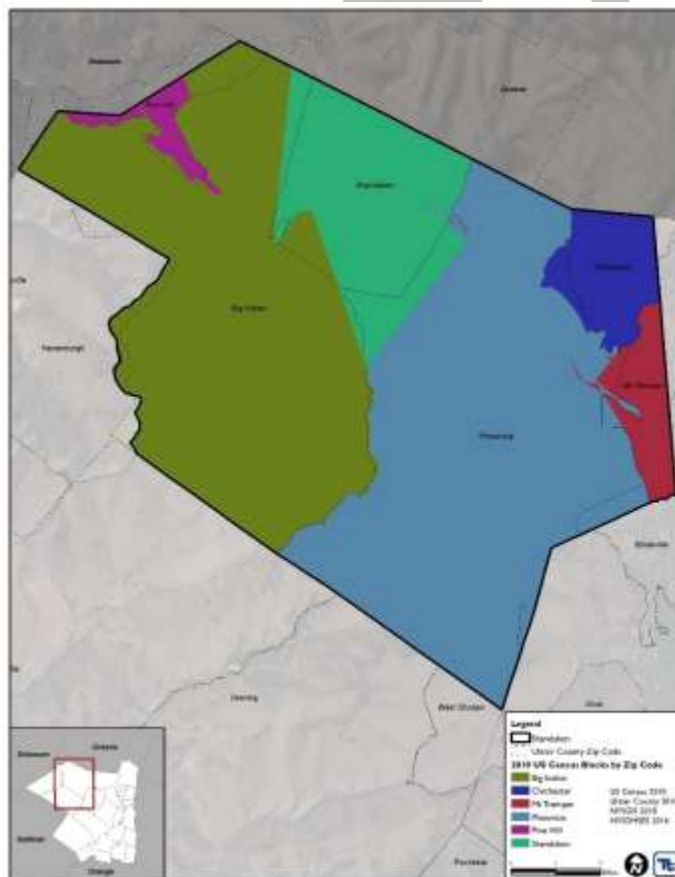
the Census blocks relative to the zip code boundaries used for this Plan. It is noted that the Census Block 361119553001065, located in the Town of Shandaken, has two zip codes: Phoenicia and Boiceville. For the purposes of this analysis, the entire block is considered within the Phoenicia zip code and is reported as such in this Plan. Further, the zip codes may not accurately portray the hamlet boundaries or demographic statistics.

Table 3-5. Town of Shandaken Population Statistics by Zip Code (2010 U.S. Census)

Zip Code	Total Population (U.S. Census 2010)	Percent Population
Big Indian	434	14.1
Chichester	345	11.2
Mt Tremper	478	15.5
Phoenicia	1,021	33.1
Pine Hill	265	8.6
Shandaken	542	17.6
Total – Town of Shandaken	3,085	100

Source: Census 2010 (U.S. Census Bureau); HAZUS-MH v4.2

Figure 3-9. U.S. Census 2010 Blocks by Zip Code for Plan Analysis



Source: U.S. Census 2010; Ulster County GIS

The 2010 U.S. Census data also identified 330 of the 1,520 households as having an annual income of less than \$15,000. The 2013-2017 U.S. Census data indicates that 14.3 percent of persons living in Shandaken have an annual below \$25,000. Figure 3-10 shows the distribution of persons over age 65 in the Town, while Figure 3-11 shows the distribution of low-income persons. Viewing exposure distribution maps can assist communities

in visualizing areas of high exposure and in evaluating aspects of the study area in relation to the specific hazard risks.

Race, Ethnicity, and Language

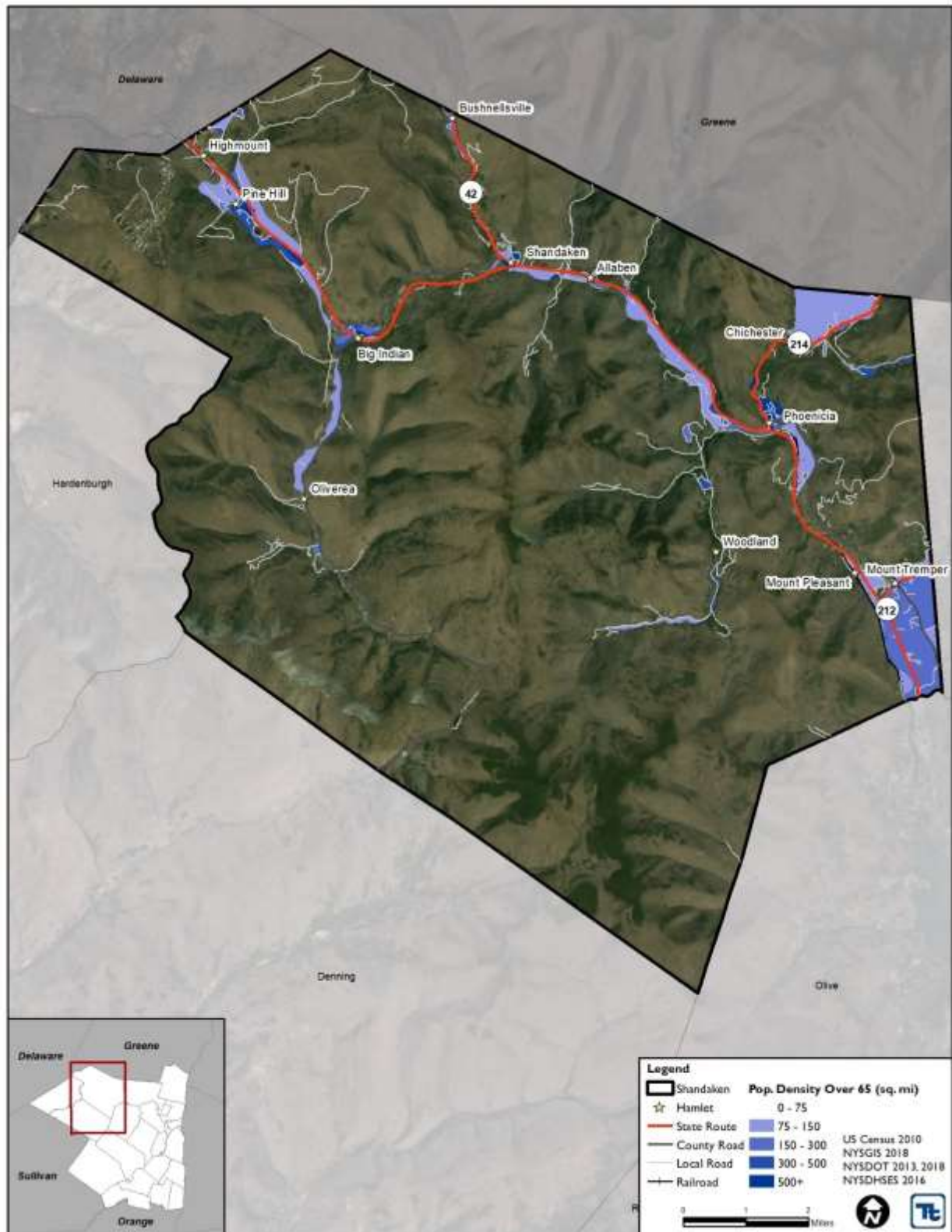
Research shows that minorities are less likely to be involved in pre-disaster planning and experience higher mortality rates during a disaster event. Post-disaster recovery can be ineffective and is often characterized by cultural insensitivity. Since higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability. According to the 2017 U.S. Census Bureau's American Community Survey, the racial composition of the planning area is predominantly white, at 92.9 percent. The second largest demographic group within the town is "Some Other Race" at 6.6 percent. (U.S. Census, 2017)

The planning area has a 5.5-percent foreign-born population. Other than English, the most commonly spoken languages in the planning area is Spanish at 5.1 percent. The census estimates that 2.6 percent of the residents 5 years of age and over speak English "less than very well." (U.S. Census, 2017).

Disabled Populations

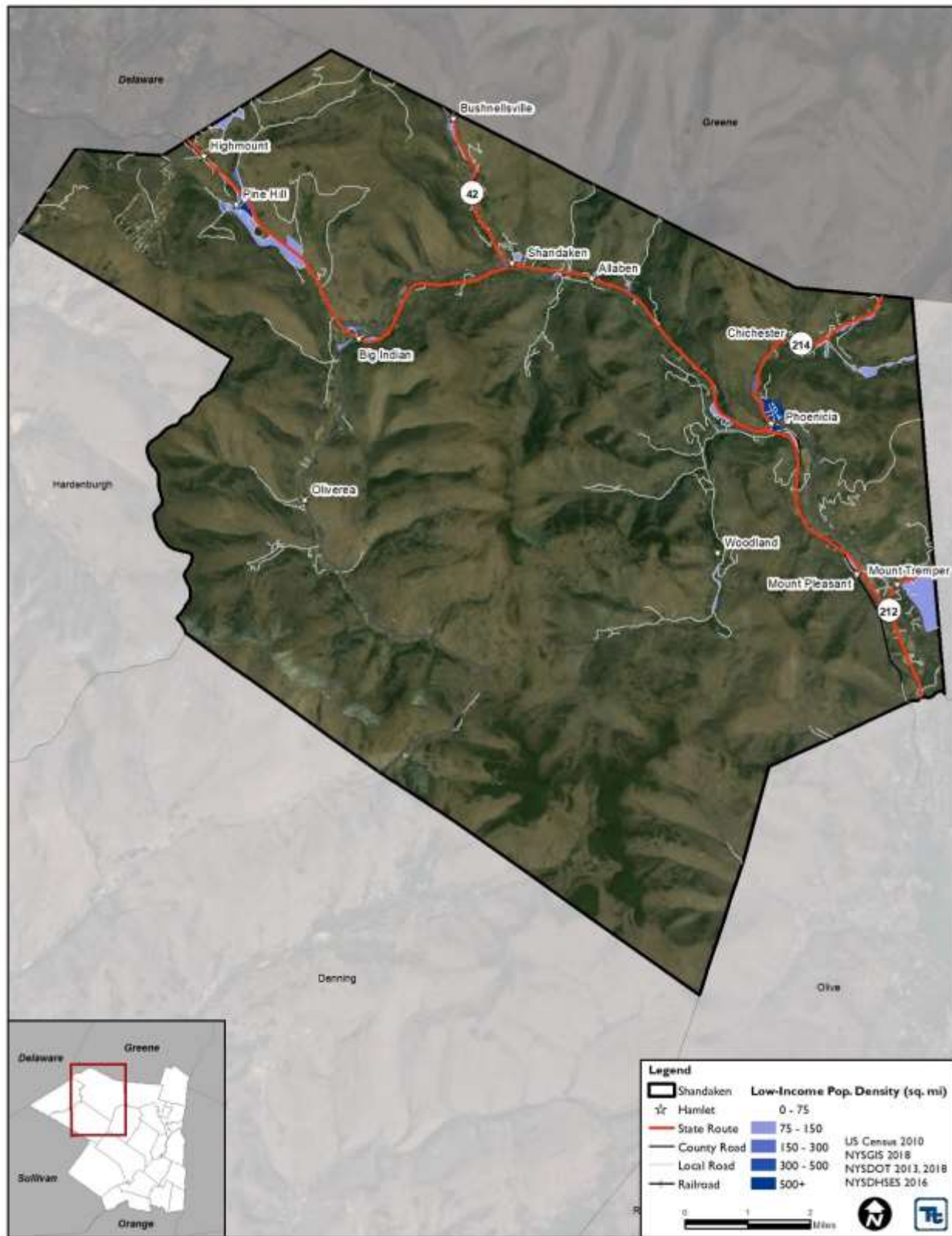
The 2013-2017 American Community Survey 5-Year Estimate states that approximately 592 (20.8 percent) individuals within the Town of Shandaken are living with a disability. People with disabilities are more likely to have difficulty responding to a hazard event than the general population. Local government is the first level of response to assist these individuals, and coordination of efforts to meet their access and functional needs is paramount to life safety efforts. It is important for emergency managers to distinguish between functional and medical needs in order to plan for incidents that require evacuation and sheltering. Knowing the percentage of population with a disability will allow emergency management personnel and first responders to have personnel available who can provide services needed by those with access and functional needs.

Figure 3-10. Distribution of Persons over the Age of 65 in the Town of Shandaken, New York



Source: HAZUS-MH v4.2 (U.S. Census 2010)

Figure 3-11. Distribution of Low-Income Population in the Town of Shandaken, New York



Source: HAZUS-MH v4.2 (U.S. Census 2010)

3.3 ECONOMY

Income

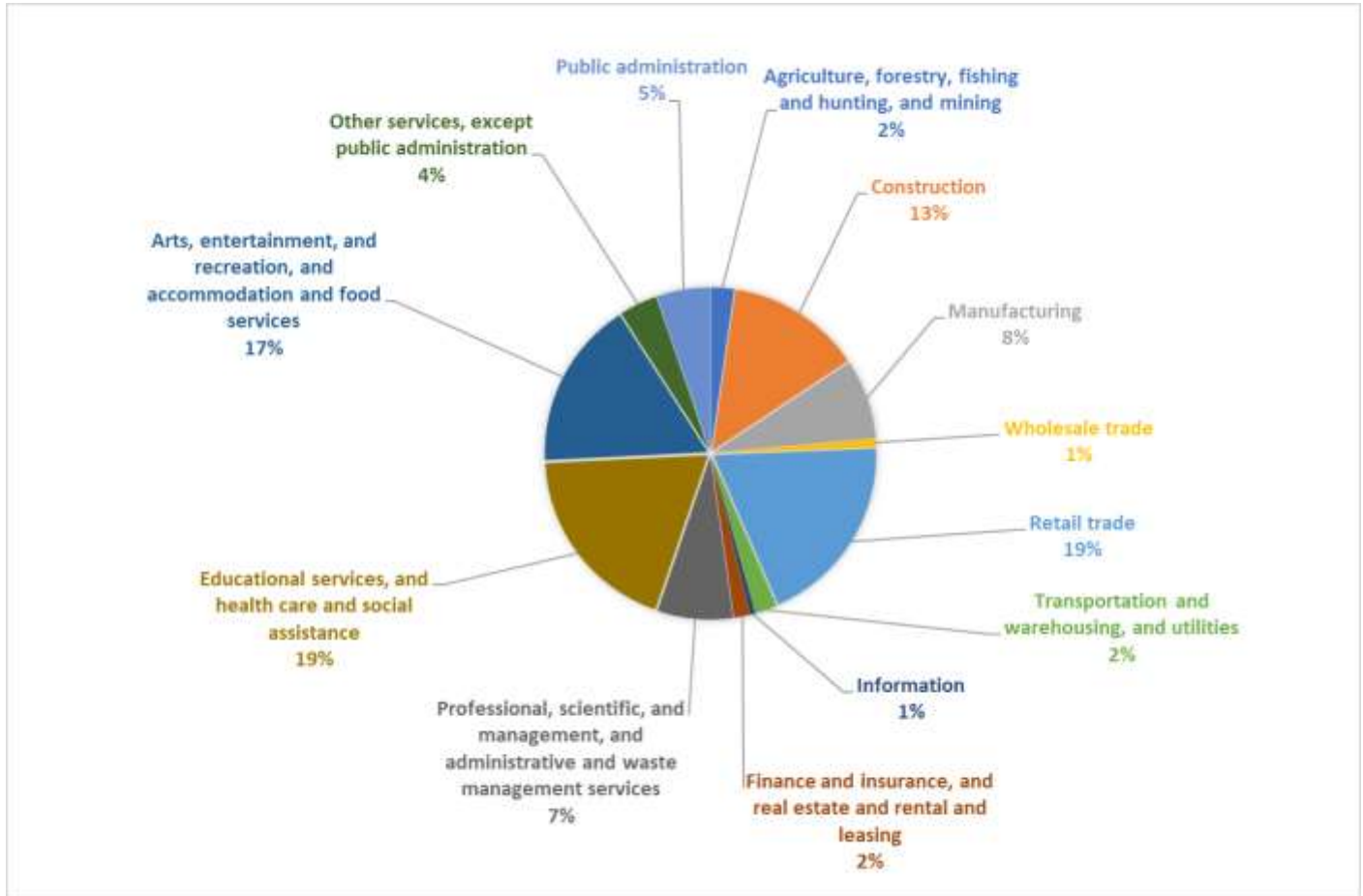
In the United States, individual households are expected to use private resources to prepare for, respond to and recover from disasters to some extent. This means that households living in poverty are disadvantaged when confronting hazards such as flooding. Additionally, the poor typically occupy more poorly built and inadequately maintained housing. Mobile or modular homes, for examples, are more susceptible to damage in floods than other types of housing. Furthermore, residents below the poverty level are less likely to have insurance to compensate for losses incurred from natural disasters. This means that residents below the poverty level have a great deal to lose during an event and are the least prepared to deal with potential losses. The events following Hurricane Katrina in 2005 illustrated that personal household economics significantly impact people's decision on whether to evacuate. Individuals who cannot afford gas for their cars will likely decide not to evacuate.

Based on the most recent 5-year estimates (2013-2017) from the U.S. Census Bureau American Community Survey, per capita income in the Town of Shandaken is \$32, 211 and the median household income is \$37,170. It is estimated that about 7.3 percent of households receive an income of \$100,000 and \$149,999 and 4.1 percent of household incomes are above \$150,000 annually. The Census Bureau estimates that 14.3 percent of the population in the planning area lives below the poverty level (U.S. Census Bureau, 2017).

Industry, Businesses and Institutions

The economy for the Town of Shandaken has three primary industries driving its economy: retail trade (19 percent); educational services, and health care and social assistance (19 percent); and arts, entertainment, and recreation, and accommodation and food services (17 percent). Information (2 percent); wholesale trade (2 percent); finance and insurance, and real estate and rental and leasing (2 percent); and agriculture, forestry, fishing and hunting, and mining (2 percent) make up the smallest source of the local economy. Figure 3-12 shows the breakdown of industry types in the Town of Shandaken (U.S. Census Bureau, 2017).

Figure 3-12. Industry within the Town of Shandaken



Source: 2013-2017 American Community Survey 5-Year Estimates

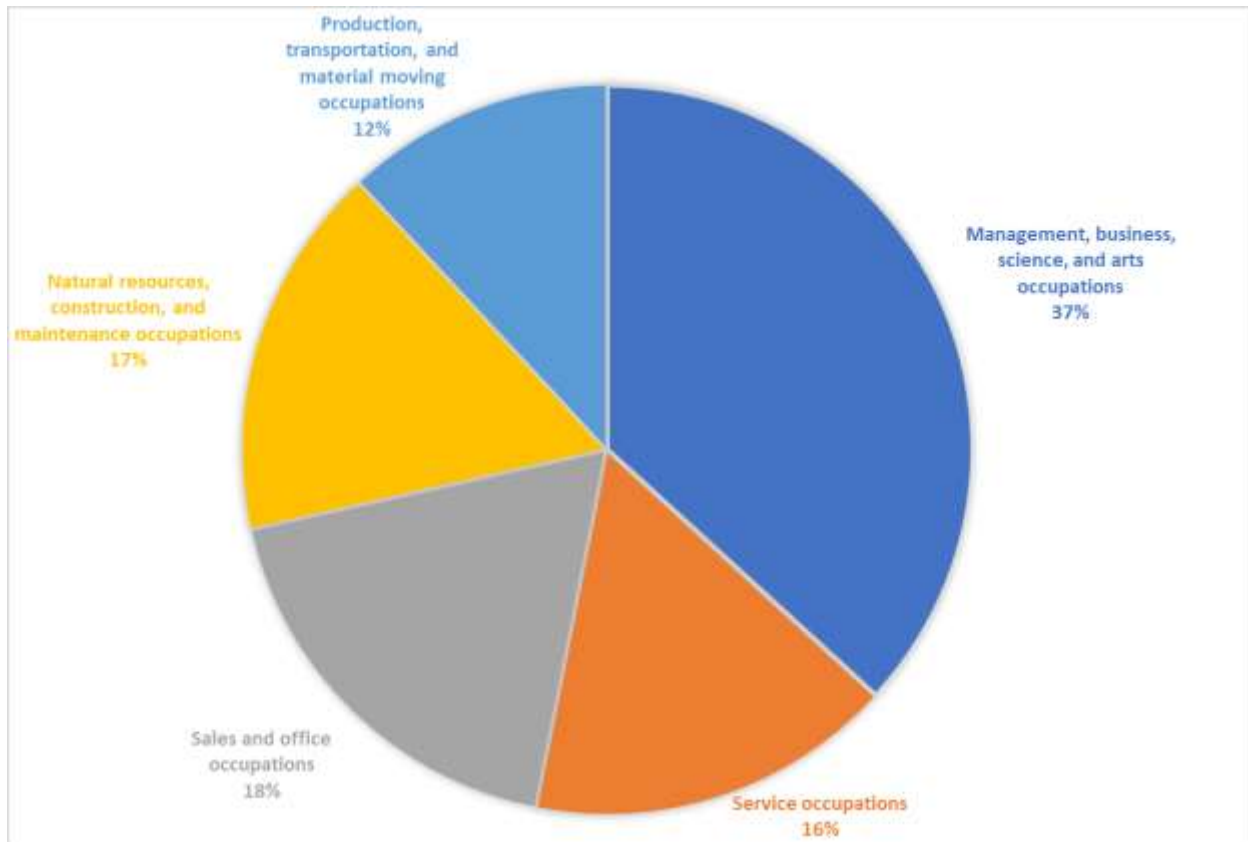
Employment Trends and Occupations

According to the 2013-2017 American Community Survey, 48.9% of the Town of Shandaken's population 16 years or older is in the labor force.

Figure 3-13 shows U.S. Census estimates of employment distribution by occupation category (U.S. Census Bureau, 2017). Management, business, science and arts occupations make up 37 percent of the jobs in the planning area. Sales and office occupations make up 18 percent.

The U.S. Census estimates that 70.6 percent of workers in the planning area commute alone (by car, truck or van) to work (U.S. Census, 2017).

Figure 3-13. Occupations within the Town of Shandaken



Source: 2013-2017 American Community Survey 5-Year Estimates

3.4 GENERAL BUILDING STOCK

The 2010 U.S. Census data identifies 1,520 households in the Town of Shandaken. The U.S. Census data identified 2,776 housing units in the Town of Shandaken in 2010, with 1,505 of those being occupied housing units and 1,271 being vacant housing units. The median price of a single-family home in the Town of Shandaken was estimated at \$218,800 in 2010 (U.S. Census, 2010).

The HAZUS-MH v4.2 default building inventory was updated and replaced at the structure level for the Town of Shandaken. A custom-building inventory was developed using detailed structure-specific assessor data, as well as parcel and building footprint spatial layers. Ulster County provided 2018 Real Property System (RPS) tax assessor data and the most current parcel spatial layer. Attributes including basement type, construction type, number of stories, and year built were extracted from the RPS data and used to generate the building inventory, which could be imported into HAZUS-MH v4.2. Additional attributes, including coordinates and square footage, were obtained using the nationwide building footprint spatial layer released by Microsoft in 2018. Structural and content replacement cost values were calculated for each building utilizing available assessor data and RSMeans 2018 values.

The building inventory generated for the town contains 2,334 structures with a total building replacement value (structure and content) of \$1.2 billion. According to the building inventory developed for this plan, approximately 2,096 buildings (\$936 million) or approximately 89.8-percent of the total buildings are residential housing. More specifically, the 2010 Census data identify that more than 80% of housing units in the town are

single-family detached units. As **Figure 3-14** illustrates, the majority of the buildings are along the riverine reaches in the Town.

Figure 3-14. Distribution of Buildings in the Town of Shandaken

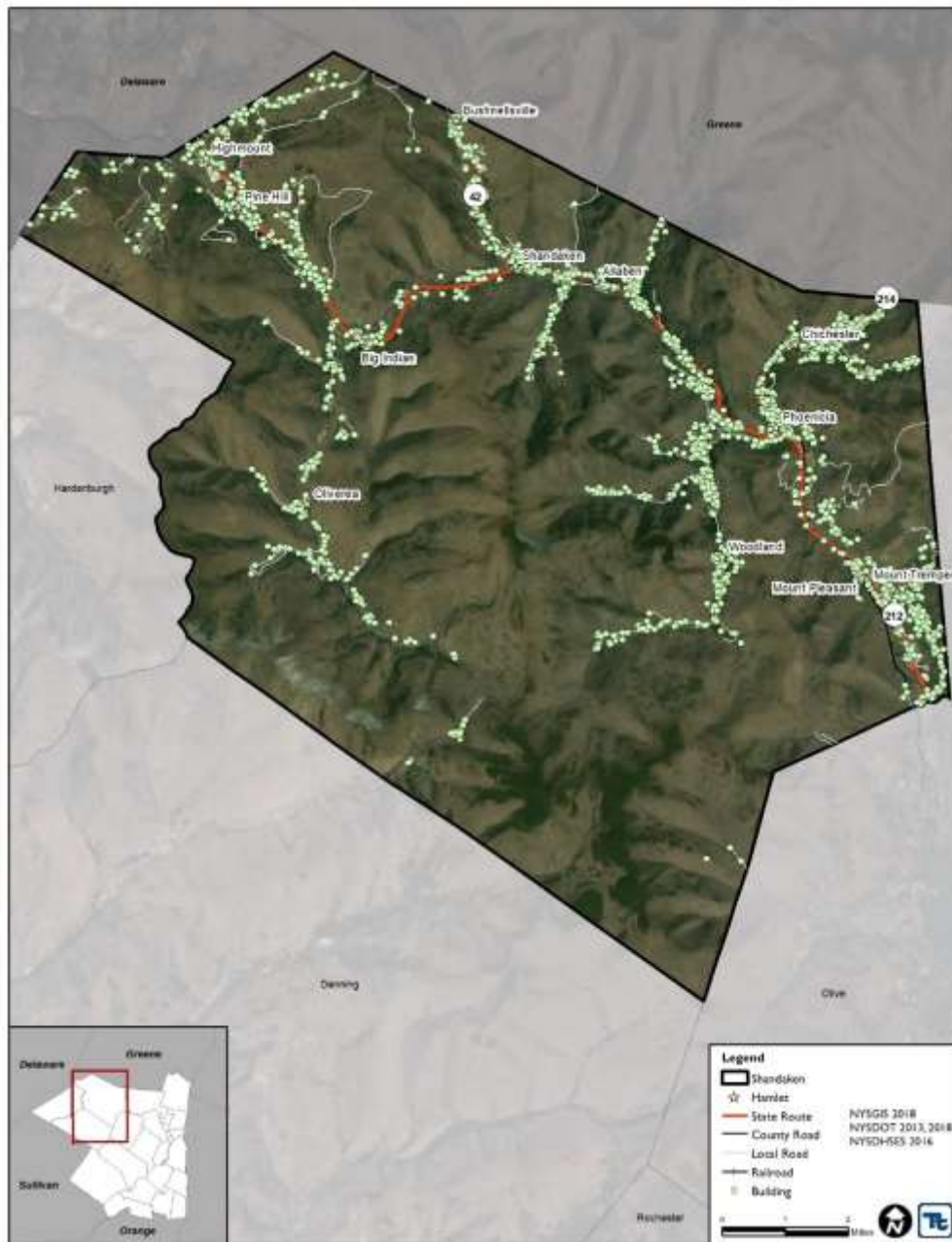


Table 3-6. Building Stock Count and Replacement Value by Occupancy Class

Zip Code	Total		Residential		Commercial		Government		Education, Industrial, Religious/Non-Profit	
	Count	Value	Count	Value	Count	Value	Count	Value	Count	Value
Big Indian	421	\$240,811,532	360	\$166,545,671	57	\$58,995,770	3	\$11,815,507	1	\$3,454,585
Chichester	188	\$80,078,629	185	\$78,396,703	1	\$569,273	1	\$701,628	1	\$411,025
Mt Tremper	274	\$155,607,209	257	\$130,586,434	4	\$4,055,035	4	\$10,535,118	9	\$10,430,622
Phoenicia	837	\$408,924,106	725	\$308,029,362	73	\$57,751,548	5	\$2,174,733	34	\$40,968,464
Pine Hill	242	\$128,728,079	228	\$110,463,822	9	\$8,718,392	2	\$6,092,170	3	\$3,453,694
Shandaken	372	\$179,957,600	341	\$142,238,731	24	\$25,656,763	4	\$8,656,217	3	\$3,405,889
Town of Shandaken	2,334	\$1,194,107,155	2,096	\$936,260,724	168	\$155,746,781	19	\$39,975,372	51	\$62,124,279

Source: Ulster County, 2018; Microsoft, 2018

3.5 LAND USE AND POPULATION TRENDS

Land use regulatory authority is vested in New York State's towns, villages, and cities. However, many development and preservation issues transcend location political boundaries. Land use trends significantly impact exposure and vulnerability to various hazards. For example, significant development in a hazard area increases the building stock and population exposed to that hazard.

This Plan provides a general overview of population and land use and types of development occurring within the study area. An understanding of these development trends can assist in planning for further development and ensuring that appropriate mitigation, planning, and preparedness measures are in place to protect human health and community infrastructure.

3.5.1 Land Use Trends

The following section presents an overview of the Town's land use trends.

3.5.2 Population Trends

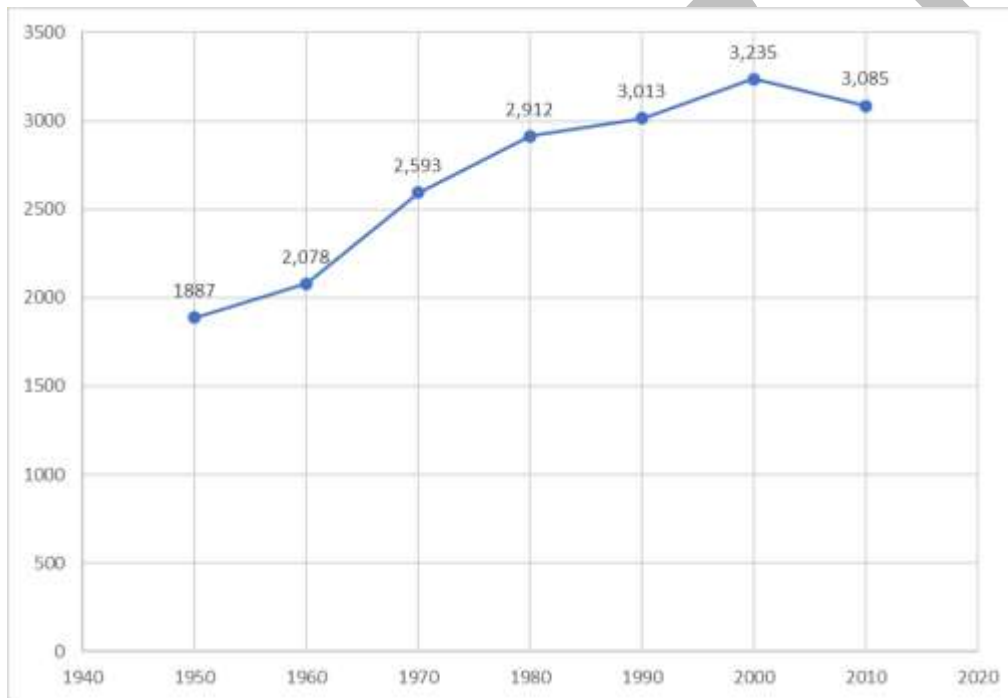
Table 3-7. Town of Shandaken Population Trends, 1950 to 2010

Year	Population	Change in Population	Percent (%) Population Change
1950	1887	-	-
1960	2,078	191	10.1
1970	2,593	515	24.8
1980	2,912	319	12.3
1990	3,013	101	3.5
2000	3,235	222	7.4
2010	3,085	-150	-4.6

Source: U.S. Census Bureau, 2012

Table 3-7 illustrates that the Town of Shandaken experienced 50 years of population growth between 1950 and 2000. The Town experienced population decline from 2000 to 2010 with a 4.6 percent decrease in population. The 2013-2017 American Community Survey 5-Year Estimate reports an estimated population of 2,847, which represents a population decrease of 7.7 percent.

Figure 3-15. Town of Shandaken Population Trendline



Source: U.S. Census Bureau, 1950-2010

3.5.3 Future Growth and Development

At present no areas are targeted for future growth and development. Growth is expected to be minimal due to the steep slope topography of available land parcels and the amount of state-owned land which prohibits development. Any areas of growth could be potentially impacted by the flood hazard if located within the identified hazard areas.

3.6 CRITICAL FACILITIES

A comprehensive inventory of critical facilities in the Town of Shandaken was developed from various sources including Ulster County GIS and input from the Planning Committee. The inventory of critical facilities presented in this section represents the current state of this effort at the time of publication and used for the risk assessment in Section 5.

Critical Facilities are those facilities considered critical to the health and welfare of the population and that are especially important following a hazard. As defined for this HMP, critical facilities include essential facilities, transportation systems, lifeline utility systems, high-potential loss facilities, and hazardous material facilities.

Essential facilities are a subset of critical facilities that include those facilities that are important to ensure a full recovery following the occurrence of a hazard event. For the County risk assessment, this category was defined to include police, fire, EMS, schools/colleges, shelters, senior facilities, and medical facilities.

3.6.1 Essential Facilities

This section provides information on emergency facilities, hospital and medical facilities, shelters, schools, and senior care and living facilities.

Emergency Facilities

For the purposes of this Plan, emergency facilities include emergency operation centers (EOCs), police, fire and emergency medical services (EMS). Table 3-8, Table 3-9, and Table 3-10, below provide an inventory of EOCs, police stations, fire stations and EMS facilities in the Town of Shandaken. Figure 3-16 displays the location of these facilities based on the HAZUS-MH inventory data, County GIS and input from the Planning Committee.

Table 3-8. Emergency Operation Centers in the Town of Shandaken

Name	Address	Zip Code	Building Type	Backup Power
Shandaken Town Hall	7209 Route 28	Shandaken	Wood	Yes (phone and lighting for 12 hours)
Phoenicia Fire House	9 Ava Maria Drive, Phoenicia	Phoenicia	Wood	Yes
Belleayre Mt Ski Center	State Highway to Belleayre	Big Indian	Wood	Yes

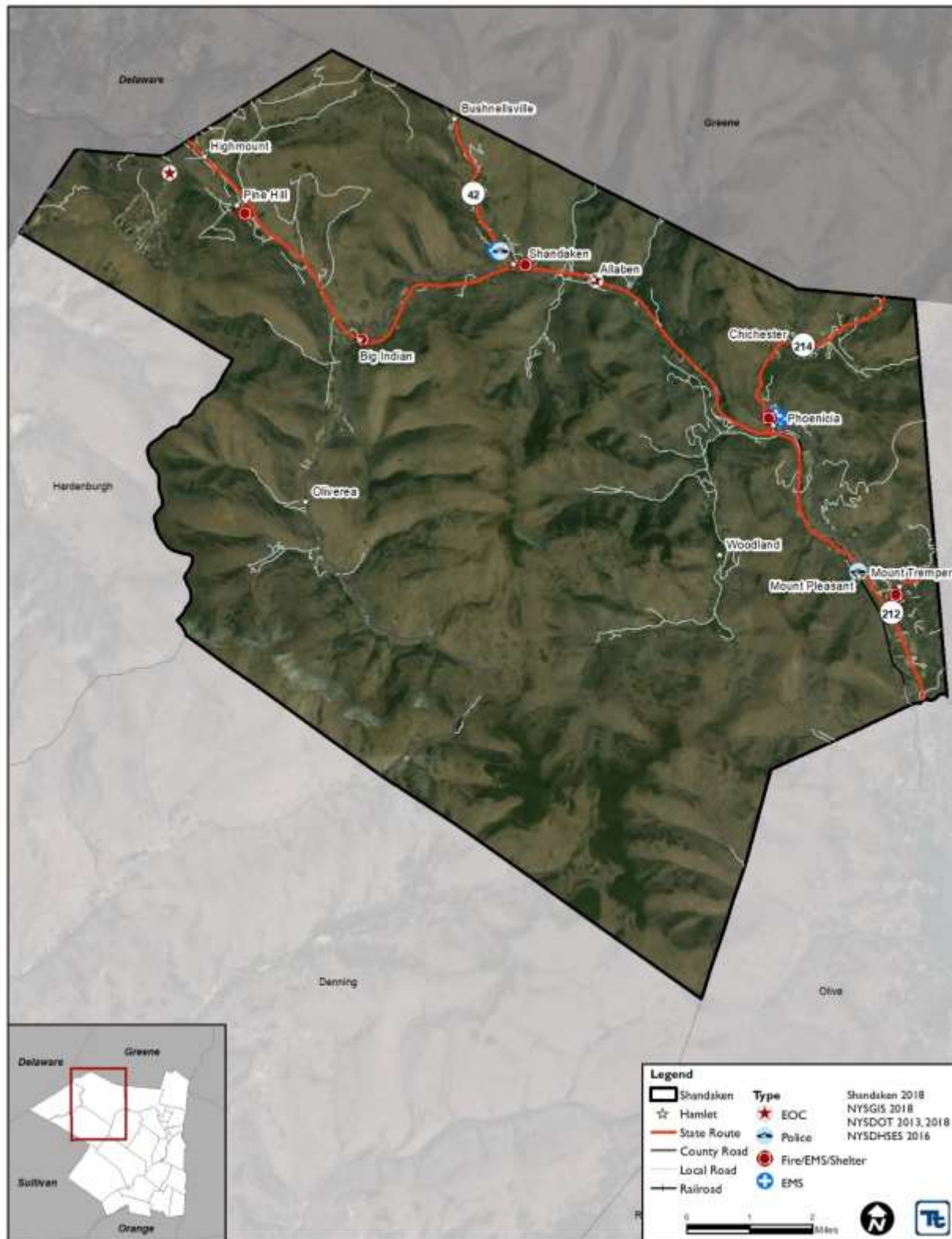
Table 3-9. Police Stations in the Town of Shandaken

Name	Address	Zip Code	Building Type	Backup Power
Shandaken	48 State Highway 42, Shandaken	Shandaken	Steel	TBD
Ulster County Sheriff Sub Station	146-152 Mt. Pleasant Rd., Mt. Tremper	Mt. Tremper	Wood	TBD

Table 3-10. Fire/EMS in the Town of Shandaken

Name	Address	Zip Code	Type	Building Type	Backup Power
Ambulance and EMS	Route 42	EMS	Shandaken	Steel	No (Portable Generator)
Big Indian Firehouse	8 Firehouse Road, Big Indian	Fire/EMS/Shelter	Big Indian	Masonry	Yes
Mount Tremper Firehouse	24 Ingersoll Road, Mt. Temper	Fire/EMS/Shelter	Mount Tremper	Wood	TBD
Olive	31 Church Street	EMS	Phoenicia	TBD	TBD
Paramedic Housing	9 Ava Maria Drive	EMS	Phoenicia	Wood	No
Phoenicia Firehouse	58 Route 214, Phoenicia	Fire/EMS/Shelter	Phoenicia	Concrete	Yes
Pine Hill Firehouse	265 Main Street, Pine Hill	Fire/EMS/Shelter	Pine Hill	Steel	Yes
Shandaken EMS	58 Route 214	EMS	Phoenicia	TBD	TBD
Shandaken Firehouse	7390 Route 28	Fire/EMS/Shelter	Shandaken	Wood	No (Portable Generator)

Figure 3-16. Emergency Facilities in the Town of Shandaken



Hospitals and Medical Centers

There are no hospitals located within the Town of Shandaken. The closest hospitals include the Margaretville Memorial Hospital located in the Village of Margaretville in Delaware County, New York and Kingston Hospital in Kingston, New York.

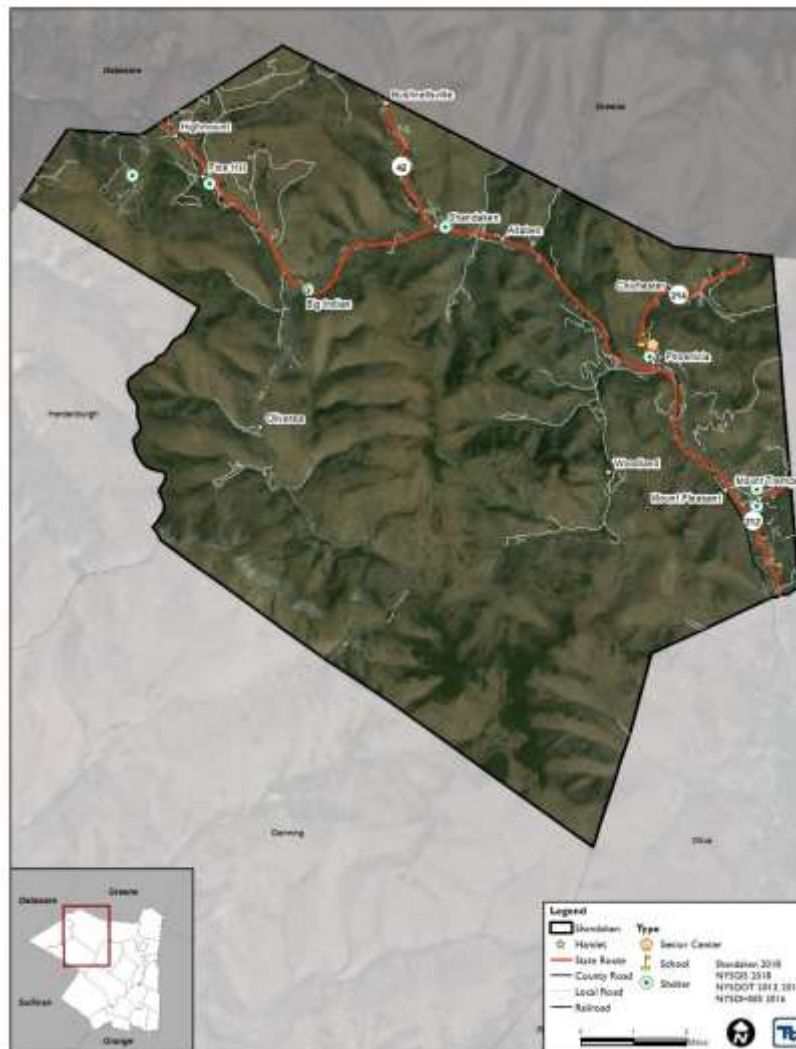
Schools

Table 3-11 lists all schools and other education facilities in the town. Figure 3-17 displays the locations of these schools within the Town of Shandaken.

Table 3-11. Education Facilities in the Town of Shandaken

Name	Address	Zip Code	Enroll.	Designated Shelter /Shelter Capacity	Building Type	Backup Power
Phoenicia Elementary	School Lane	Phoenicia	TBD	TBD	Masonry	Yes

Figure 3-17. Schools, Shelters and Senior Centers in the Town of Shandaken



Shelters

Table 3-12 provides an inventory of the shelters in the Town of Shandaken.

Table 3-12. Shelter Facilities in the Town of Shandaken

Name	Zip Code	Capacity	Building Type	Backup Power
Belleayre Ski	Big Indian	TBD	Wood/Concrete	Yes
Town Hall	Shandaken	TBD	Wood/Concrete	TBD
Zen Monastery	Mt. Tremper	TBD	Masonry	Yes
Mount Tremper Firehouse	Mt. Tremper	TBD	Wood/Concrete	TBD
Pine Hill Firehouse	Pine Hill	TBD	TBD	TBD
Big Indian Firehouse	Big Indian	TBD	Wood/Concrete	TBD
Shandaken Firehouse	Shandaken	TBD	Wood/Concrete	TBD
Phoenicia Firehouse	Phoenicia	TBD	Wood/Concrete	TBD

Senior Care and Senior Living Facilities

Table 3-13 provides an inventory of senior facilities in the Town.

Table 3-13. Senior Facilities in the Town of Shandaken

Name	Address	Zip Code	Building Type	Backup Power
Senior Center	Ave Maria Drive	Phoenicia	Masonry/Concrete	Yes

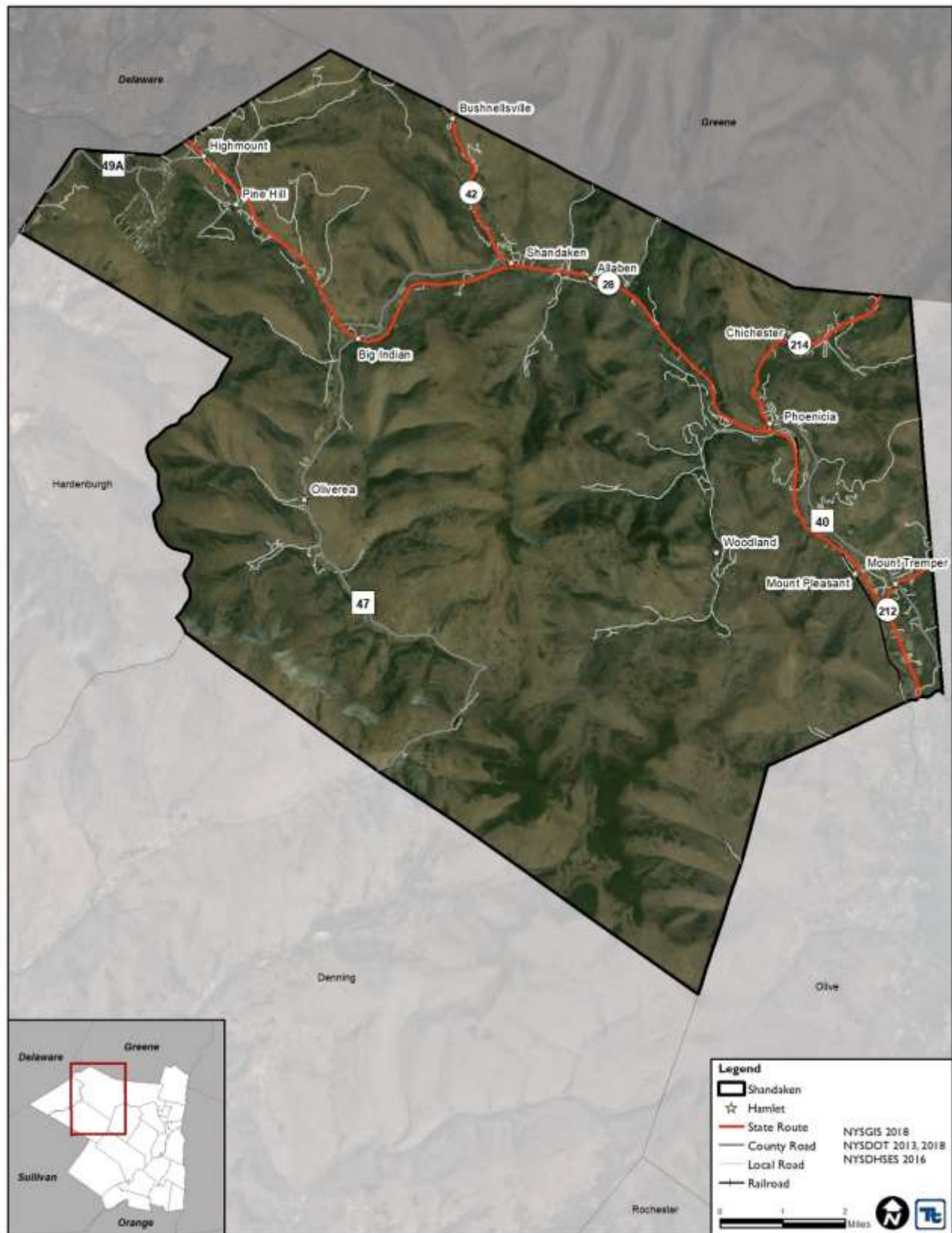
3.6.2 Transportation Systems

This section presents available inventory data for major transportation systems in the Town of Shandaken. There are no airports in the town.

Highway, Roadways and Associated Systems

The Catskill Mountain Railroad services the Town of Shandaken, through the hamlets of Pine Hill, Shandaken, Phoenicia, and Mount Tremper. Currently the railroad is inactive from the hamlet of Phoenicia west to the town line. State Route 28 enters the town from Delaware County and is the main highway that generally runs east to west across the town following sections of the Esopus Creek. County Route 47 runs north to south connecting the hamlets of Big Indian and Oliverea. Routes 42 and 214 connect the town with Greene County to the north. Figure 3-18 illustrates the major transportation systems in the town.

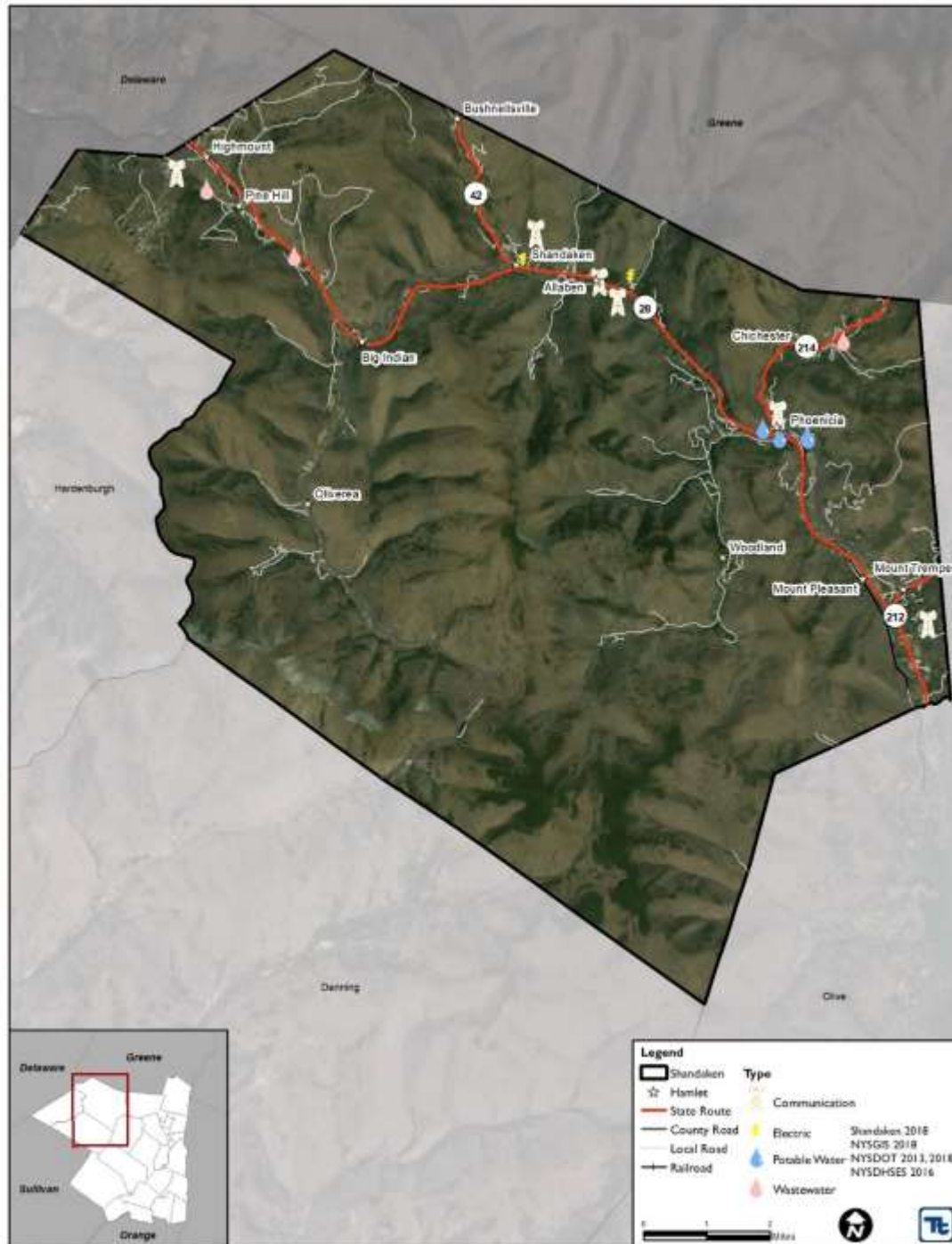
Figure 3-18. Transportation System in the Town of Shandaken



3.6.3 Lifeline Utility Systems

This section presents potable water, wastewater, and energy resource utility system data. Due to heightened security concerns, local utility lifeline data sufficient to complete the analysis have only partially been obtained. Utility data are included in HAZUS-MH v4.2 but are not sufficient to support detailed analyses for this town. Figure 3-19 illustrates the locations of the provided utilities in the Town of Shandaken.

Figure 3-19. Utilities in the Town of Shandaken



Potable Water Supply

The Phoenicia Water District supplies about 40,000 gallons of water per day to residents and businesses in the hamlet of Phoenicia. The water system consists of three water sources; a filtration plant; a storage tank and a water distribution system. Water from two surface water sources, an infiltration gallery and a spring supply, are treated at the water filtration plant. The third source (High Street Wells) consists of two drilled wells that convey water directly into the water distribution system. The Phoenicia treatment building has a back-up generator.

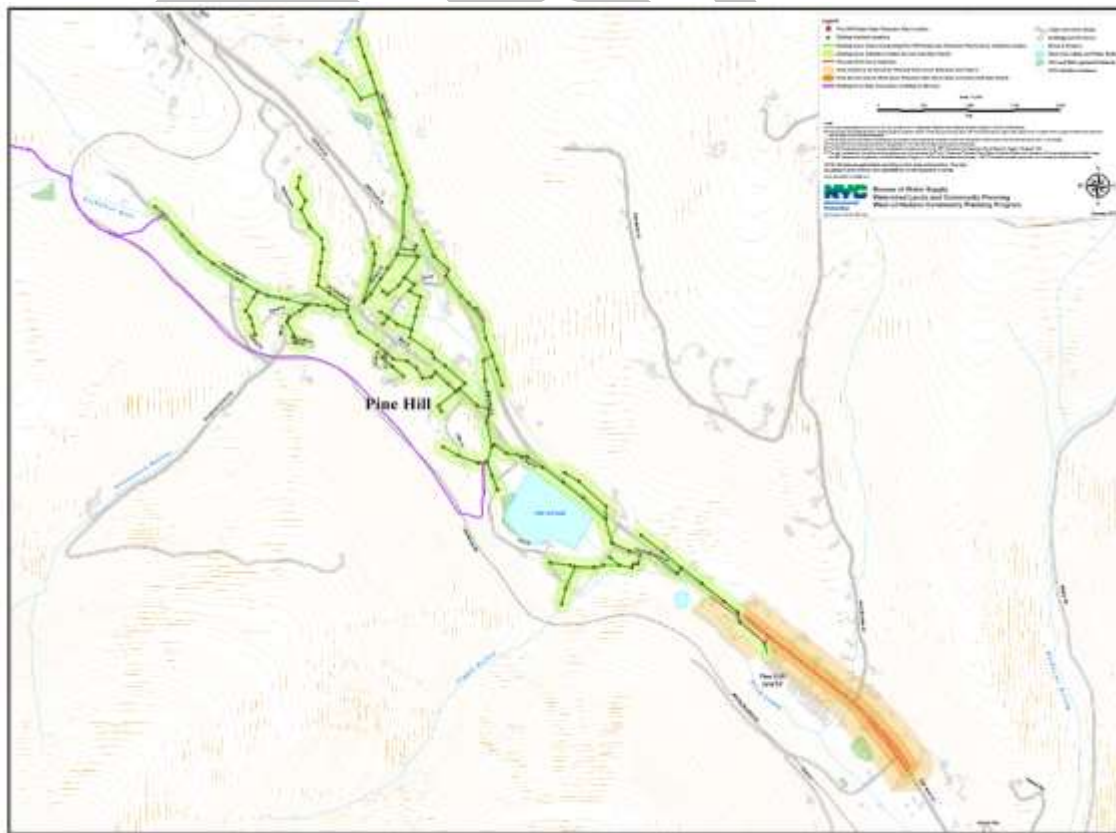
The Pine Hill Water District supplies an average of about 15,000 gallons per day to its largely residential users. The system includes the water supply, storage reservoir, treatment building and distribution system. The water supply consists of several springs and a backup well.

Municipal and public non-municipal wells and water towers are present in the Town of Shandaken. Facilities in the town include the Phoenicia Water District Main Filtration Plant and the Pine Hill Water District Treatment building. In addition, there is a water tower and a pump house located in the town.

Wastewater Facilities

NYC DEP owns and operates two wastewater systems in the town, a wastewater treatment facility on State Route 28 that serves the hamlet of Pine Hill, and a community septic system in the hamlet of Chichester that treats about 13,000 gpd. Figure 3-20 below displays the Pine Hill Water Treatment Plant's sewer collection system service area.

Figure 3-20. Pine Hill Wastewater Treatment Plant's Sewer Collection System Service Area in the Town of Shandaken



Source: Appendix A of the Town of Shandaken's Sewer Use Law

Communication Resources

Table 3-14 lists the communication facilities (facilities, radio stations, radio towers) located in the Town of Shandaken.

Table 3-14. Communication Facilities in the Town of Shandaken

Name	Zip Code	Building Type	Backup Power
Town Hall / TV	Shandaken	Wood	TBD
Town Highway Garage/Radio	Shandaken	Steel	TBD
Verizon	Mt. Tremper	Concrete	TBD
Verizon	Phoenicia	TBD	TBD
Cell Tower	Shandaken	NA	TBD
Cell Tower	Shandaken	NA	TBD
Municipal/Communication	Shandaken	TBD	TBD

NA = Not applicable

3.6.4 High-Potential Loss Facilities

High-potential loss facilities include dams, levees, nuclear power plants, military installations and hazardous materials (HAZMAT) facilities. No nuclear power plants, military installations or HAZMAT facilities were identified in the town. Dams and levees are discussed below.

Dams/Levees

Dams

The New York State Inventory of Dams, identifies 15 dams in Shandaken: 8 low hazard, 1 intermediate hazard, 0 high hazard, and 6 negligible or no hazard classification (NYS DEC 2018). Table 3-15 below provides the dam inventory for the Town of Shandaken.



Table 3-15. Dams in the Town of Shandaken

ID	Name	Owner	River	Nearest Place	Distance To City (miles)	Year Complete	Dam Length	Dam Height	E A P	NYSDEC Hazard
NY1 4622	(176-1000)	Not Found	BUSHNELLSVILLE CREEK		0	U	0	0	N	D
NY1 4623	(176-1006)	Not Found	BUSHNELLSVILLE CREEK		0	U	0	0	N	D
NY1 4624	(176-1010a)	Not Found	TR-BIRCH CREEK		0	U	0	0	N	D
NY1 2911	Camp Pond Dam	J EDWARDS	MUDDY BROOK	Phoenicia	1	1946	0	6	N	A
NY1 2912	Lilliput Camp Pond Dam	MURRAY SINGER	BIRCH CREEK	Pine Hill	1	1949	80	9	N	A
NY0 1586	Pine Hill Lake Dam	NYS Olympic Regional Development Authority, Belleayre Mountain Ski Center, NYS DEC DIVISION OF LANDS & FORESTS	BIRCH CREEK	Big Indian	2	1987	1257	28	O	B
NY1 2913	Shandaken Rod and Gun Club Dam	SHANDAKEN ROD AND GUN CLUB	WEST BRANCH NEVERSINK CREEK	Frost Valley	5	1965	640	15	N	A
NY1 2916	Snow Making Pond Dam	NYS Olympic Regional Development Authority, Belleayre Mountain Ski Center, NYS DEC DIVISION OF LANDS & FORESTS	CATHDRAL GLEN BROOK	Pine Hill	0	1975	325	36	N	A
NY1 6127	Chichester Dam	PAUL & HEIDI NUTE	TR-STONY CLOVE	Chichester	1	U	250	13	N	A
NY1 2908	Moonhaw Club Pond Dam	MOONHAW CLUB	WITTENBURG BROOK	West Shokan	2	1906	0	12	N	A
NY0 0952	Winnisook Lake Dam	WINNISOOK INC	ESOPUS CREEK	Oliverea	4	U	344	42	O	A
NY1 4620	(176-0960)	Not Found	ESOPUS CREEK		0	U	0	0	N	D
NY1 2909	Day Pond Dam	Tibet House USA	PANTHER KILL	Phoenicia	2	1930	50	6	N	A
NY1 4621	(176-0983)	Not Found	TR-CLOVE CREEK		0	U	0	0	N	D
NY1 6942	Belleayre Snowmaking Pond Dam	NYS DEC	Trib - Birch Creek	Pine Hill	1	U	0	58	N	D

Source: NYSDEC, 2018; N=None, O=On File, U=Unknown



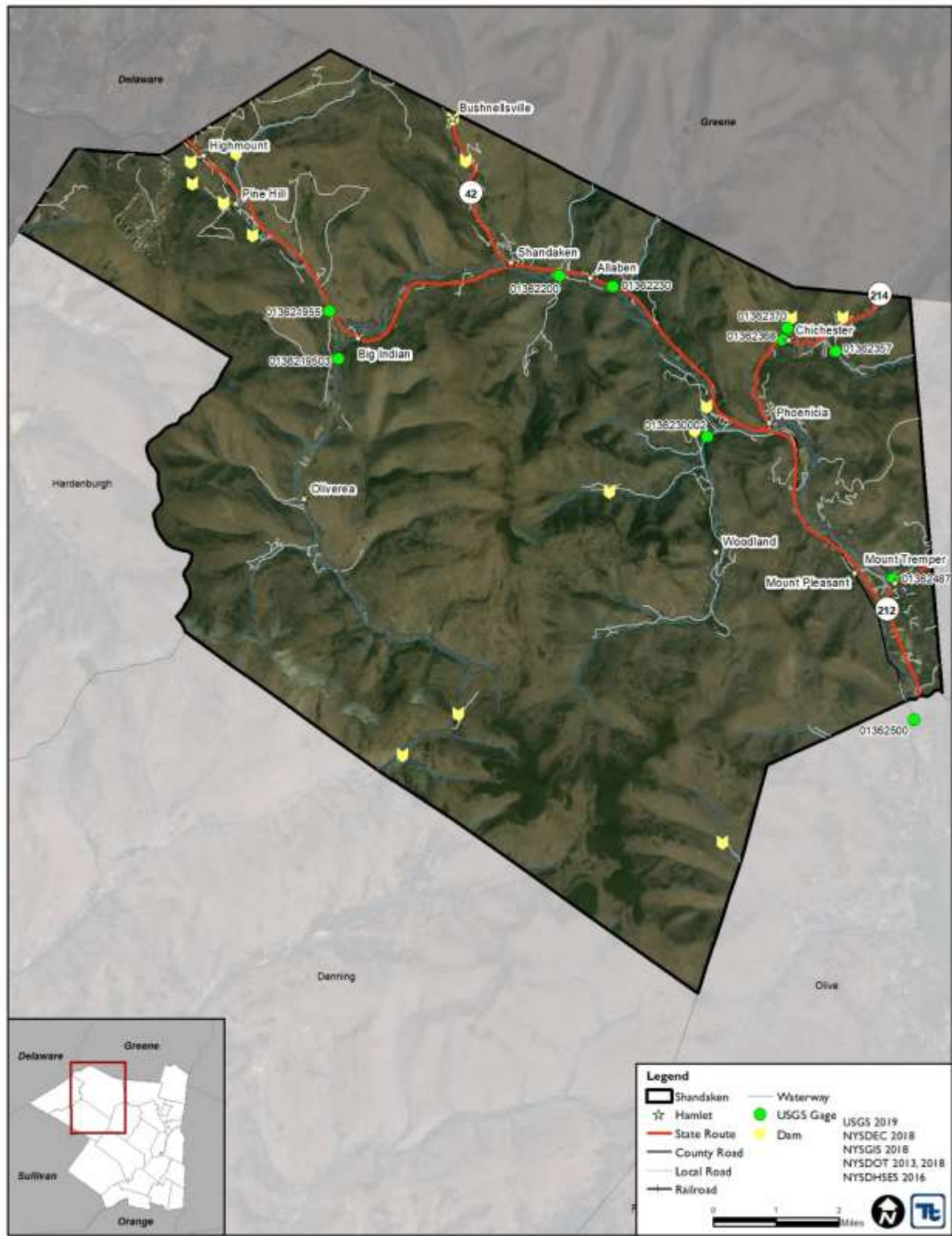
Small dams include a private on the Birch Creek, and another at the end of Lower Birch Creek Road on New York State Land.

In addition, the town has identified locations of three NYSDEC-maintained "flood protection projects" along the Esopus Creek in the town 1) along NYS Route 212 in Mount Tremper; 2) along Dike Road (Mt. Pleasant Rd) near Mount Tremper (https://www.dec.ny.gov/docs/water_pdf/fcpjrjmtplst.pdf); and 3) near NYS Route 42 & Route 28 in the hamlet of Shandaken (https://www.dec.ny.gov/docs/water_pdf/fcpjrjshndkn.pdf). Refer to Figures 3-22 through 3-24. Refer to Figure 3-22 through Figure 3-24

There are 9 USGS riverine gages in the Town of Shandaken summarized below and displayed in **Figure 3-21. USGS Gages and Dams in the Town of Shandaken.**

- 136219503: Esopus Creek Below Lost Clove Rd At Big Indian NY
- 13621955: Birch Creek at Big Indian NY
- 1362200: Esopus Creek at Allaben NY
- 1362230: Diversion from Schoharie Reservoir NY
- 136230002: Woodland Creek Above Mouth at Phoenicia NY
- 1362357: Warner Creek Near Chichester NY
- 1362368: Ox Clove Near Mouth at Chichester NY
- 1362370: Stony Clove Creek Blw Ox Clove at Chichester NY
- 1362487: Beaver Kill at Mount Tremper NY

Figure 3-21. USGS Gages and Dams in the Town of Shandaken



Source: USGS 2019; NYSDEC, 2018

Figure 3-22. Levee on the Esopus Creek along Mount Pleasant Road



Source: NYDEC, 2019

Figure 3-23. Levee on the Esopus Creek along Route 212



Source: NYDEC, 2019

Figure 3-24. Levee on the Esopus Creek along Route 42



Source: NYDEC, 2019

***Other Facilities***

The Planning Committee identified additional facilities (user-defined facilities) as critical. These facilities were included in the risk assessment conducted for the town. Table 3-16 lists the other critical facilities identified by the Town of Shandaken.

Table 3-16. Public Buildings in the Town of Shandaken

Name	Zip Code	Type	Building Type	Backup Power
Olympic Regional Development Authority	Big Indian	Evacuation Center	Wood/Concrete	Yes (Battery back-up for phones/lights)
Ulster County DWP Substation	Shandaken	Municipal Garage	Steel	Yes
Shandaken	Shandaken	Municipal Garage	TBD	TBD
Shandaken Town Hall	Shandaken	Municipal Offices	TBD	TBD
NYSDOT Garage Mt Tremper	Mount Tremper	NYSDOT Garage	TBD	TBD

Section 4 Relevant Programs and Regulations

The Mitigation Plan integrates relevant local, state and federal data and plans as discussed below. Local municipalities are charged with the development of local FMPs required under Section 322 of the Stafford Act. Therefore, the SAFARI Committee, representing the interests of the Town of Shandaken and as designated by Town resolution, coordinated the development of this FMP. In the State of New York, local municipalities are authorized to prepare local disaster Plans based on the contention that they are best equipped to assess their strengths and weaknesses, opportunities, and constraints. Local governments have intimate knowledge of the local geography, and in a disaster, local government personnel are on the front lines providing personnel and equipment to support the community.

Examples of other hazard mitigation programs in which the Town is involved with are the National Flood Insurance Program (NFIP) and the Hazard Mitigation Grant Program (HMGP). These programs assist the Town in receiving funding for flood mitigation projects and flood insurance (this Plan can also provide funds to mitigate other natural hazards). Data from the Town, based on participation in these programs, was incorporated in the risk assessment in Section 5 and used to identify mitigation options in Section 6. Continued involvement in these flood-related programs will help to administer funds and resources to support this HMP.

4.1 FEDERAL PLANS

4.1.1 DISASTER MITIGATION ACT OF 2000

The federal Disaster Mitigation Act (DMA) of 2000 (Public Law 106-390) provides the legal basis for FEMA mitigation planning requirements for state, local and Indian tribal governments as a condition of mitigation grant assistance. The DMA amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act by replacing previous mitigation planning provisions with new requirements that emphasize the need for planning entities to coordinate mitigation planning and implementation efforts. The law added incentives for increased coordination and integration of mitigation activities at the state level by establishing two levels of state plans. The DMA also established a new requirement for local mitigation plans and authorized up to 7 percent of Hazard Mitigation Grant Program funds to be available for development of state, local, and Indian tribal mitigation plans.

Participation in FEMA 404 HMGP may cover mitigation activities including raising, removing, relocating or replacing structures within flood hazard areas.

National Flood Insurance Program

Established in 1968, the NFIP provides federally-backed flood insurance to residents of communities that enact and enforce regulations that more carefully regulate development within floodplain areas. For individual property owners to be eligible to buy the federally-backed flood insurance, their property must be located within a community that participates in NFIP.

For a community to be eligible in NFIP, it must adopt and enforce a floodplain management ordinance to regulate proposed development in floodplains and officially designate a local floodplain coordinator/administrator. The intent of the program is to ensure that new construction does not exacerbate existing flood hazards and is designed to better withstand flooding. The community also has Digital Flood Insurance Rate Maps (DFIRM) that at a minimum show floodways, 100-year flood zones, and 500-year flood zones. Mitigation activities related to this program are included in Section 6 and data from FEMA Region II regarding NFIP Insurance Reports was used in the risk assessment for the flood hazard included in Section 5.



The Town of Shandaken floodplain administrator is Mr. Robert Stanley who has been involved in this planning process, at minimum providing specific flood-related information and mitigation initiatives, as well as providing review and input on the planning documents.

Community Rating System (CRS)

The NFIP has been successful in protecting property owners who acquire flood insurance through the program from catastrophic financial losses due to flooding, and in requiring that new buildings constructed within 100-year flood plains are better protected from flood damage.

In the 1990s, the Flood Insurance Administration (FIA) established the CRS to encourage local governments to increase their standards for floodplain development. The goal of this program is to encourage communities, through flood insurance rate adjustments, to implement standards above and beyond the minimum required in order to:

- Reduce losses from floods
- Facilitate accurate insurance ratings
- Promote public awareness of the availability of flood insurance

The CRS is a voluntary program within the NFIP that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions to meet the CRS goals of reducing flood losses, facilitating accurate insurance rating and promoting awareness of flood insurance.

For participating communities, flood insurance premium rates are discounted in increments of 5 percent. For example, a Class 1 community would receive a 45 percent premium discount, and a Class 9 community would receive a 5 percent discount. (Class 10 communities are those that do not participate in the CRS; they receive no discount.) The CRS classes for local communities are based on 18 creditable activities in the following categories:

- Public information
- Mapping and regulations
- Flood damage reduction
- Flood preparedness.

CRS activities can help to save lives and reduce property damage. Communities participating in the CRS represent a significant portion of the nation's flood risk; over 66 percent of the NFIP's policy base is located in these communities. Communities receiving premium discounts through the CRS range from small to large and represent a broad mixture of flood risks, including both coastal and riverine flood risks.

The following is verbatim from the 2017 CRS coordinators manual:

Compliance with Provisions for Environmental and Historic Preservation

Federal actions and undertakings, including ongoing programs, must comply with applicable federal environmental and historic preservation laws, implementing regulations, and executive orders. The CRS is a federal program and FEMA has identified certain building or land-altering activities that must meet this requirement if they are to be considered for CRS credit. These include projects undertaken under Activity 520



(Acquisition and Relocation), Activity 530 (Flood Protection), Activity 540 (Drainage System Maintenance), and Activity 620 (Levees).

The level of environmental and historic preservation compliance and documentation required for each project is determined by the type of project and the source of its funding. For CRS purposes, a project falls into one of these two categories:

- Projects funded (in whole or in part) by a federal agency, and

Flood Damage Reduction Activities

- Projects funded by a state and/or local government.

NOTE: Using any amount of federal or FEMA funding (including using it as a match for a locally sponsored project) has the effect of bringing that project into the “federally funded” category. For any such project, therefore, all the federal environmental and historic preservation requirements must be met.

Self-certification is provided through the completion of Community Certifications of Compliance with Environmental and Historic Preservation Requirements (CC-EHPs). The CC-EHP forms can be found in Appendix F, downloaded from www.CRSresources.org/500, or requested from the ISO/CRS Specialist.

- Certifications are required for all projects in Activity 520 (Acquisition and Relocation) and Activity 530 (Flood Protection) that were permitted or initiated after the implementation of the 2013 Coordinator’s Manual.
- Certifications are required at each verification visit for the ongoing maintenance programs credited under Activity 540 (Drainage System Maintenance) and Activity 620 (Levee Maintenance).
- Projects funded by FEMA are considered to meet FEMA’s environmental and historic preservation compliance requirements. A summary of such projects needs to be included in the Community Certifications.

If a community is not able to provide the information needed to certify that compliance occurred before implementation of the project or activity, then CRS credit will not be provided for that project or for that element of a CRS Activity.

507.a. Activity 520 (Acquisition and Relocation) and Activity 530 (Flood Protection)

The CC-EHPs, certifying compliance with the appropriate requirements, are required for all projects credited under Activity 520 or Activity 530 that were implemented AFTER the effective date of the 2013 Coordinator’s Manual (April 1, 2013). They are not required for projects that were implemented before the 2013 Coordinator’s Manual became effective, including projects that received CRS credit under an earlier Coordinator’s Manual.

Projects funded in whole or in part by FEMA are considered to have already complied with FEMA’s environmental and historic preservation requirements. A summary description of these projects needs to be documented in the CC-EHPs.

507.b. Activity 540 (Drainage System Maintenance) and Activity 620 (Levees)

The CC-EHPs certifying compliance with the appropriate requirements must be submitted at the time that CRS credit is requested for projects under Activities 540 or 620. This includes the first time that Activity 540 or Activity 620 credit is requested as well as each subsequent verification visit at which continued credit is requested.

Flood Damage Reduction Activities507.c. More Information on Environmental Compliance

The CC-EHPs consist of CC-520EHP, CC-530EHP, CC-540EHP, and CC-620EHP. They can be found in Appendix F, downloaded from www.CRSresources.org/500 and www.CRSresources.org/600, or requested from the ISO/CRS Specialist.

A matrix of the various requirements for environmental and historic preservation compliance as they relate to CRS-credited projects is posted at www.CRSresources.org/500.

Figure 500-4 summarizes the applicable federal requirements for environmental and historic preservation. For more information about FEMA's preservation policies, visit www.fema.gov/environmental-planning-and-historic-preservation-program.

Figure 500-5 gives brief descriptions of applicable federal environmental laws and executive orders, along with links to websites that offer more information.

Figure 500-4. Summary of FEMA's policy on environmental and historic preservation.

It is FEMA's policy to act with care to ensure that its disaster response and recovery, mitigation and preparedness responsibilities are carried out in a manner that is consistent with all Federal environmental and historic preservation policies and laws. FEMA uses all practical means and measures to protect, restore and enhance the quality of the environment, to avoid or minimize adverse impacts to the environment, and to attain the objectives of

- Achieving use of the environment without degradation or undesirable and unintended consequences;
- Preserving historic, cultural, and natural aspects of national heritage and maintaining, wherever possible, an environment that supports diversity and variety of individual choice;
- Achieving a balance between resource use and development within the sustained carrying capacity of the ecosystem involved; and
- Enhancing the quality of renewable resources and working toward the maximum attainable recycling of depletable resources.

Source: www.fema.gov/environmental-planning-and-historic-preservation-program

Figure 500-4 Federal Environmental Laws and Executive Orders that may Apply to some CRS-Related Activities

Archeological & Historic Preservation Act

Requires federal agencies to take into account the preservation of cultural resources that may be damaged by federal or federally authorized construction activities. Requires that the U.S. Secretary of Interior be notified when unanticipated archeological materials are discovered during construction of a federal undertaking.

Administered by: State Historic Preservation Officer, Tribal Historic Preservation Officer, National Park Service

For more information: www.nps.gov/archeology/tools/Laws/ahpa.htm
www.achp.gov/nhpa.html

Clean Water Act, Section 402

Limits the quantity of pollutants that may be discharged into surface waters. Includes permits for municipal separate storm sewer discharges. National Pollution Discharge Elimination System (NPDES) discharge permits may be required from the U.S. Environmental Protection Agency or the state.

Administered by: State agency for water quality in states with delegated regulatory responsibility; otherwise, U.S. Environmental Protection Agency

For more information: <http://water.epa.gov/lawsregs/guidance/wetlands/section402.cfm>

Clean Water Act, Section 404 (Nationwide Permit 13)

Requires a permit for bank stabilization projects less than 500 feet long and being implemented solely for erosion protection.

Administered by: U.S. Army Corps of Engineers, U.S. Environmental Protection Agency

For more information: www.usace.army.mil/ (see “Regulatory permits—Obtain a permit”)
<https://www.epa.gov/cwa-404/section-404-permit-program>

Clean Water Act, Section 404 (Section 404 permit)

Establishes permit requirements for actions to discharge dredge or fill material into waters of the United States, including wetlands. Includes fill for development and for water resources projects such as dams and levees.

Administered by: U.S. Army Corps of Engineers, U.S. Environmental Protection Agency

For more information: www.usace.army.mil/ (see “Regulatory permits—Obtain a permit”),
<https://www.epa.gov/cwa-404/section-404-permit-program>
www.fws.gov/wetlands

Communities are encouraged to learn more about federal, state, and other programs for the protection of environmental, cultural, and historic resources. Many of the principles and techniques used by such programs can be incorporated into the community’s floodplain management efforts, and thereby help to reduce flood losses and sustain the natural functions of floodprone areas.

Figure 500-4 Federal Environmental Laws and Executive Orders that may Apply to some CRS-Related Activities, continued

Endangered Species Act

Prevents or requires modification of a project that could jeopardize endangered or threatened species and/or their habitat. Section 7 requires consultation with the U.S. Fish and Wildlife Service and/or National Marine Fisheries Service, as applicable.

Administered by: U.S. Fish and Wildlife Service, National Marine Fisheries Service, applicable state agencies for state-protected species and their habitat.

For more information: www.fws.gov/endangered/
www.nmfs.noaa.gov/pr/permits

Executive Order 11988—Floodplain Management

Requires federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains. Requires federal agencies to avoid the direct and indirect support of floodplain development where there is a practicable alternative.

Administered by: Federal Emergency Management Agency

For more information: <https://www.fema.gov/executive-order-11988-floodplain-management>

Executive Order 11990—Protection of Wetlands

Requires federal agencies to minimize, to the fullest extent possible, the destruction, loss, or degradation of wetlands. Requires federal agencies to preserve and enhance the natural and beneficial values of wetlands.

Administered by: U.S. Fish and Wildlife Service

For more information: www.fws.gov/wetlands

Executive Order 12898—Environmental Justice for Low Income and Minority Populations

Requires fair treatment of all ethnic and income groups regarding public health and environmental effects from federal agency laws, regulations, policies, programs, and projects. Requires federal agencies to address disproportionately high and adverse human health or environmental effects on minority populations and low-income populations.

Administered by: All federal agencies

Farmlands Protection Policy Act

Requires federal agencies to minimize the extent to which federal programs contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses.

Administered by: Natural Resources Conservation Service state office, state agencies for soils (soil and water conservation districts)

For more information: www.nrcs.usda.gov/programs/fppa/

Figure 500-4 Federal Environmental Laws and Executive Orders that may Apply to some CRS-Related Activities, continued

Fish and Wildlife Coordination Act

Requires federal agencies to consider the effects that projects may have on fish and wildlife resources, take action to prevent loss or damage to these resources, and support the development or improvement of these resources. Protects fish and wildlife when federal actions result in the control or modification of natural streams, waterways, water bodies, or associated wetlands. Administered by: U.S. Fish and Wildlife Service, National Marine Fisheries Service For more information: www.fws.gov/Landscape-Conservation/index.html
www.habitat.noaa.gov/index.html

National Historic Preservation Act

Section 106 of the NHPA requires federal agencies to take into account the impact of their actions on historic properties listed (or eligible for listing) on the National Register of Historic Places. Administered by: State Historic Preservation Officer, Tribal Historic Preservation Officer, Advisory Council on Historic Preservation, National Park Service
For more information: www.achp.gov/overview.html
www.achp.gov/nhpa.html
www.nps.gov/subjects/historicpreservation/index.htm

Rivers and Harbors Act,-Section 10

Requires a permit for building any structure in the channel or along the banks of navigable waters of the United States that changes the course, conditions, location, or capacity of those waters. Administered by: U.S. Army Corps of Engineers
For more information: www.usace.army.mil/Missions/Civil-Works/Section408/
www.uscg.mil/hq/cg5/cg551/

THE CLEAN WATER ACT

The federal Clean Water Act (CWA) employs regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's surface waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."

Evolution of CWA programs over the last decade has included a shift from a program-by-program, source-by-source, pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. A full array of issues is addressed, not just those subject to CWA regulatory authority. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining water quality and other environmental goals is a hallmark of this approach.

4.2 STATE PLANS AND RESOURCES

New York State Floodplain Management

There are two departments that have statutory authorities and programs that affect floodplain management at the local jurisdiction level in New York State: the New York State Department of Environmental Conservation (NYSDEC) and the Department of State's Division of Code Enforcement and Administration (DCEA).

New York State Department of Environmental Conservation (NYSDEC)

The NYSDEC is charged with conserving, improving, and protecting the state's natural resources and environment, and preventing, abating, and controlling water, land, and air pollution. Programs that have bearing on floodplain management are managed by the Bureau of Flood Protection and Dam Safety, which cooperates with federal, state, regional, and local partners to protect lives and property from floods, coastal erosion, and dam failures. These objectives are accomplished through floodplain management and both structural and nonstructural means.

The Dam Safety Section is responsible for "reviewing repairs and modifications to dams and assuring [sic] that dam owners operate and maintain dams in a safe condition through inspections, technical reviews, enforcement, and emergency planning." The Flood Control Projects Section is responsible for reducing flood risk to life and property through construction, operation, and maintenance of flood control facilities.

The Floodplain Management Section is responsible for reducing flood risk to life and property through management of activities, such as development in flood hazard areas, and for reviewing and developing revised flood maps. The Section serves as the NFIP State Coordinating Agency and in this capacity, is the liaison between FEMA and New York communities that elect to participate in the NFIP. The Section provides a wide range of technical assistance.

Department of State's Division of Code Enforcement and Administration (DCEA)

The DCEA *ensures the Health, Safety and Resilience of the Built Environment for all New Yorkers*. The Division of Building Standards and Codes (BSC) administers the mandatory statewide Uniform Fire Prevention and Building Code (Uniform Code) and State Energy Conservation Construction Code (Energy Code). The Division provides a variety of services related to the Uniform Code and Energy Code. It provides technical assistance, administers variances, delivers educational courses, oversees the enforcement practices of local governments and serves as secretariat to the State Fire Prevention and Building Code Council. The Albany Central Office and eleven regional offices throughout the state provide regional service to elected officials and local code enforcement personnel regarding general requirements for code enforcement. The Division program was created by Chapter 707 of the Laws of 1981. The New York Legislature enacted Article 18 of the Executive Law, directing the formulation of a Uniform Fire Prevention and Building Code (Uniform Code). The Uniform Code is designed to cover new construction, building rehabilitation, fire safety, and housing maintenance. (NYD DOS 2019 - <https://www.dos.ny.gov/dcea/>)

Catskill Park State Land Master Plan

The Catskill Park State Land Master Plan was created as a guiding document for the preservation of state-owned lands within Catskill Park. This plan is intended to help preserve the land and forested lands in Delaware, Greene, Sullivan, and Ulster County. This plan identifies management programs for the protection of natural resources from flooding events to ensure preservation of wildlife habitats. Dams and flood control structures are eligible to be constructed for ensuring operations of campgrounds and park facilities.

Northeast Regional Climate Center

The Northeast Regional Climate Center (NRCC) has partnered with the New York State Energy Research and Development Authority (NYSERDA) to compare various methods of downscaling global climate model (GCM) output and create extreme precipitation projections for New York State. These projections will ultimately be incorporated into climate change adaptation planning. In 2009 alone, 175 total flooding events in New York State led to \$32.82 million in property damage. The state is also still recovering from the \$42 billion toll of Superstorm Sandy, among others. Climate change is resulting in an increase in the frequency of heavy rainfall events. To help New York State communities plan for effects of climate change, new graphics are now available showing the increased likelihood of heavy precipitation events. These graphs, called Intensity Duration Frequency (IDF) curves, show anticipated increases of storm events from 2- to 100-year intervals, and are projected into the future as far as 2099. These products are designed for use by municipal officials, researchers, planners, highway departments, and other decision-makers who need to take storm events into account. These IDF curves display how precipitation events are being affected by New York State's rapidly changing climate (NRCC 2015). The figure below displays the screenshot of the website.

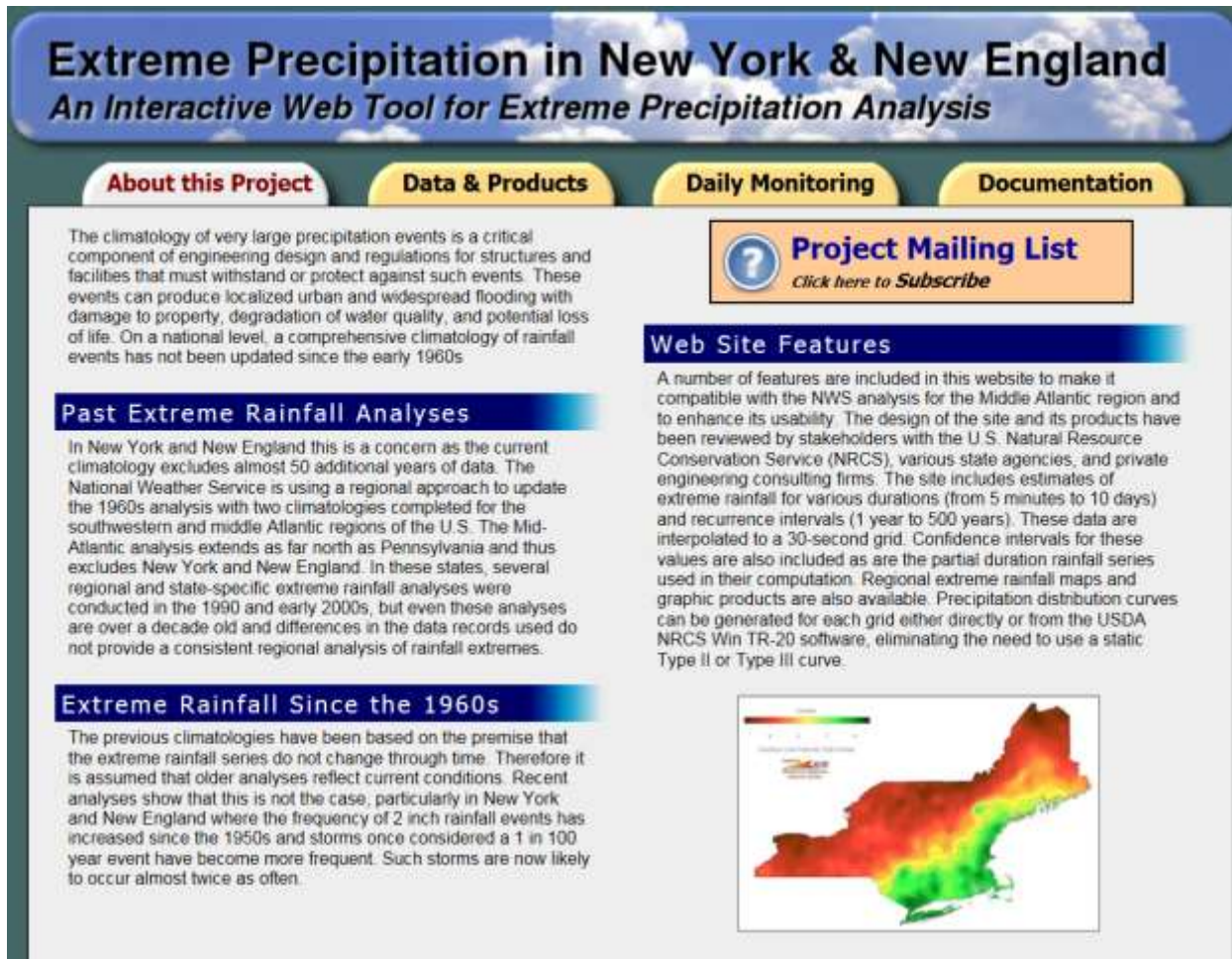
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Figure 4-1. Screenshot of the IDF Curves for New York State



NRCC also maintains the Extreme Precipitation in New York & New England website. It is an interactive tool for extreme precipitation analysis. The site includes estimates of extreme rainfall for various durations (from 5 minutes to 10 days) and recurrence intervals (1 year to 500 years). These data are interpolated to a 30-second grid. Confidence intervals for these values are also included as are the partial duration rainfall series used in their computation. Regional extreme rainfall maps and graphic products are also available. Precipitation distribution curves can be generated for each grid either directly or from the USDA NRCS Win TR-20 software, eliminating the need to use a static Type II or Type III curve (NRCC 2018). This tool can be used by municipalities to assist them in the design and feasibility assessment of future projects and allow them to see the future intensity and frequency of rain events. Figure 4-2 below shows a screenshot of the website.

Figure 4-2. Screenshot of the Extreme Precipitation in New York & New England website



4.3 LOCAL PLANS AND ORDINANCES

Beaver Kill Stream Management Plan, 2015

The Beaver Kill Stream Management Plan (SMP) is an assessment of the Beaver Kill's health, stability, and hydraulic and geomorphic conditions in the towns of Woodstock and Shandaken, Ulster County, New York. This assessment was conducted to identify hazards and prioritize restoration and flood hazard mitigation efforts based on threats to infrastructure, property, and water quality. The information gathered by this assessment has been compiled into a stream management plan with recommendations for improved stream stewardship practices and restoration ideas to enhance stream stability, water quality and mitigate flood and erosion hazards. (Ashokan Watershed Stream Management Program, 2015).

Phoenicia and Mt. Tremper Local Flood Analysis, 2015

This Local Flood Analysis (LFA) was created to evaluate flood mitigation within the Town of Shandaken in the hamlets of Phoenicia and Mt. Tremper along Esopus Creek, Stony Clove Creek, and the Beaver Kill. The LFA utilizes engineering and hydraulic analyses to illustrate the flood risk within these communities and allow for the identification of flood mitigation initiatives. (Milone & MacBroom, 2015)



Shandaken Allaben Local Flood Analysis, 2017

This LFA was created to evaluate flood mitigation within the hamlets of Shandaken and Allaben. This LFA examines sections of Esopus Creek, Bushnellsville Creek, Fox Hollow Creek, Peck Hollow Creek, and Broadstreet Hollow Creek. The LFA utilizes engineering and hydraulic analyses to illustrate the flood risk within these communities and allow for the identification of flood mitigation initiatives. The topography and development patterns of the town, effective flood mitigation initiatives were unable to be identified. (Milone & MacBroom, 2017)

Woodland Creek Stream Management Plan, 2018

The Woodland Creek SMP outlines strategies to address flood hazards, streambank erosion, water quality concerns, and riparian habitat impairments. This SMP contains information which can help to identify where stream instabilities are threatening infrastructure or homes, what may be the cause of the instability, and where stream restoration efforts will be most effective for achieving the needs of a wide range of Woodland Creek stakeholders in the Town of Shandaken, New York. (Ashokan Watershed Stream Management Program, 2018)

Ulster County Multi-Jurisdictional Hazard Mitigation Plan Update, 2017

The Ulster County Multi-Jurisdictional Hazard Mitigation Plan was updated in September 2017. This plan was created as a part of an ongoing effort to ensure a coordinated approach to hazard mitigation for Ulster County, New York. This Hazard Mitigation Plan was developed with the input from county stakeholders to identify and reduce potential future losses related to natural hazard events. This plan also includes a jurisdictional annex for the Town of Shandaken which identifies some of the mitigation actions that the Town has pursued and a capability assessment of the municipality. This annex also includes a status of five mitigation actions which were identified during the last planning cycle of which two were completed.

Ulster County Comprehensive Emergency Management Plan, 2014

The Ulster County Comprehensive Emergency Management Plan was adopted by the Ulster County Legislature on June 17, 2014. The purpose of this plan is to *serve as a guiding document for risk reduction, emergency response and recovery from emergency situation* (Ulster County, 2014). Flooding was identified as one of the most severe hazards within Ulster County and one of the primary objectives within the risk reduction was to reduce flood exposure within the County by buyout programs, relocation, and stream management programs. Proactive mitigation can include *local land use controls and infrastructure investment policies that discourages inappropriate land use and development and flood prone areas. Use of LiDAR, couple with new hydraulic modeling, and other technologies, should be encouraged to develop more accurate flood plain delineation leading to greater accuracy in predicting expected flood levels, associated damages and prioritization in the use of funding.*

Ulster County – Emergency Evacuation / Detour Route Annex, November 2005

The Ulster County Comprehensive Emergency Management Plan has an annex which identifies and establishes the procedure(s) necessary to facilitate a county evacuation in response to a natural hazard or disaster. This annex was created in November 2005. Four hazards were identified as being likely to cause an evacuation: hazardous materials accident, flood, fire or transportation accident.

Ulster County Transportation Council Rethinking Transportation: Plan 2040 - Year 2040 Long Range Transportation Plan, September 29, 2015



The Ulster County Year 2040 Long Range Transportation Plan is created for the period of October 1, 2015 to September 30, 2020. This transportation plan is intended to serve as a comprehensive source of information regarding transportation development for Ulster County, New York through the year 2040. The Town of Shandaken is referenced in terms of major development which is proposed or pending, which was the Belleayre Ski Resort.

Ulster County Subdivision Requirements. Ulster County DPW. November 2008

The Ulster County Department of Public Works Subdivision requirements establish specifications for *travelways that serve three or more single family dwellings*. Specific design requirements relating to drainage and culverts are outlined which would ensure that subdivision development would have adequate capacity to handle precipitation or groundwater flow.

Town of Shandaken Comprehensive Plan, July 2005

The Town of Shandaken Comprehensive Plan was approved by the Shandaken Town Board on July 11, 2005. This Comprehensive Plan serves as a guiding document to facilitate economic development and to encourage the development of the Town into a more prosperous municipality. The plan also discusses land usage and the availability of developable land in relation to floodplains. Land use and development is also discussed in the comprehensive plan due to the relatively steep topography in the area, which means that exposure to flooding could result in significant exposure and losses due to flooding. Flood mitigation was identified as an immediate priority within the Comprehensive Plan.

Town of Shandaken Fire Prevention and Building Code Administration – Chapter 74, Adopted April 7, 2008

Chapter 74 of the Shandaken Town Code *provides for the administration and enforcement of the New York State Uniform Prevention and Building Code as well as the State Energy Conservation Construction Code*. This code also pertains to certificates of occupancy, unsafe buildings, and construction permits. Chapter 74 requires that a flood hazard certification be submitted to the Code Enforcement Officer before a Certificate of Occupancy be issued.

Town of Shandaken Flood Damage Prevention Ordinance – Chapter 77, Adopted October 3, 2016

The Town of Shandaken Flood Damage Prevention Ordinance was created to minimize public and private losses due to flood conditions within the Town of Shandaken. The application of this flood damage prevention ordinance can help to regulate development and ensure that structures within the floodplain are able to withstand flooding or be protected from flooding as well as ensure that future development within the floodplain does not occur. The ordinance also contains some regulations exceeding federal minimums, most notably the requirement of two feet of freeboard.

Subdivision Ordinance – Chapter 105, Adopted December 11, 1971

The Subdivision Ordinance states that the subdivision of land shall take place with consideration for fire, flood, and other hazards as well as ensuring that adequate drainage be provided. The subdivision ordinance can be used in conjunction with the zoning ordinance and flood legislation to strengthen the Town's flood management program.

Zoning Ordinance – Chapter 116, Adopted December 9, 1987



The Zoning Law of the Town of Shandaken regulates the location, construction, alteration and use of buildings and structures and the development and use of land within the Town of Shandaken and for said purposes divides the Town into zoning districts (Town of Shandaken, 1987). The zoning ordinance was passed to regulate safe and sustainable development in the Town. The Zoning Law takes other hazards besides flooding into consideration to maintain and promote public health and welfare. Regulation of development location and type is a critical aspect of ensuring community growth and resilience. This zoning regulation can be used in conjunction with other legislation to enforce safe development patterns out of the floodplain.

Article VIII of the Town of Shandaken Zoning Ordinance requires non-residential property be approved *prior to the issuance of Building Permits and Certificates of Occupancy*. A detailed plan for proposed development must be submitted to the Planning Board and must include an area map, land holdings information, and an existing conditions map. The existing conditions maps map has provides detailed landscape information and natural features such as *streams, wetlands, rock outcroppings, soil conditions, and floodprone areas*. This site plan review process can help the Town of Shandaken to have a greater degree of control over proposed development and to integrate floodplain management practices into future development.

DRAFT

Section 5 RISK ASSESSMENT

This section of the FMP provides a profile and vulnerability assessment for the flood hazard in order to quantify the description, location, extent, history, probability, and impact of flood events in the Town of Shandaken. In addition, this section evaluates the risk of the flood hazard in the planning area.

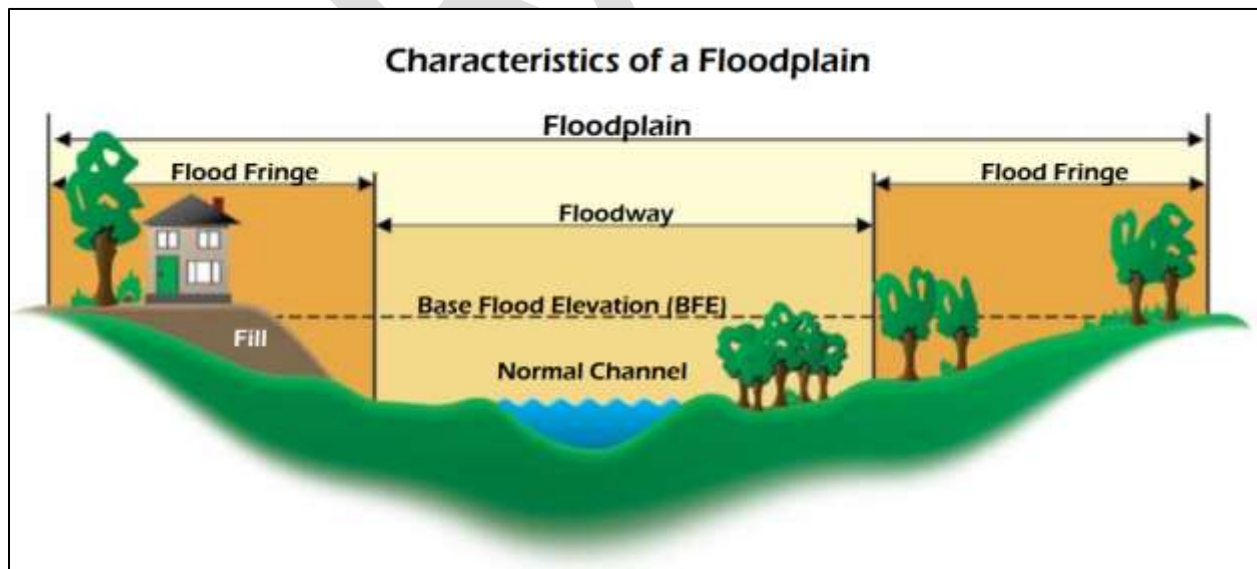
5.1 HAZARD PROFILE

This section provides information regarding the description, extent, location, previous occurrences and losses, climate change projections and the probability of future occurrences for the flood hazard.

5.1.1 General Concepts

A floodplain is defined as the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that becomes inundated with water during a flood. Most often floodplains are referred to as 100-year floodplains. Defined in further detail in the 'Frequency' subsection of this profile, the 100-year flood (also known as the 1-percent annual chance flood) has a 1-percent chance of being equaled or exceeded each year. This 1-percent annual chance flood is now the standard used by most federal and state agencies and by the National Flood Insurance Program (NFIP) (FEMA 2005). Figure 5-1 depicts the flood hazard area, the flood fringe, and the floodway areas of a floodplain.

Figure 5-1. Floodplain



Source: FEMA 2009

Measuring Floods and Floodplains

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. The 1 percent annual chance flood is also referred to as the base flood or 100-year flood. A 100-year floodplain is not a flood that will occur once every 100 years; the designation indicates a flood that has a 1-percent chance of being equaled or exceeded each year. Thus, the 100-year flood could occur more than once in a relatively short period of time. Similarly, the moderate flood hazard area (500-

year floodplain) will not occur every 500 years but is an event with a 0.2-percent chance of being equaled or exceeded each year (FEMA 2018). The 1-percent annual chance floodplain establishes the area that has flood insurance and floodplain management requirements.

The extent of flooding associated with a 1-percent annual probability occurrence (the base flood or 100-year flood) is used as the regulatory boundary by many agencies. This is known as the Special Flood Hazard Area (SFHA). It is a convenient tool for assessing vulnerability and risk in floodprone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the elevation of water that will result from a given discharge level, which is one of the most important factors used in estimating flood damage.

5.1.2 Principal Types of Flooding the Town of Shandaken

Floods are the most frequent and costly natural hazards in New York State in terms of human hardship and economic loss, particularly to communities that lie within flood prone areas or flood plains of a major water source. As defined in the NYS HMP (NYS DHSES 2014), flooding is a general and temporary condition of partial or complete inundation on normally dry land from the following:

- Riverine overbank flooding;
- Flash floods;
- Mudflows or debris floods;
- Dam- and levee (berm)-break floods;
- Local draining or high groundwater levels;
- Ice jams; and

Many floods fall into three categories: riverine, coastal and shallow (FEMA 2007). Other types of floods may include ice-jam floods, alluvial fan floods, dam failure floods, and floods associated with local drainage or high groundwater (as indicated in the previous flood definition). For the purpose of this FMP and as deemed appropriate by the Town of Shandaken, riverine, shallow, flash, ice jam, and dam failure flooding are the main flood types of concern for the town and are further discussed below.

Riverine and Flash Flooding

Riverine floods are the most common flood type. They occur along a channel and include overbank and flash flooding. Channels are defined, ground features that carry water through and out of a watershed. They may be called rivers, creeks, streams, or ditches. When a channel receives too much water, the excess water flows over its banks and inundates low-lying areas (The Illinois Association for Floodplain and Stormwater Management 2006).

Flash floods are defined by the National Weather Service as “A flood caused by heavy or excessive rainfall in a short period of time, generally less than 6 hours. Flash floods are usually characterized by raging torrents after heavy rains that rip through river beds, urban streets, or mountain canyons sweeping everything before them. They can occur within minutes or a few hours of excessive rainfall. They can also occur even if no rain has fallen, for instance after a levee or dam has failed, or after a sudden release of water by a debris or ice jam.” (National Weather Service [NWS], n.d.).

Shallow Flooding

Stormwater flooding described below is due to local drainage issues and high groundwater levels. Locally, heavy precipitation may produce flooding in areas other than delineated floodplains or along recognizable channels. If local conditions cannot accommodate intense precipitation through a combination of infiltration and surface runoff, water may accumulate and cause flooding problems. During winter and spring, frozen ground and snow accumulations may contribute to inadequate drainage and localized ponding. Flooding issues of this nature generally occur in areas with flat gradients and generally increase with urbanization which speeds the accumulation of floodwaters because of impervious areas. Shallow street flooding can occur unless channels have been improved to account for increased flows (FEMA 1997).

High groundwater levels can be a concern and cause problems even where there is no surface flooding. Basements are susceptible to high groundwater levels. Seasonally high groundwater is common in many areas, while elsewhere high groundwater occurs only after long periods of above-average precipitation (FEMA 1997).

Urban drainage flooding is caused by increased water runoff due to urban development and drainage systems. Drainage systems are designed to remove surface water from developed areas as quickly as possible to prevent localized flooding on streets and other urban areas. They make use of a closed conveyance system that channels water away from an urban area to surrounding streams. This bypasses the natural processes of water filtration through the ground, containment, and evaporation of excess water. Since drainage systems reduce the amount of time the surface water takes to reach surrounding streams, flooding in those streams can occur more quickly and reach greater depths than prior to development in that area (FEMA 2007).

Combined sewer overflow (CSO), or the discharge from a combined sewer system that is caused by snowmelt or stormwater runoff can result in the discharge from a combined sewer system that is caused by snowmelt or stormwater runoff. CSOs are sewer systems that collect stormwater runoff, domestic sewage, and industrial wastewater in the same pipe and bring it to the wastewater treatment facility. They are designed to overflow during wet weather. CSOs are sewer systems that collect stormwater runoff, domestic sewage, and industrial wastewater in the same pipe and bring it to the wastewater treatment facility. They are designed to overflow during wet weather.

Ice Jam Flooding

An ice jam occurs when pieces of floating ice are carried with a stream's current and accumulate behind any obstruction to the stream flow. Obstructions may include river bends, mouths of tributaries, points where the river slope decreases, as well as dams and bridges. The water held back by this obstruction can cause flooding upstream, and if the obstruction suddenly breaks, flash flooding can occur as well (NOAA 2013). The formation of ice jams depends on the weather and physical condition of the river and stream channels. They are most likely to occur where the channel slope naturally decreases, in culverts, and along shallows where channels may freeze solid. Ice jams and resulting floods can occur during at different times of the year: fall freeze-up from the formation of frazil ice; mid-winter periods when stream channels freeze solid, forming anchor ice; and spring breakup when rising water levels from snowmelt or rainfall break existing ice cover into pieces that accumulate at bridges or other types of obstructions (NYS DHSES 2014).

There are two main types of ice jams: freeze-up and breakup. Freeze-up jams occur when floating ice may slow or stop due to a change in water slope as it reaches an obstruction to movement. Breakup jams occur during periods of thaw, generally in late winter and early spring. The ice cover breakup is usually associated with a rapid increase in runoff and corresponding river discharge due to a heavy rainfall, snowmelt or warmer temperatures (USACE 2002; NYS DHSES 2014).

Dam Failure Flooding

A dam or a levee is an artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material for the purpose of storage or control of water (FEMA 2007). Dams are man-made structures built across a stream or river that impound water and reduce the flow downstream (FEMA 2003). They are built for the purpose of power production, agriculture, water supply, recreation, and flood protection. Dam failure is any malfunction or abnormality outside of the design that adversely affects a dam's primary function of impounding water (FEMA 2007). Levees typically are earthen embankments constructed from a variety of materials ranging from cohesive to cohesionless soils (USBR 2012). Dams and levees can fail for one or a combination of the following reasons:

- Overtopping caused by floods that exceed the capacity of the dam (inadequate spillway capacity due to uncontrolled release or exceedance of design);
- Prolonged periods of rainfall and flooding;
- Deliberate acts of sabotage (terrorism);
- Structural failure of materials used in dam construction;
- Movement and/or failure of the foundation supporting the dam;
- Settlement and cracking of concrete or embankment dams;
- Piping and internal erosion of soil in embankment dams;
- Inadequate or negligent operation, maintenance and upkeep;
- Failure of upstream dams on the same waterway; or
- Earthquake (liquefaction / landslides) (FEMA 2010).

5.1.3 Major Flood Events

Many sources provided flooding information regarding previous occurrences and losses associated with flooding events throughout the Town of Shandaken. With multiple sources reviewed for the purpose of this Flood Management Plan, loss and impact information for many events could vary depending on the source and the accuracy of monetary figures is based on information available at the time of development of this plan.

Between 1954 and March 2019, FEMA included the State of New York in 52 flood-related disasters (DR) or emergencies (EM) classified as one or a combination of the following disaster types: severe storms, flooding, hurricane, tropical storm, tropical depression, coastal flooding, inland flooding, tornadoes, and straight-line winds. Generally, these disasters cover a wide region of the state; therefore, they may have impacted many counties. Ulster County was included in 17 of these flood-related declarations.

Known flood events, including FEMA disaster declarations, which have impacted the Town of Shandaken between 1950 and March 2019 are identified in Table 5-1. As seen in the table below, a majority of the flood-related events have been riverine and flash flooding. The town has not experienced any flood events related to dam failures. It is noted that not all events that have occurred in the Town of Shandaken are included due to the extent of documentation and the fact that not all sources may have been identified or researched. Loss and impact information could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this Flood Management Plan.



Table 5-1. Flooding Events in the Town of Shandaken, 1950 to 2018

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Ulster County Designated?	Event Details	Source(s)
December 8, 1950	Flooding	N/A	N/A	During a storm event, the Esopus Creek did a devastating job and by the time it reached Oliverea, it took out bridges and rushed over the road four feet deep. Where the Hatchery Stream crosses Oliverea Road, the little bridge remained but the roadway was washed out on either side. Where the Esopus Creek reaches the turn near Platt's barn, it tore out a corner and carried away a car. It cut gouges out of the bank within one or two feet of some tourist cottages just above the Dunham Bridge. The Stream, as it joined the Birch Creek, it completed flooded the Fennelly meadow with eight to ten feet of water. A home was lifted from its foundation and took out the Weybridge and oad. Birch Creek took out the bridge at Greenbergs and undermined a barn.	Catskill Mountain News, Town Input
April 6, 1951	Flooding	N/A	N/A	Heavy rains and melting snow caused the Esopus Creek to raise above its November highwater mark. It caused widespread damage in Ulster County. Most of the damage was at Phoenicia and areas below. The Chichester and Woodland Valley streams combined in this area. The streets of Phoenicia were flooded and some people had to leave their homes. Many businesses were flooded as well. A bridge was carried away near the Stony Clove Notch. In Lanesville, residents called this event one of the worst floods. The Stony Clove Valley Stream dug out a chunk of pavement on Notch Road, 100 feet long and 50 feet deep..	Catskill Mountain News, Town Input
October 18-20, 1955	Heavy Rain and Flooding	N/A	N/A	Heavy rains flooded the Oliverea Valley, completely destroying the post office and a small cottage in Oliverea. Land and roads washed away. Telephone and electricity were cut off. Guests at the Valley View House and at the Slide Mountain House were caught in the Valley and were unable to return home. A bridge was washed out behind a home in the Big Indian Mountain club. The Manor House bridge was almost impassable due to debris and gravel. In Pine Hill, a bank behind a home gave way and slide down, breaking through kitchen doors and spreading through the entire first floor. Several other people experienced damages to their homes. Many basements were flooded, oil burners were put out and several lawns washed out. One water main was broken which caused a few homes to be without water. Several residents in Woodland Valley had to evacuate due to the rising waters of the Esopus and its tributaries. Many roadways were blocked and traffic had to be rerouted. Road damage due to undermining was severe along sections of Route 28. Other damage included the washing away of part of the Shandaken Manor Hotel. In	Catskill Mountain News, Town Input



Table 5-1. Flooding Events in the Town of Shandaken, 1950 to 2018

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Ulster County Designated?	Event Details	Source(s)
				Bushnellville, Route 42 was closed with large sections washed out. Homes near the Bushnellville Creek were the hardest hit. The Creek overflowed its banks and flowed towards the main street. The Shandaken post office was flooded. The road from Route 28 to Fox Hollow was under four feet of water. Small bridges were washed out in this area, which included the Percy White Bridge over the Esopus and the Claude Gossco Bridge and bridges at Rossingers and at Mountain Lodge Inn on Bushnellville Road. This flooding event caused one fatality in Woodland Valley.	
September 13, 1971	Severe Storms and Flooding	DR-311	Yes	N/A	FEMA
June 23, 1972	Tropical Storm Agnes	DR-338	Yes	Tropical Storm Agnes caused some damage in the Catskill area. Several bridges and roads suffered minor damage and there were reports of damage to private properties in the Town of Shandaken. Esopus Creek and its tributaries crested during the morning. Four campers had to be rescued from Woodland Valley when their exit was cut off and one of them suffered leg burns from a gas lantern explosion. Ulster County highway crews cleared fallen trees from county roads in the Woodland Valley and Phoenicia area. In Oliverea Valley, the main damage was seen on the property of Suzie's Cabins, where several feet of lawn and fill next to the stream were washed away. Further inspection of bridges and streams in the Town was made by federal and state officials.	FEMA, Town Input
July 20, 1973	Severe Storms, Flooding	DR-401	Yes	N/A	FEMA
December 27, 1973	Severe Storms, Flooding	N/A	N/A	Torrential rain fell in the Town of Shandaken, causing large amounts of damage due to water running off the mountain side. Residents in the area of the Woodland Valley county bridge reported to the supervisor's office Friday morning that water was up to the floor of the bridge and the span seemed to be swaying in the current of the Esopus. Two 8-foot by 50-foot culvert pipes, each weighing several tons, were washed away from the property of Ray Smith, where contractors are replacing a highway bridge on Route 212, Willow Road. One of the pipes wedged under the old Route 28 bridge was Mount Tremper Four Corners was partially sticking out, diverting the water to Brookside Road, which became flooded. Plank Road, the former Route 28, was washed out and closed to traffic. The worst flooding conditions was at the O'Donnell Five-Star camp near Mount Tremper. The former Hoffman diner and a property in the vicinity of the Hoffman bridge were flooded. Three trailers	Town Input



Table 5-1. Flooding Events in the Town of Shandaken, 1950 to 2018

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Ulster County Designated?	Event Details	Source(s)
				were damaged by water, and two cars were towed out. A new housing development off Plank Road was hit hard. A new road was being completed, with bridges and culvert installations, and these were destroyed. The Sleepy Hollow campsite below Phoenicia had two or three feet of water by the parked trailers, and three trailers were flooded at their foundations. The site of the proposed Odell shopping area on new Route 28 had slight flooding. The Mount Tremper fire trail constructed by the Department of Environmental Conservation was completely washed out.	
February 2, 1981	Ice Jam	N/A	N/A	An ice jam occurred along the Esopus Creek in the Town of Shandaken. A gage recorded a height of 7.82 feet and a discharge of 120 cfs.	CRREL
February 11, 1981	Ice Jam	N/A	N/A	An ice jam occurred along the Esopus Creek in the Town of Shandaken. A gage recorded a height of 7.78 feet and a discharge of 450 cfs.	CRREL
March 28 – April 8, 1984	Coastal Storms, Flooding	DR-702	Yes	On April 5 th , the gage on Esopus Creek at Cold Brook recorded a height of 17.75 feet (flood stage of 11 feet).	FEMA, NWS
April 3-6, 1987	Flooding	DR-792	Yes	A low-pressure system associated with a cold front produced heavy rain over the Catskills on March 30 and 31 and showers on April 1. More than three inches fell over the headwaters of the Schoharie and Esopus basins, while generally less than two inches fell elsewhere. The maximum rain recorded during the 24-hour period that ended on April 5 exceeded six inches and was centered on the highest peaks in the Catskills, Slide Mountain (4,204 ft) and Hunter Mountain (4,025 ft). Prevailing winds from the east and southeast and orographic effects of the Catskills combined to generate the greatest rainfall totals on the eastern slopes of the mountains. Five counties in southeastern New York were declared major disaster areas after intense rainfall on April 3-5, 1987, caused widespread flooding. Severe frontal storms often cause flooding in the narrow, steep valleys of the Catskill Mountains. This storm occurred at a time when soils were saturated, reservoir storage was near capacity, and stream discharge was high from snowmelt. Rainfall during the storm period totaled 9.09 inches at Slide Mountain and 8.20 inches at Tannersville. Schoharie, Catskill, Esopus, and Rondout Creeks and East Branch Delaware and Neversink Rivers and their tributaries underwent the most severe flooding.	FEMA, Town Input



Table 5-1. Flooding Events in the Town of Shandaken, 1950 to 2018

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Ulster County Designated?	Event Details	Source(s)
November 11, 1995	Flooding	N/A	N/A	Between three and four inches of rain fell in eastern New York State which resulted in flooding. In the hamlet of Phoenicia, the Esopus Creek flooded and a state of emergency was declared. Several families were evacuated in the hamlet of Woodland Valley. Ulster County had approximately \$100 K in damages.	NOAA-NCDC, Ulster County HMP
January 19 – 21, 1996	Flooding	N/A	N/A	Warm temperatures caused rapid snowmelt in Ulster County. Along with the melting snow, a storm brought one to three inches of rain, resulting in widespread flooding in the County. Small streams flooded across the County, washing out roads. Extensive flooding occurred along the Hudson River and Esopus Creek. Many towns in Ulster County experienced flooding. In the Town of Shandaken, five town roads were destroyed and several homes were damaged. Evacuations occurred in the hamlets of Phoenicia and Shandaken. Ulster County experienced \$10 M in damages.	NOAA-NCDC Ulster County HMP
January 27-28, 1996	Flooding	DR-1095	Yes	One to two inches of rain fell across eastern New York State, with some areas in the Catskills receiving three inches of rain. This storm, on top of already saturated soils, caused many small streams to flood in Ulster County. The Walkkill River and Rondout and Esopus Creeks flooded in the County. Evacuations occurred along the Esopus Creek and Route 28. Along the Rondout Creek at Eddyville, flooding was severe and widespread. In the Town of Shandaken, numerous roads were washed out and the Town declared a state of emergency. Overall, the County experienced \$400 K in damages.	NOAA-NCDC, FEMA, Ulster County HMP
June 12-14, 1998	Flooding	N/A	N/A	Heavy rain fell across the Catskills and eastern Mohawk Valley. Three-day precipitation totals ranged from eight to 10 inches. Flooding of creeks and tributaries occurred in Ulster, Fulton, Montgomery and Greene Counties. In Ulster County, the Esopus Creek above the Ashokan Reservoir flooded. At the hamlet of Mount Tremper, the creek crested at 12.5 feet (flood stage is 11 feet). Overall, Ulster County experienced approximately \$45 K in damages.	NOAA-NCDC, Ulster County HMP
September 16-18, 1999	Hurricane Floyd	DR-1296	Yes	Rainfall totals for Ulster County ranged from 4.56 inches in the Town of Kingston to 6.57 inches at Slide Mountain. In the hamlet of Phoenicia, 5.91 inches of rain was reported. Throughout the County, many trees and wires were down. Roofs of homes were blown off.	FEMA, NWS
May 18, 2000	TSTM	N/A	N/A	TSTM winds knocked down trees and powerlines at several locations in Albany, Columbia, Greene, Montgomery, Saratoga, Schoharie and Ulster Counties. The Town had approximately \$87,000 in property damage.	NOAA-NCDC



Table 5-1. Flooding Events in the Town of Shandaken, 1950 to 2018

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Ulster County Designated?	Event Details	Source(s)
December 17, 2000	Flooding	N/A	N/A	A record-breaking rainstorm struck eastern New York State, bringing between two and four inches of rain. Ulster County has hit hard. Six towns declared a state of emergency. In the Town of Shandaken, a boy drowned when he attempted to cross the West Branch of the Neversink River. Overall, the County experienced \$500 K in damages.	NOAA-NCDC
May 3 - August 12, 2000	Severe Storms and Flooding	DR-1335	Yes	N/A	FEMA
May 13 – June 2004	Severe Storms and Flooding	DR-1534	Yes	In the Town of Shandaken, Birch Creek flooded, topping the Academy Street Bridge and closing Main Street. Birch Creek Road washed out between Academy and Upper Birch Roads. Numerous culverts were washed out and roads were closed due to flooding. The Town had approximately \$500 K in damages.	NOAA-NCDC, FEMA, Ulster County HMP
August 13 – September 16, 2004	Severe Storms and Flooding	DR-1564	Yes	In the hamlet of Phoenicia, streams in the area flowed over County Route 40.	FEMA, NOAA-NCDC
September 17, 2004	Tropical Depression Ivan	DR-1565	Yes	Tropical Depression Ivan caused streams overflowed onto Route 40 in Phoenicia. The gage on Esopus Creek at Cold Brook recorded a height of 13.6 feet on September 18 th (flood stage is 11 feet).	FEMA, Town Input, NWS
April 2-4, 2005	Severe Storms and Flooding	DR-1589	Yes	A state of emergency was declared, due to flooding, throughout Ulster County. Rainfall totals in the County ranged from 2.67 inches in Saugerties and 6.15 inches in West Shokan. In the Town of Shandaken, Bushnellsville Creek overflowed its banks and flooded Route 42. Overall, the County had approximately \$275 K in damages. FEMA approved over \$1.6 M in public assistance for Ulster County.	NOAA-NCDC, FEMA, NWS
June 26 – July 10, 2006	Severe Storms and Flooding	DR-1650	Yes	The gage on Esopus Creek at Cold Brook recorded a height of 15.52 feet on June 28 th (flood stage is 11 feet).	FEMA, NWS
April 15-16, 2007	Severe Storms and Inland/Coastal Flooding	DR-1692	Yes	An intense storm brought flooding, heavy rain and wet snow to the region. Rainfall amounts of six to eight inches were reported across the eastern Catskills, mid-Hudson Valley and western New England. Rainfall totals for Ulster County ranged from 4.30 inches in Kingston to 7.43 inches in West Shokan. The gage on Esopus Creek at Cold Brook recorded a height of 13.36 feet on April 16 th (flood stage is 11 feet).	FEMA, NWS



Table 5-1. Flooding Events in the Town of Shandaken, 1950 to 2018

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Ulster County Designated?	Event Details	Source(s)
June 19, 2007	Severe Storms and Flooding	DR-1710	Yes	FEMA approved over \$960 K in disaster assistance for Ulster County.	FEMA
September 30 – October 1, 2010	Severe Storms and Flooding	N/A	N/A	Rainfall totals in Ulster County ranged from 3.14 inches in Saugerties to 8.27 inches in the hamlet of Phoenicia. In the Town of Shandaken, Route 214 was closed in both directions due to flooding.	NWS
December 1, 2010	Flood	N/A	N/A	Floodwaters from the Stony Clove Creek over-topped their banks and the Main Street Bridge and flooded the business district of Phoenicia.	Town of Shandaken
April 25 – 30, 2011	Severe Storms, Flooding, Tornadoes and Straight-line Winds	DR-1993	Yes	Rainfall totals in Ulster County ranged from 0.75 inches in Kingston to 2.24 inches in the hamlet of Phoenicia.	FEMA, NWS
August 28-29, 2011	Tropical Storm Irene	DR-4020	Yes	<p>Torrential rains from Tropical Storm Irene forced hundreds of evacuations in the Hudson Valley, causing power outages, closed 137 miles of the New York Thruway, swelled creeks and rivers, and widespread property damage. Ulster County was among the three worst-hit counties in the state. A total of 86 roads were closed across the county due to downed trees, fallen power lines, and flooded roadways. About 56,000 utility customers were without power and over 200 people evacuated their homes.</p> <p>The Town of Shandaken was one of the harder hit communities. The Upper Esopus and Stoney Clove Creeks overflowed their banks and flooded the hamlets of the town, including Phoenicia. Emergency responders and swift-water rescue teams had to rescue two families in the town when their homes were washed off of their foundations. Businesses in the town were inundated with mud two feet deep, and three bridges in the town were severely damaged. The bridges had to be replaced. The Cold Brook Bridge was completely washed away. The Town Supervisor stated that this was the highest the Esopus Creek has been in years. NWS rain gages measured more than 11.5 inches on Slide Mountain in the Town of Shandaken. The Esopus Creek at Cold Brook flood gage recorded a crest of 23.4 feet, the flood stage is 11 feet. This is the flood of record for this gage.</p>	FEMA, NOAA-NCEI, Record Online, NBC 4, NWS



Table 5-1. Flooding Events in the Town of Shandaken, 1950 to 2018

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Ulster County Designated?	Event Details	Source(s)
September 7-11, 2011	Remnants of Tropical Storm Lee	DR-4031	Yes	<p>On September 7th, just after flood waters from Tropical Storm Irene had receded in the Town of Shandaken, remnants of Tropical Storm Lee crept into the region, producing substantial rains and river flooding across parts of central New York State. Bands of heavy rain throughout the day on September 8th brought streams back to flood stage threatened more flooding in areas of recovery from Tropical Storm Irene with temporary infrastructure across the town. The storm did cause minor flooding along the Esopus Creek, upstream of the Ashokan Reservoir. The Esopus Creek at Cold Brook gage recorded a crest of 14.21 feet on September 7th (flood stage is 11 feet) and 11.8 feet on September 8th.</p> <p>The majority of impacts from the storm were primarily due to the weakened state of critical infrastructure and operations from Tropical Storm Irene. Rainfall runoff from the storm broke through some of the temporary stream channel and roadway repairs that had been completed in the aftermath of Irene. The town lost temporary infrastructure on Oliverea Road, McKenley Hollow, and Little Peck Hollow. In addition, the town had damage to Burnham Hollow. Large amount of debris from the storm forced Bridge Street bridge to close.</p>	NY Rising
September 28, 2011	Flash Flood	N/A	N/A	<p>Very heavy rain fell across Ulster County on the morning of September 28th. Rainfall totals ranged from 2.6 inches in Kerhonkson to 4.63 inches in Phoenicia to 5.76 inches in West Shokan. In the hamlet of Mount Tremper, Route 212 was closed due to flooding between Route 28 and Plank Road, where the Beaver Kill feeds into the Esopus Creek. The gage on Esopus Creek at Cold Brook recorded a height of 13.3 feet (flood stage is 11 feet).</p>	NOAA-NCDC, NWS
September 18, 2012	Flood	N/A	N/A	<p>A very powerful system brought heavy rain, strong winds, downed trees and power lines over parts of New York State. Rainfall totals ranged from one inch to over seven inches, with the highest amounts recorded in the eastern Catskills. The heavy rainfall in a short period of time produced flash flooding over portions of the area.</p> <p>In the hamlet of Oliverea, a portion of Oliverea Road was closed due to flash flooding. Flooding also washed out a recently repaired road on County Route 47, below the intersection of McKinley Hollow Road. The Esopus Creek at Cold Brook gage recorded a crest of 14.65 feet (flood stage of 11 feet).</p>	Town of Shandaken, NOAA-NCEI, NWS



Table 5-1. Flooding Events in the Town of Shandaken, 1950 to 2018

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Ulster County Designated?	Event Details	Source(s)
December 21, 2012	Heavy Rain and Flooding	N/A	N/A	Heavy rainfall over the eastern Catskills caused some minor river flooding. Some minor tidal flooding occurred along the Hudson River which backed up into the Rondout Creek. In the Town of Shandaken, the Esopus Creek at Cold Brook recorded a crest of 12.4 feet (flood stage of 11 feet).	NWS, NOAA-NCEI
February 24-25, 2016	Heavy Rain, Snow Melt, and Flooding	N/A	N/A	Periods of snow and rain fell over parts of Ulster County. A warm front developed, bringing strong thunderstorms. The storms produced very heavy rain, with rainfall rates exceeding one inch per hour at times. The rainfall, combined with a frozen ground in places and some snow melt, caused widespread flooding of urban, poor drainage, and low-lying areas. Some streams and rivers exceeded their flood stages. In the Town of Shandaken, the Esopus Creek at Cold Brook recorded a crest of 12.4 feet (flood stage of 11 feet).	NOAA-NCEI, NWS
October 29-30, 2017	Heavy Rain and Flooding	N/A	N/A	Strong storms brought heavy rain, flooding, and damaging winds to the region. Rainfall totals ranged from two inches in Rensselaer County to seven inches in Greene County. Over four inches of rain was recorded in Ulster County. In the Town of Shandaken, the Esopus Creek at Cold Brook recorded a crest of 12.2 feet (flood stage of 11 feet).	NWS
August 18, 2018	Heavy Rain and Flash Flooding	N/A	N/A	A line of storms brought rain and thunderstorms, resulting in flash flooding in some areas. Gusty winds from the storm also downed power lines. The Esopus Creek at Cold Brook recorded a crest of 11.8 feet (flood stage of 11 feet).	NOAA-NCEI, NWS

Notes:

FEMA Federal Emergency Management Agency
mph miles per hour
NCEI National Centers for Environmental Information
NOAA National Oceanic and Atmospheric Administration
NWS National Weather Service
N/A Not Applicable

5.1.4 Location

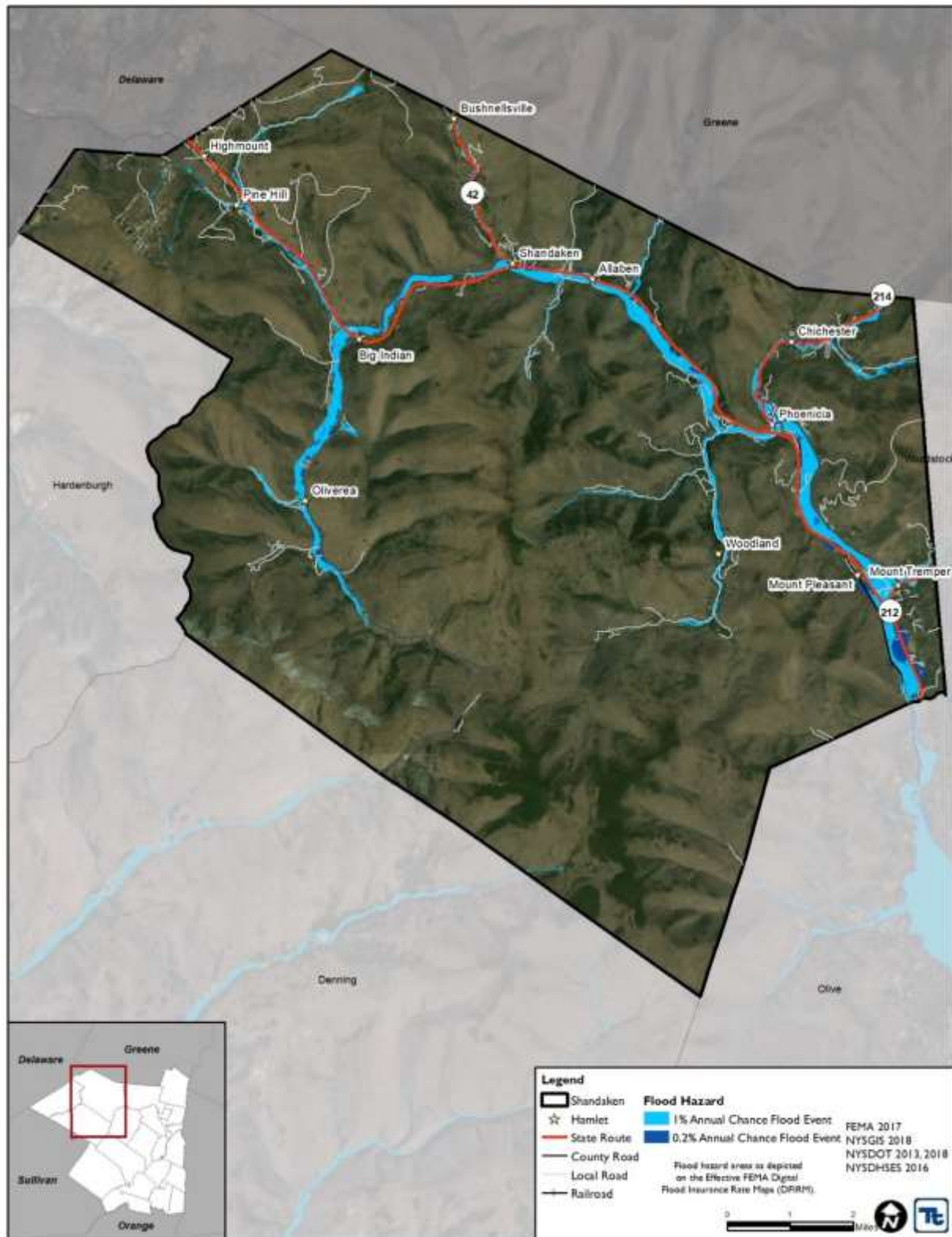
Flooding potential is influenced by climatology, meteorology, and topography (elevations, latitude, and water bodies and waterways). Flooding potential for each type of flooding that affects the Town of Shandaken is described in the subsections below.

Floodplains

Locations of flood zones in the Town of Shandaken as depicted on the FEMA effective Digital Flood Insurance Rate Map (DFIRM) are illustrated in Figure 5-2 and the total land area in the floodplain, inclusive of waterbodies, is summarized in Table 5-2. The DFIRM data provided by FEMA for the Town shows the following flood hazard areas:

- **1-Percent Annual Chance Flood Hazard:** Areas subject to inundation by the 1-percent-annual-chance flood event. This includes Zone A and Zone AE. Mandatory flood insurance requirements and floodplain management standards apply. Base flood elevations are provided in Zone AE. Zone A has no determined flood depths.
- **0.2-Percent Annual Chance Flood Hazard:** Area of minimal flood hazard, usually depicted on FIRMs as the 500-year flood level or Shaded X Zone.

Figure 5-2. FEMA Flood Hazard Areas in the Town of Shandaken



Total Area Located in the Hazard Areas

Table 5-2 below displays the total area in the floodplain for each of the zip codes in the Town. Of the six zip codes in the Town, Mount Tremper as the greatest percentage of area located within both the 1- and 0.2-percent annual chance flood event boundaries, while Phoenicia has the largest total area located within both the 1- and 0.2-percent annual chance flood event boundaries. Despite having the largest exposed areas, Phoenicia has one of the lowest percentages in the floodplain; only greater than Big Indian.

Table 5-2. Total Land Area in the Flood Hazard Areas (Acres)

Zip Code	Total Area	Area in Floodplain (acres)	% of Total
1-percent Annual Chance Flood Event			
Big Indian	29,762	587	2.0%
Chichester	3,532	124	3.5%
Mount Tremper	2,925	309	10.6%
Phoenicia	32,817	937	2.9%
Pine Hill	1,302	53	4.1%
Shandaken	8,858	362	4.1%
Total	79,197	2,372	3.0%
0.2-percent Annual Chance Flood Event			
Big Indian	29,762	687	2.3%
Chichester	3,532	160	4.5%
Mount Tremper	2,925	477	16.3%
Phoenicia	32,817	1,121	3.4%
Pine Hill	1,302	65	5.0%
Shandaken	8,858	462	5.2%
Total	79,197	2,972	3.8%

Source: FEMA 2017

Note: % - Percent; Cumulative analysis conducted.

Ice Jams

There have been 2 recorded ice jam events occurring in the Town of Shandaken between 1780 and 2012. Information regarding losses associated with these reported ice jams was limited.

Table 5-3. Ice Jam Events in the Town of Shandaken Between 1780 and 2012

Event Date	River/Location	Gage Number	Description	Source (s)
February 2, 1981	Esopus Creek at Shandaken	1362198	An ice jam occurred resulting in a gage height of 7.82 ft. and discharge of 120 cfs.	CRREL
February 2, 1981	Esopus Creek	1362198	An ice jam occurred resulting in a gage height of 7.78 and discharge of 450 cfs.	CRREL



	at Shandaken			
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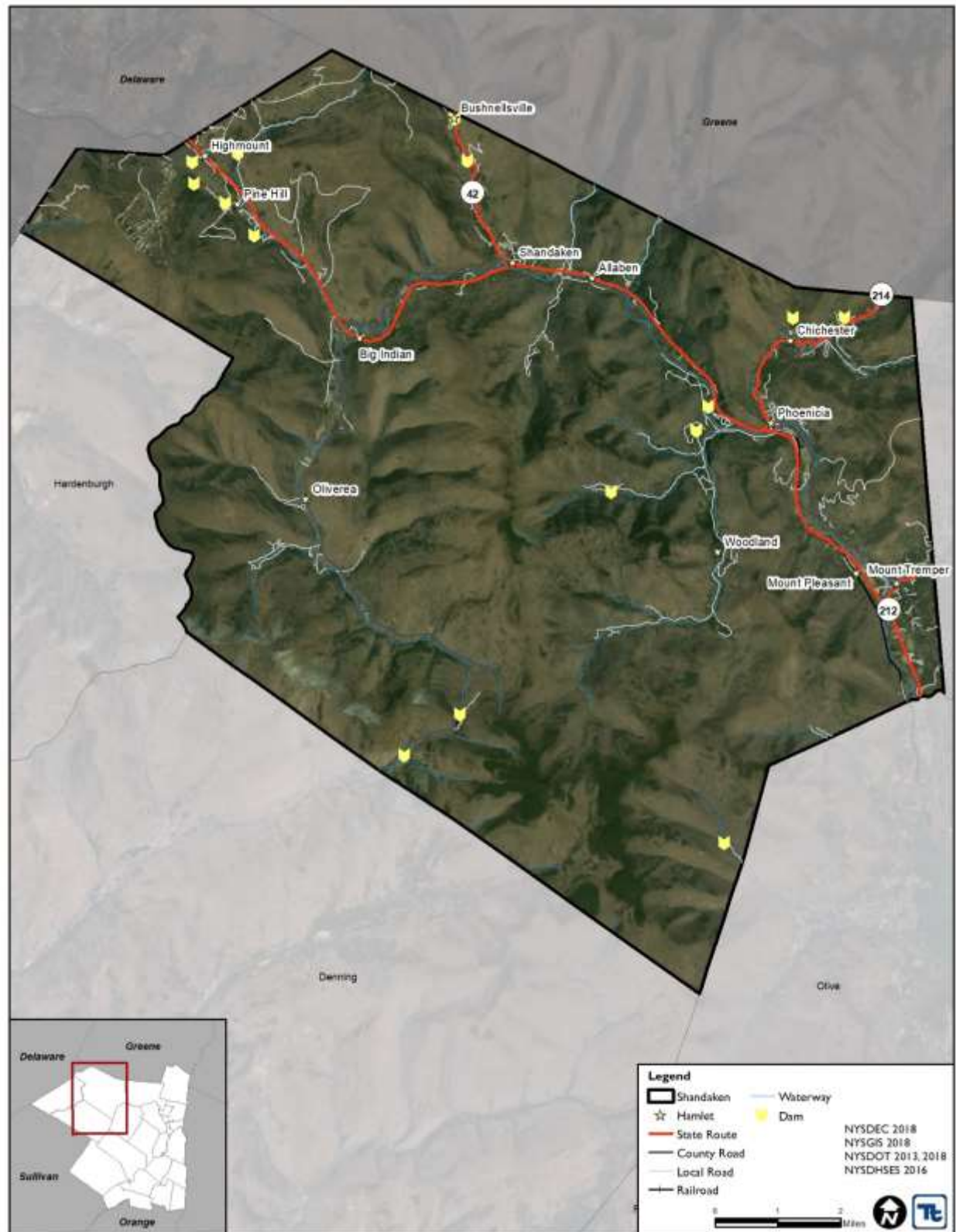
Source: CRREL, 2012

Note: Although many events were reported for Ulster County, information pertaining to every event was not easily ascertainable; therefore, this table may not represent all ice jams in the Town of Shandaken.

Dams

The New York State Inventory of Dams, identifies 15 dams in Shandaken: 8 low hazard, 1 intermediate hazard, 0 high hazard, and 6 negligible or no hazard classification (NYS DEC 2018). Figure 5-3 below shows their location throughout the town. A table of the town's dam inventory is provided in Section 3 (Town Profile) of this plan which provides their hazard classification.

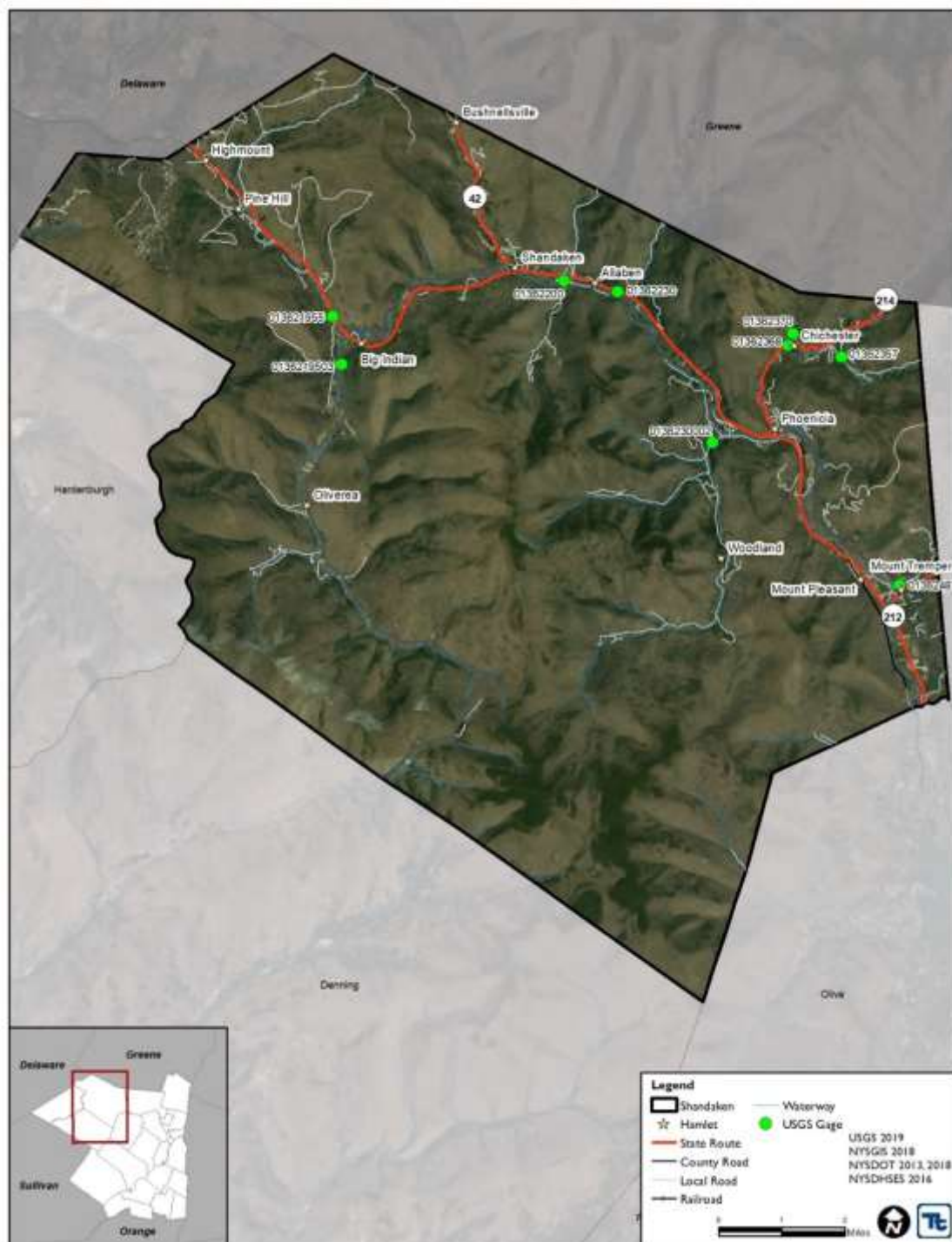
Figure 5-5-3. Dams in the Town of Shandaken



Stream Gages

USGS uses stream gages to determine the severity of flood at different points along a body of water. There are nine total gages in the Town of Shandaken found along Esopus Creek, Stone Clove Creek, Ox Clove, Warner Creek, Little Beaver Kill, and Beaver Kill (Figure 5-4).

Figure 5-4. USGS Stream Gages in the Town of Shandaken



5.1.5 Frequency

Recurrence intervals and average annual number of events in the Town of Shandaken were calculated based on data from 1996 to 2018 in NOAA-NCEI Storm Events Database. The Town of Shandaken has experienced 25 events since 1996 classified as flood in the database. Based on this data, floods and flash floods have a 100-percent chance of occurring in any given year. Ice jams have an eight-percent chance of occurring in any given year. Overall, flooding, of all magnitudes, will likely continue to be an annual hazard for the Town of Shandaken.

5.1.6 Severity

The severity of a flood event is typically determined by a combination of several factors including: stream and river basin topography and physiography; precipitation and weather patterns; recent soil moisture conditions; and degree of vegetative clearing and impervious surface. Generally, floods are long-term events that may last for several days. Flood severity is often evaluated by examining peak discharges. Table 5-4 lists peaks flows used by FEMA to map the floodplains in the Town of Shandaken.

Table 5-4. Summary of Peak Discharges Within the Town of Shandaken

Source/Location	Drainage Area (sq. miles)	10-year	Discharge (cubic feet/second)		
		50-year	100-year	500-year	
Esopus Creek Reach 2					
Above Ashokan Reservoir	193.64	30,440	63,747	86,781	169,597
Above confluence of Little Beaver Kill	173.1	28,476	59,272	80,683	158,630
Above confluence of Beaver Kill	144.23	24,183	50,173	68,362	134,869
Above confluence of Stony Clove Creek	105.3	18,209	38,121	51,036	97,916
Above confluence of Woodland Creek	83.98	15,173	31,970	42,159	79,494
Above confluence of Broadstreet Hollow	69.95	12,600	26,827	35,214	66,342
Above confluence of Peck Hollow	63.71	11,390	24,274	31,925	60,210
Above confluence of Bushnellsville Creek	47.57	8,716	18,444	24,287	45,372
Above confluence of Birch Creek	29.95	5,886	12,406	16,312	30,206
Above confluence of Lost Clove	26.66	5,439	11,397	15,007	27,333
Above confluence of Hatchery Hollow	20.66	4,393	8,919	11,611	20,869
Above confluence of McKinley Hollow	16.14	3,539	7,051	9,104	16,133
Above confluence of Elk Bush Kill	11.8	2,711	5,390	6,943	12,199
Bushnellsville Creek					
Above confluence with Esopus Creek Reach 2	11.12	2,200	4,654	6,114	11,213
2,000 feet upstream of Gossoo Road	8.59	1,823	3,787	4,944	8,930
Stony Clove Creek					
Above confluence with Esopus Creek	32.44	6,966	15,463	20,895	38,759
Above confluence of Ox Clove	27.06	5,807	12,979	17,606	32,650
Above confluence of Warner Creek	17.51	4,772	10,569	14,324	26,694

Source/Location	Drainage Area (sq. miles)	Discharge (cubic feet/second)			
		10-year	50-year	100-year	500-year
Beaver Kill					
Above confluence with Esopus Creek Reach 2	25.06	4,613	9,583	12,764	23,147
At confluence of Hoyt Hollow	20.58	3,683	7,583	10,109	18,446
Above confluence of Wagner Creek	13.59	2,601	5,232	6,942	12,666
Above confluence of Mink Hollow	1.45	234	448	583	1,002
Birch Creek					
Above confluence with Esopus Creek Reach 2	12.86	2,253	4,937	6,569	12,348
Above confluence of Rochester Hollow	10.24	1,838	4,033	5,390	10,016
Above confluence of Giggie Hollow	7.96	1,564	3,433	4,570	8,484
Above confluence of Alton Creek	4.96	936	2,060	2,738	5,094
At intersection of Birch Creek Road and Lower Birch Creek Road	3.05	602	1,348	1,797	3,365

Source: FEMA 2018

Ice Jam Flooding

The severity of flooding from an ice jam is similar to that of riverine flooding. During a period of rapid snowmelt, river levels will increase and ice in the rivers will melt and float down the rivers. As the ice piles up along a river, the flow of water is blocked and can cause the river to overflow its banks, flooding nearby properties (Northeast States Emergency Consortium 2019).

Dam Failure Flooding

According to the NYSDEC Division of Water Bureau of Flood Protection and Dam Safety, the hazard classification of a dam is assigned according to the potential impacts of a dam failure pursuant to 6 New York Codes, Rules, and Regulations (NYCRR) Part 673.3 (NYSDEC 2009). Dams are classified in terms of potential for downstream damage if the dam were to fail. These hazard classifications are identified and defined below:

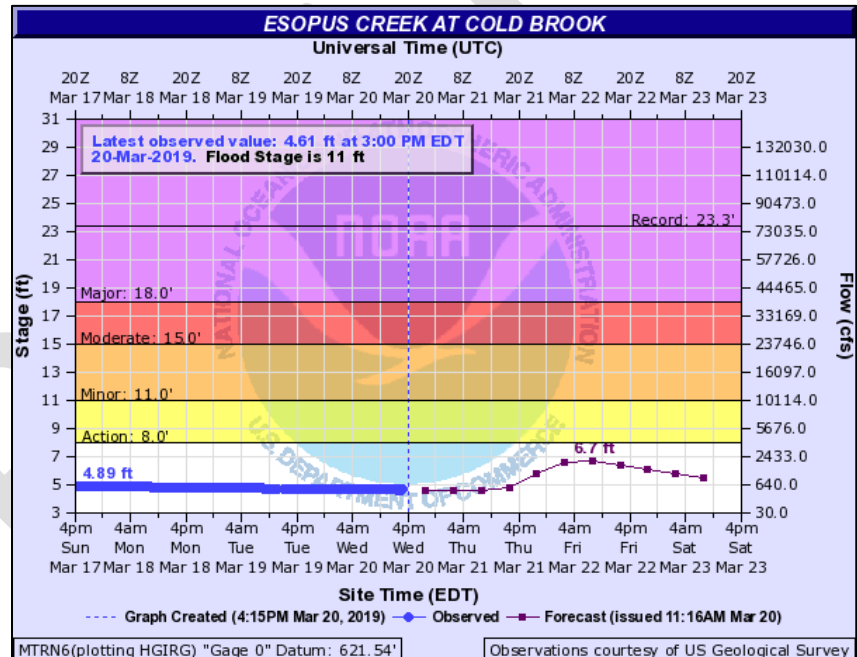
- *Low Hazard (Class A)* is a dam located in an area where failure will damage nothing more than isolated buildings, undeveloped lands, or township or county roads and/or will cause no significant economic loss or serious environmental damage. Failure or mis-operation would result in no probable loss of human life. Losses are principally limited to the owner's property
- *Intermediate Hazard (Class B)* is a dam located in an area where failure may damage isolated homes, main highways, minor railroads, interrupt the use of relatively important public utilities, and/or will cause significant economic loss or serious environmental damage. Failure or mis-operation would result in no probable loss of human life, but can cause economic loss, environment damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.
- *High Hazard (Class C)* is a dam located in an area where failure may cause loss of human life, serious damage to homes, industrial or commercial buildings, important public utilities, main highways or railroads and/or will cause extensive economic loss. This is a downstream hazard classification for dams in which excessive economic loss (urban area including extensive

community, industry, agriculture, or outstanding natural resources) would occur as a direct result of dam failure.

- *Negligible or No Hazard (Class D)* is (1) a dam that has been breached or removed, or has failed or otherwise no longer materially impounds waters, or (2) a dam that was planned but never constructed. Class "D" dams are considered to be defunct dams posing negligible or no hazard. The department may retain pertinent records regarding such dams.

5.1.7 Warning Time

The Town of Shandaken has undertaken extensive flood control measures to mitigate risk in floodprone areas, including the maintenance and operation of a flood warning system. The system is used to identify the flood threat and respond to it. It consists of a network of precipitation and stream gages located at strategic locations throughout the watershed. These gages continuously monitor and report stream levels. The information is then fed into a USGS forecasting program, which assesses the flood threat based on the amount of flow running within the stream. The town utilizes the gage located along Esopus Creek at Cold Brook to help analyze the town's risk of flooding. At this gage, action stage is 8 feet, minor flooding/initial flood stage is 11 feet, moderate flooding is 15 feet, and major flooding is 18 feet. Refer to the Town of Shandaken's Flood Warning and Response Plan for details on the response process for the different flood levels.



Due to the sequential pattern of meteorological conditions needed to cause serious flooding in an area, it is unusual for a flood to occur without warning. Warnings times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger.

The NWS issues flood watches and warnings when forecasts indicate rivers may approach bank-full levels or when other types of localized flooding are possible. The watches and warnings are as follows:

- *Flash Flood Warning* is issued to inform the public, emergency management and other cooperating agencies that flash flooding is in progress, imminent, or highly likely. Flash Flood Warnings are urgent messages as dangerous flooding can develop very rapidly, with a serious threat to life and/or property. Flash Flood Warnings are usually issued minutes to hours in advance of the onset of flooding.

- *Flash Flood Watch* is issued to indicate current or developing conditions that are favorable for flash flooding. The occurrence is neither certain nor imminent. A watch is typically issued within several hours to days ahead of the onset of possible flash flooding.
- *Flood Warning* is issued to inform the public of flooding that poses a serious threat to life and/or property. A Flood Warning may be issued hours to days in advance of the onset of flooding based on forecast conditions. Floods occurring along a river usually contain river stage (level) forecasts.
- *Flood Watch* is issued to indicate current or developing conditions that are favorable for flooding. The occurrence is neither certain nor imminent. A watch is typically issued within several hours to days ahead of the onset of possible flooding. In situations where a river or stream is expected to be the main source of the flooding, forecast confidence may allow for a Flood Watch to be issued several days in advance.
- *Flood Advisory* is issued when a flood event warrants notification but is less urgent than a warning. . Advisories are issued for conditions that could cause a significant inconvenience, and if caution is not exercised, could lead to situations that may threaten life and/or property.

Stream Gages

The flood stage is identified at each gage. The town relies on these gages to determine the height of the rivers and creeks during heavy rain events and to determine whether or not residents will experience flooding or if they need to evacuate their homes. Table 5-5 shows the nine gages in the town with their determined flood stage and their record flood event. The USGS provides details about each of the gages and the gage heights of flooding events.

Table 5-5. Stream Gage Statistics in the Vicinity of the Town of Shandaken

Gage Site Number	Site Name	Record Flood
013621955	Birch Creek at Big Indian	7.18 feet on 8/28/2011
0136219503	Esopus Creek Below Lost Clove Rd at Big Indian	7.52 feet on 2/25/2017*
01362200	Esopus Creek at Allaben NY	16.34 feet on 8/28/2011
0136230002	Woodland Creek Above Mouth at Phoenicia NY	10.65 feet on 4/2/2005
01362357	Warner Creek Near Chichester NY	6.29 feet on 9/18/2012
01362368	Ox Clove Near Mouth at Chichester NY	5.35 feet on 8/17/2018**
01362370	Stony Clove Creek Blw Ox Clove at Chichester NY	9.61 feet on 8/28/2011
01362487	Beaver Kill at Mount Tremper NY	15.15 feet on 8/28/2011
01362497	Little Beaver Kill at Beechford Near Mt Tremper NY	8.71 feet on 6/26/2006
01362500	Esopus Creek at Cold Brook	23.34 feet on 8/28/2011

Source: USGS 2019

*Period of record is October 2016 to present

**Period of record is December 2016 to present

5.1.8 Secondary Hazards

Flood can have significant secondary impacts on a community. Floods can lead to disruption of services, including drinking water, utilities, and transportation systems. Potable water can become contaminated, especially if a wastewater or sewage treatment plants were flooded. Gas, electrical, and other utility services can also be disrupted. Transportation and roadways can also be disrupted, resulting in food supply and cleanup supplies as deliveries to local stores cannot be made. Closed roadways can also impact the response time of emergency personnel. Flooding can also cause landslides. Landslides might occur when water flows over saturated soils on steep slopes, causing them to fail. Lastly, hazardous materials spills are also a secondary hazard of flooding if storage tanks rupture and spill into streams, rivers, or storm sewers.

Dam failure can cause severe downstream flooding, depending on the magnitude of the failure. Other potential secondary hazards of dam failure are landslides around the reservoir perimeter, bank erosion on the rivers, and destruction of downstream habitat. Dam failures can occur as a result of structural failures, such as progressive erosion of an embankment or overtopping and breaching by a severe flood. Earthquakes may weaken dams. Floods caused by dam failures have caused loss of life and property damage (FEMA 1996). To date, there have been no recorded incidents or events at any of the dams located in the Town of Shandaken.

5.1.9 Future Trends

Climate change is beginning to affect both people and resources of the State [sic of NY] and County and the impacts of climate change will continue. Impacts related to increasing temperatures and sea level rise are already being felt in the County (NYSDEC 2019). *ClimAID: The Integrated Assessment for Effective Climate Change in New York State (ClimAID)* was undertaken to provide decision-makers with information on the State's vulnerability to climate change and to facilitate the development of adaptation strategies informed by both local experience and scientific knowledge (New York State Energy Research and Development Authority [NYSERDA] 2011).

Temperatures in New York State are warming, with an average rate of warming over the past century of 0.25° F per decade. Average annual temperatures are projected to increase across New York State by 2° F to 3.4° F by the 2020s, 4.1° F to 6.8° F by the 2050s, and 5.3° F to 10.1° F by the 2080s. By the end of the century, the greatest warming is projected to be in the northern section of the State (NYSERDA 2014).

Regional precipitation across New York State is projected to increase by approximately one to eight-percent by the 2020s, three to 12-percent by the 2050s, and four to 15-percent by the 2080s. By the end of the century, the greatest increases in precipitation are projected to be in the northern areas of the State (NYSERDA 2014).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Ulster County is part of Region 2, Catskill Mountains and the West Hudson River Valley. In Region 2, it is estimated that temperatures will increase by 3.1°F to 6.9°F by the 2050s and 4.0°F to 10.7°F by the 2080s (baseline of 50.0°F, middle range projection). Precipitation totals will increase between 1 and 14% by the 2050s and 2 to 18% by the 2080s (baseline of 46.0 inches, middle range projection). Table displays the projected seasonal precipitation change for Catskill Mountains and the West Hudson River Valley ClimAID Region (NYSERDA 2014).

Table 5-6. Projected Seasonal Precipitation Change in Region 2, 2050s (% change)

Winter	Spring	Summer	Fall
0 to +15	0 to +10	-5 to +10	-5 to +10

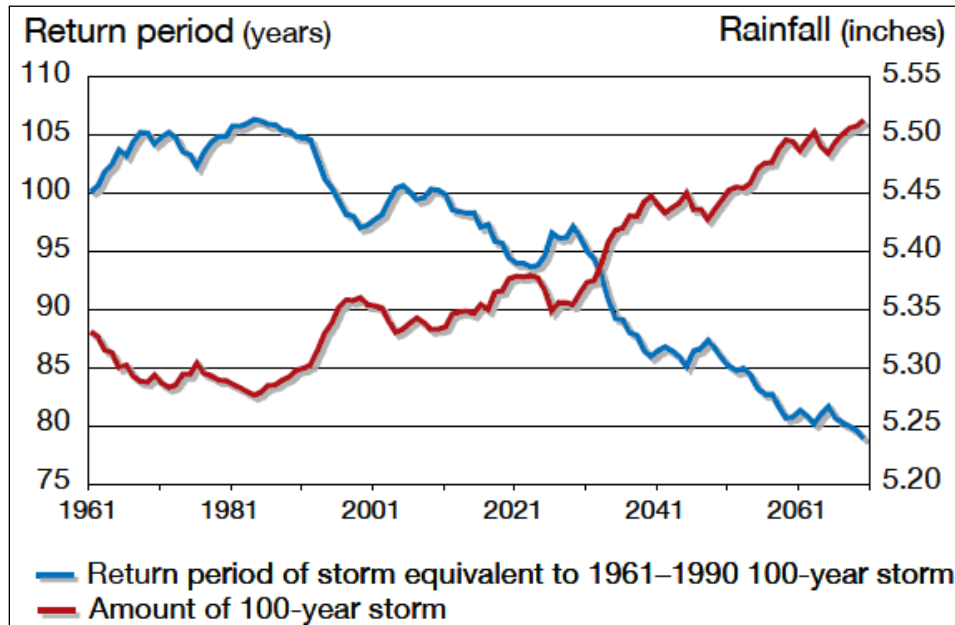
Source: NYSEDA 2011

The projected increase in precipitation is expected to fall in heavy downpours and less in light rains. The increase in heavy downpours has the potential to affect drinking water; heighten the risk of riverine flooding; flood key rail lines, roadways and transportation hubs; and increase delays and hazards related to extreme weather events (NYSERDA 2011).

Increasing air temperatures intensify the water cycle by increasing evaporation and precipitation. This can cause an increase in rain totals during events with longer dry periods in between those events. These changes can have a variety of effects on the State's water resources (NYSERDA 2011). Figure 5-5 displays the project rainfall and frequency of extreme storms in New York State. The amount of rain fall in a 100-year event is projected to

increase, while the number of years between such storms (return period) is projected to decrease. Rainstorms will become more severe and more frequent (NYSERDA 2011).

Figure 5-5 Projected Rainfall and Frequency of Extreme Storms



Source: NYSERDA 2011

Downscaled data regarding increased intensity and frequency of precipitation in New York State with respect to climate change scenarios has been developed by the Northeast Regional Climate Center and is available online via an online tool for extreme precipitation analysis found at <http://precip.eas.cornell.edu/>. For an overview of this tool refer to Section 4 (Relevant Plans) of this document. This information can be used to provide context for evaluation and design of proposed mitigation projects.

5.1.10 Scenario

The primary water courses in the Town of Shandaken have the potential to flood at regular intervals generally in response to a series of heavy rain events. The worst-case scenario to date was seen during and in the aftermath of Tropical Storm Lee (August 2011) when in just 10 minutes after the first indication of the high water level at Cold Brook Gage was recorded at 9.73 feet, the Town officials declared a state of emergency and within an hour the stream had risen almost a foot, and almost 13 feet by in a quarter day (6 hours). The creek became a raging current, destroying culverts, roads, lifting and relocating the Bridge St. Bridge in Phoenicia and causing significant erosion (Town of Shandaken NYRCR Plan, 2014).

5.1.11 Challenges, Data Gaps, and Issues

The following challenges, data gaps, and issues associated with the flood hazard in the Town of Shandaken have been identified:

- There needs to be a sustained effort to gather historical damage data, such as highwater marks on structures and damage reports, to measure the cost-effectiveness of potential mitigation projects.
- Ongoing flood mitigation will require funding from multiple sources.

- Education for residents in flood hazard areas about flood preparedness and the resources available during and after floods should continue.
- The potential impact of climate change on flood conditions in the planning area is unknown and needs to be monitored.

5.2 VULNERABILITY ASSESSMENT

A spatial analysis was conducted using the best available spatially-delineated flood hazard areas to assess the Town of Shandaken's risk to the flood hazard. The 1- and 0.2-percent annual chance flood events were examined to determine the assets located in the hazard areas and to estimate potential loss using the FEMA HAZUS-MH v4.2 model. These results are summarized below.

5.2.1 Overview of Vulnerability

The flood hazard is a significant concern for the Town of Shandaken. As discussed, this includes riverine flooding, flash flooding, and flooding from dam failure, and sea level rise. In addition, coastal erosion is a significant coastal hazard to the Township as well. To assess flood vulnerability, exposure to the 1- and 0.2-percent annual chance flood events was examined using the FEMA preliminary FIRM released in April 2017. Potential losses were also calculated for 1- percent annual chance flood event. The flood hazard exposure and loss estimate analysis is presented below.

5.2.2 Data and Methodology

The 1- and 0.2-percent annual chance flood events were examined to evaluate the County's risk from the flood hazard. These flood events are generally those considered by planners and evaluated under federal programs such as NFIP.

The effective Ulster County FEMA Digital Flood Insurance Rate Maps (DFIRM) dated November 2016 were used to evaluate exposure and determine potential future losses for this 2018 plan update. The latest Letter of Map Revision (LOMR) effective date is April 2017; the two LOMRs were for areas in the Towns of Saugerties and Ulster. The 1-percent annual chance depth grid was generated using base flood elevation (BFE) and cross-section (XS) data and the 1-percent annual chance flood boundaries from the 2017 effective DFIRM and the USGS 1-meter resolution Digital Elevation Model (DEM) released in 2016. Milone and MacBroom has conducted several local flood analysis studies in the Town; 1-percent annual chance event depth grids generated for the Phoenicia/Mt. Tremper detailed study in 2016 were integrated into the depth grid and replaced the following reaches: Beaver Kill from the confluence of the Esopus Creek to the Shandaken-Woodstock border; Esopus Creek from approximately 0.6 miles upstream of Woodland Creek to approximately 0.6 miles upstream of the Shandaken-Olive border. The resulting depth grid was integrated into the 2018 HAZUS-MH v4.2 riverine flood model. The 0.2-percent annual chance flood event depth grid was generated using the lettered XSs and 0.2-percent annual chance flood event boundaries from the 2017 effective DFIRM and the USGS 1-meter resolution DEM; 0.2-percent annual chance flood event depth grids were obtained and applied to the XS spatial layer using the 2016 effective Ulster County FIS profiles. The following Approximate A-zone reaches did not have detailed depth data for the 0.2-percent annual chance flood event, so the area generated for the 1-percent annual chance flood event were integrated into the depth grid: East Branch Neversink River, Panther Kill, McKinley Hollow, Esopus Creek, and Birch Creek.

To estimate exposure to the 1- and 0.2- annual chance flood events, the DFIRM flood boundaries, updated general building stock inventory, 2018 Ulster County parcels, updated critical facility inventories, and 2010 U.S. Census population data were used. Assets (population, building stock, critical facilities, and new development)

with their centroid in the hazard areas were totaled to estimate the numbers and values exposed to a flooding event. To estimate the population over 65 and low-income population exposed to the flood hazard areas, the 2010 U.S. Census demographic data in HAZUS-MH v4.2 was utilized; income data is presented as total households, so the totals for households with income below \$20,000/year were multiplied by the average household size for Shandaken – 2.02 (as of the 2010 U.S. Census). To estimate potential losses, a Level 2 HAZUS-MH v4.2 riverine flood analysis was performed for the 1- and 0.2-percent annual chance flood events. Potential losses to the building stock were estimated at the structure level by integrating each structure located in the 1- and 0.2-percent annual chance flood event boundaries as a user-defined facility in HAZUS-MH v4.2. The updated critical facility inventories were also incorporated into HAZUS-MH v4.2, replacing the default essential facility (police, fire, schools, etc.) and utility inventories. HAZUS-MH v4.2 calculated the estimated potential losses to the population (sheltering) and potential damages to the general building stock and critical facility inventories based on the depth grid generated and the default HAZUS-MH v4.2 damage functions in the flood model.

Locations of the properties with policies, claims, and repetitive and severe repetitive flooding were geocoded by FEMA with the understanding that differences (and variations in those differences) were possible between listed longitude and latitude coordinates of properties and actual locations of property addresses—namely, that indications of some locations were more accurate than others. For properties without longitude or latitude coordinates provided, addresses provided in datasets were used to geocode each location. The county provided information regarding repetitive loss and severe repetitive loss properties that have been mitigated and are not included in the below inventories in **table XX** due to this information.

Natural and Beneficial Floodplain Areas

Although typically associated as a hazard area, floodplains also serve beneficial and natural functions (on ecological/environmental, social, and economic levels). Disruption of these natural systems can have long-term consequences on entire regions; however, this potential impact has only recently been noted. Some of the more well-known water-related functions for floodplains include:

- Natural flood and erosion control
 - Provide flood storage and conveyance
 - Reduce flood velocities
 - Reduce flood peaks
 - Reduce sedimentation
- Surface water quality maintenance
 - Filter nutrients and impurities from runoff
 - Process organic wastes
 - Moderate temperatures of water
- Groundwater recharge
 - Promote infiltration and aquifer recharge
 - Reduce frequency and duration of low surface flows (FEMA)

Areas in the floodplain that typically provide these natural functions are wetlands, riparian areas, sensitive areas, and habitats for rare and endangered species. According to the Town of Shandaken has several floodplain areas

that could serve natural and beneficial functions. Table 5-7 below displays the acres of beneficial natural lands that intersect the 1- and 0.2-percent annual chance flood boundaries.

Table 5-7. Natural and Beneficial Land in the Town of Shandaken

Wetlands	Area (acres)	Forest	Area (acres)	Endangered Species	Area (acres)
1-percent Annual Chance Flood Event					
Emergent Herbaceous Wetlands	22	Forest	1,075		
Woody Wetlands	659	Grassland/Shrub	28		
Total	681	Total	1,103		
0.2-percent Annual Chance Flood Event					
Emergent Herbaceous Wetlands	22	Forest	1,353		
Woody Wetlands	712	Grassland/Shrub	33		
Total	735	Total	1,386		

Source: FEMA 2017; USGS National Land Cover Database 2011

Warning and Evacuation

The Town has developed a Flood Warning and response plan to assist the community in ensuring timely identification of impending flood threats and disseminating warnings to appropriate floodplain occupants in addition to coordinating flood response activities to reduce the threat to life and property. Further information may be obtained from the Town Supervisor's Office.

5.2.3 Impact on Life, Health and Safety

Impacts of flooding on life, health, and safety depend on several factors including severity of the event and whether or not adequate warning time is provided to residents. Assumedly, the population living in or near floodplain areas that could be impacted by a flood would be exposed. However, exposure should not be limited only to those who reside within a defined hazard zone, but everyone who may be affected by a hazard event (e.g., people are considered at risk if they are traveling in flooded areas, or their access to emergency services is compromised during an event). The degree of that impact varies and is not strictly measurable.

According to the 2010 U.S. Census blocks, an estimated 381 people reside in the 1-percent annual chance event boundary, and 487 people within the 0.2-percent annual chance flood boundary. These residents may be displaced by the flooding of their homes, requiring them to seek temporary shelter with friends and family or in emergency shelters. Phoenicia has the greatest estimated number of individuals within the floodplain—approximately 143 and 168 people in the 1-percent and 0.2-percent chance events, respectively. Pine Hill has the highest percentage of population within the 1- and 0.2-percent annual chance floodplains with 18.5% and 27.2% of the population living within each floodplain, respectively. Table 5-8 lists population estimates within flood hazard zones by zip code in the Town of Shandaken. Table 5-9 displays the change in population exposure from the 2013 FMP. Overall, there was an increase in the population exposed to both the 1- and 0.2-percent floodplain boundaries, 57 and 72 people, respectively. In the Mount Tremper and Shandaken zip codes, there was a decrease in the exposure to the 0.2-percent annual chance flood event, and in Chichester, there was no change in vulnerability to either flood event.

Table 5-8. Estimated U.S. Census 2010 Population Exposure to All Hazard Areas

Zip Code	Total 2010 U.S. Census Population	1-percent Annual Chance Flood Event		0.2-percent Annual Chance Flood Event	
		Total Number Exposed	% of Total	Total Number Exposed	% of Total
Big Indian	434	77	17.7%	85	19.6%
Chichester	345	8	2.3%	8	2.3%
Mount Tremper	478	41	8.6%	90	18.8%
Phoenicia	1,021	143	14.0%	168	16.5%
Pine Hill	265	49	18.5%	72	27.2%
Shandaken	542	63	11.6%	64	11.8%
Total	3,085	381	12.4%	487	15.8%

Source: FEMA 2017, US Census 2010

Note: % - Percent

Table 5-9. Change in Estimated U.S. Census 2010 Population Exposure to the 1- and 0.2-percent Annual Chance Flood Hazard Areas

Zip Code	2013 FMP		2018 FMP		Change in Exposure	
	1-Percent Flood	0.2-Percent Flood	1-Percent Flood	0.2-Percent Flood	Change in 1-Percent Exposure	Change in 0.2-Percent Exposure
Big Indian	69	69	77	108	8	39
Chichester	8	8	8	8	0	0
Mount Tremper	41	98	41	90	0	-8
Phoenicia	140	163	143	168	3	5
Pine Hill	4	4	49	49	45	45
Shandaken	62	73	63	64	1	-9
Total	324	415	381	487	57	72

Table 5-10. Estimated Population Over 65 and Low-Income Population Exposure to All Hazard Areas

Zip Code	Total 2010 U.S. Census Population Over 65	Total Number Exposed	% of Total	Total 2010 U.S. Census Low-Income Population	Total Number Exposed	% of Total
1-percent Annual Chance Flood Event						
Big Indian	82	10	12.2%	85	6	7.1%
Chichester	55	0	0.0%	115	2	1.7%
Mount Tremper	85	15	17.6%	117	5	4.3%
Phoenicia	198	29	14.6%	269	26	9.7%
Pine Hill	77	17	22.1%	95	9	9.5%
Shandaken	111	10	9.0%	105	7	6.7%
Total	608	81	13.3%	786	55	7.0%
0.2-percent Annual Chance Flood Event						
Big Indian	82	14	17.1%	85	12	14.1%

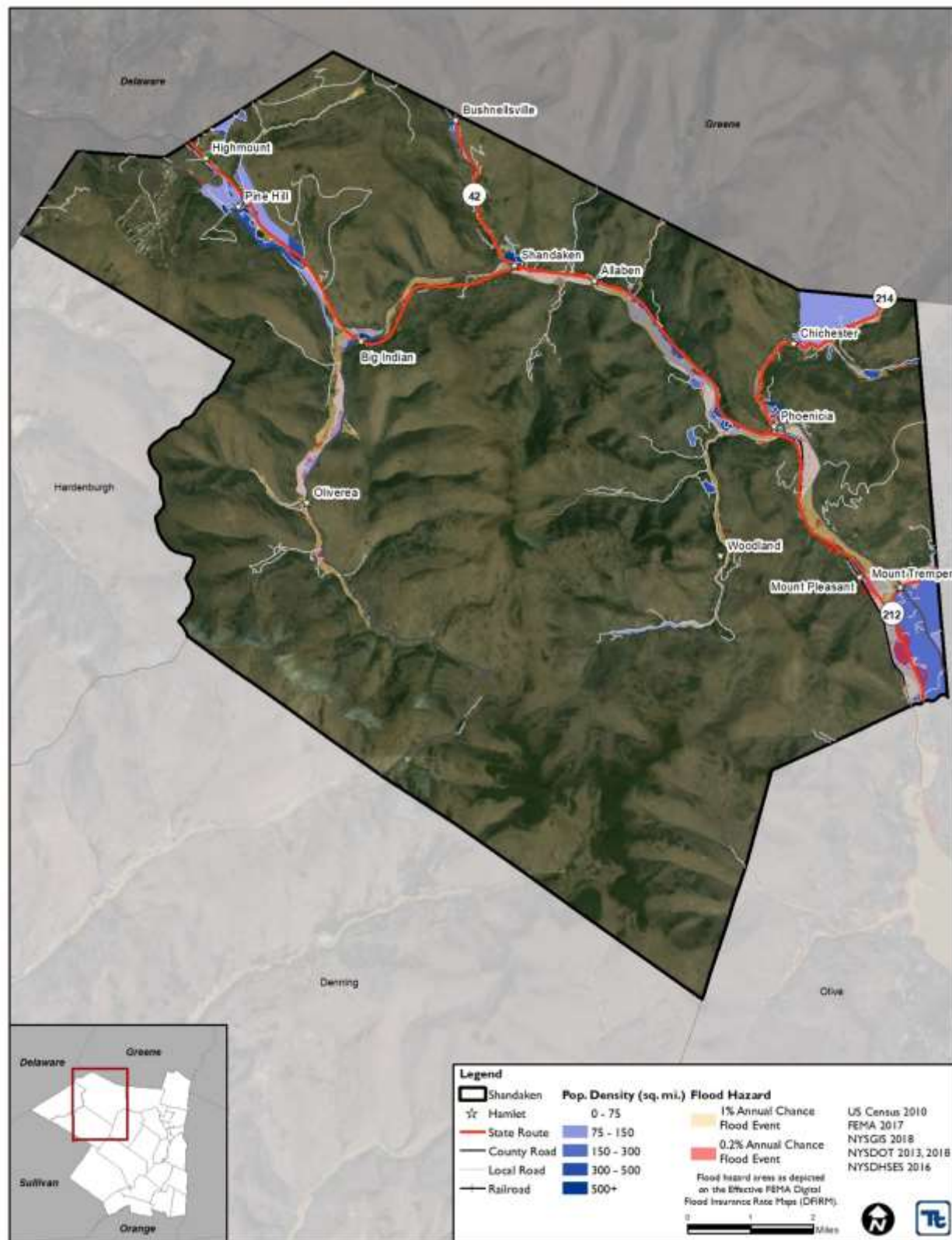
Zip Code	Total 2010 U.S. Census Population Over 65	Total Number Exposed	% of Total	Total 2010 U.S. Census Low-Income Population	Total Number Exposed	% of Total
Chichester	55	0	0.0%	115	4	3.5%
Mount Tremper	85	19	22.4%	117	18	15.4%
Phoenicia	198	33	16.7%	269	63	23.4%
Pine Hill	77	19	24.7%	95	22	23.2%
Shandaken	111	10	9.0%	105	14	13.3%
Total	608	93	15.3%	786	133	16.9%

Source: FEMA 2017, NOAA 2012, US Census 2010

Note: % - Percent

Of the population exposed, the most vulnerable include the economically disadvantaged and the population over the age of 65. Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on the net economic impact to their family. The population over the age of 65 is also more vulnerable because they are more likely to seek or need medical attention which may not be available to due isolation during a flood event and they may have more difficulty evacuating. Special consideration should be taken when planning for disaster preparation, response, and recovery for these vulnerable groups. Within the 1-percent annual chance event, there are 81 people over the age of 65 and 55 people considered low income populations. As for the 0.2-percent chance event, there are 93 people over the age 65 and 133 people considered low income populations.

Figure 5-6. Estimated Population Exposure to Flood Hazard Areas



Using 2010 U.S. Census data, HAZUS-MH v4.2 estimates the potential sheltering needs as a result of the 1- and 0.2-percent annual chance flood events. For the 1-percent annual chance flood event, HAZUS-MH v4.2 estimates 805 people will be displaced, and 28 people will seek short-term sheltering, while for the 0.2-percent annual chance flood event, 1,219 people will be displaced, and 56 people will seek short-term sheltering. These statistics, by municipality, are presented in Table 5-11.

Table 5-11. Estimated Population Displaced or Seeking Short-Term Shelter by the 1-percent Annual Chance Event

Hazard	Total 2010 U.S. Census Population	Displaced Population	% of Total	Population Seeking Short-Term Shelter	% of Total
1-percent Annual Chance Flood Event					
Big Indian	457	85	18.6%	1	0.2%
Chichester	345	81	23.5%	2	0.6%
Mount Tremper	478	161	33.7%	7	1.5%
Phoenicia	1,021	306	30.0%	17	1.7%
Pine Hill	242	41	16.9%	0	0.0%
Shandaken	542	131	24.2%	1	0.2%
Total	3,085	805	26.1%	28	0.9%
0.2-percent Annual Chance Flood Event					
Big Indian	457	122	26.7%	1	0.2%
Chichester	345	131	38.0%	9	2.6%
Mount Tremper	478	221	46.2%	11	2.3%
Phoenicia	1,021	457	44.8%	30	2.9%
Pine Hill	242	70	28.9%	1	0.4%
Shandaken	542	218	40.2%	4	0.7%
Total	3,085	1,219	39.5%	56	1.8%

Source: HAZUS-MH v4.2

Total numbers of injuries and casualties resulting from typical riverine flooding are generally limited based on advance weather forecasting, blockades, and warnings. Injuries and deaths generally are not anticipated if proper warning and precautions occur.

All population in a dam failure inundation zone is considered exposed and vulnerable. Similar to riverine flooding, of the population exposed to dam failure and flash flooding, the most vulnerable include the economically disadvantaged and the population over the age of 65. There is often limited warning time for dam failure and flash flooding. These events are frequently associated with other natural hazard events such as earthquakes, landslides or severe weather, which limits their predictability and compounds the hazard. Populations without adequate warning of the event are highly vulnerable to this hazard.

Cascading impacts may also include exposure to pathogens such as mold. After flood events, excess moisture and standing water contribute to the growth of mold in buildings. Mold may present a health risk to building occupants, especially those with already compromised immune systems such as infants, children, the elderly and pregnant women. The degree of impact will vary and is not strictly measurable. Molds can grow in as short a period as 24-48 hours in wet and damaged areas of buildings that have not been properly cleaned. Very small mold spores can easily be inhaled, creating the potential for allergic reactions, asthma episodes, and other respiratory problems. Buildings should be properly cleaned and dried out to safely prevent mold growth (CDC, 2017).

Molds and mildews are not the only public health risk associated with flooding. Floodwaters can be contaminated by pollutants such as sewage, human and animal feces, pesticides, fertilizers, oil, asbestos, and rusting building materials. Common public health risks associated with flood events also include:

- Unsafe food
- Contaminated drinking and washing water and poor sanitation
- Mosquitos and animals
- Carbon monoxide poisoning
- Secondary hazards associated with re-entering/cleaning flooded structures
- Mental stress and fatigue (CDC 2012)

Current loss estimation models such as HAZUS-MH v4.2 cannot measure public health impacts. The best ways to mitigate these impacts are to be aware that they can occur, educate the public on prevention, and be prepared to deal with these vulnerabilities in responding to flood events.

5.2.4 Impact on General Building Stock

To assess potential impacts on buildings, both exposure (located in the hazard area) and estimated loss to the exposed inventory generated by HAZUS-MH v4.2 were examined for the 1- and 0.2-percent annual chance flood events. Table 5-12 through Table 5-15 summarize these results. In summary, there are 381 buildings located in 1-percent annual chance flood boundary with an estimated \$185 million of building and contents exposed. In total, this represents approximately 15.6% of the Town's total general building stock inventory (approximately \$1.2 billion). Based on this analysis, Phoenicia has the greatest number and percentage of the buildings exposed; the zip code has nearly three times the number of buildings located in the 1-percent annual chance flood boundary than the next highest zip code (Big Indian – 55 buildings).

An estimated 625 buildings are located in the 0.2-percent annual chance flood boundary with an estimated \$299 million of building and contents exposed. This represents approximately 25.2% of the County's total general building stock inventory. Based on this analysis, Phoenicia has the greatest number of the buildings exposed, while Mount Tremper has a slightly greater percentage of buildings exposed; similarly, to the 1-percent annual chance flood event, Phoenicia has nearly three times the number of buildings located in the 0.2-percent annual chance flood boundary than the next highest zip code (Mount Tremper – 87 buildings).

Table 5-12. Estimated General Building Stock Exposure to 1- and 0.2-percent Annual Chance Flood Hazard Areas

Zip Code	Number of Structures Exposed	% of Total	Total RCV Exposed	% of Total	Total Tax Ratable Exposed	% of Total
1-percent Annual Chance Flood Event						
Big Indian	55	13.2%	\$25,412,073	10.6%	\$1,994,700	6.9%
Chichester	25	13.3%	\$11,013,451	13.8%	\$1,034,900	15.5%
Mount Tremper	47	17.5%	\$15,997,055	10.4%	\$4,025,100	32.9%
Phoenicia	171	20.4%	\$87,761,129	21.5%	\$7,168,900	22.9%
Pine Hill	34	14.0%	\$14,895,626	11.6%	\$880,800	9.0%
Shandaken	49	13.2%	\$30,360,996	16.9%	\$2,181,500	15.6%

Table 5-12. Estimated General Building Stock Exposure to 1- and 0.2-percent Annual Chance Flood Hazard Areas

Zip Code	Number of Structures Exposed	% of Total	Total RCV Exposed	% of Total	Total Tax Ratable Exposed	% of Total
Total	381	16.4%	\$185,440,330	15.6%	\$17,285,900	16.8%
0.2-percent Annual Chance Flood Event						
Big Indian	82	19.7%	\$35,723,723	14.9%	\$15,865,200	54.7%
Chichester	42	22.3%	\$16,585,059	20.7%	\$1,518,800	22.8%
Mount Tremper	87	32.5%	\$34,063,467	22.2%	\$5,224,900	42.7%
Phoenicia	273	32.6%	\$141,952,409	34.7%	\$9,567,400	30.6%
Pine Hill	55	22.7%	\$24,623,603	19.1%	\$1,232,300	12.7%
Shandaken	86	23.2%	\$46,510,167	25.9%	\$3,106,200	22.2%
Total	625	26.9%	\$299,458,430	25.2%	\$36,514,800	35.5%

Source: FEMA 2017, Ulster County, 2018; Microsoft 2018

Note: The 1-percent flood boundary was overlaid on the custom general building stock inventory; the structures with their centroids within hazard areas were totaled for each municipality.

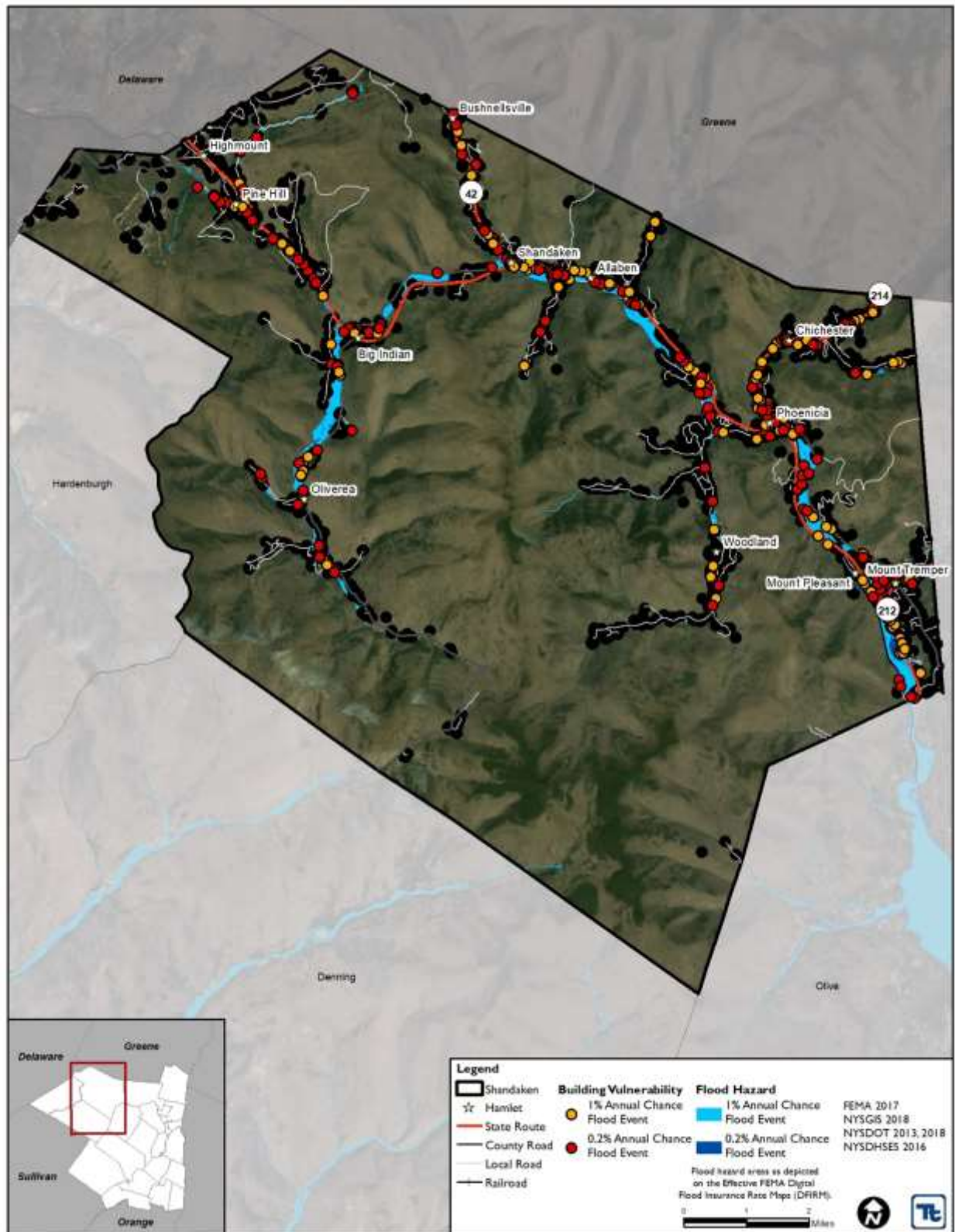
Table 5-13. Estimated Number of Buildings Exposed by Occupancy Type to All Flood Hazard Areas

Hazard	Number of Residential Structures	Number of Commercial Structures	Number of Industrial Structures	Number of Government Structures	Number of Education Structures	Number of Religion/ Non-Profit Structures
1-percent Annual Chance Flood Event						
Big Indian	51	4	0	0	0	0
Chichester	25	0	0	0	0	0
Mount Tremper	44	2	0	0	0	1
Phoenicia	144	21	0	0	1	5
Pine Hill	33	1	0	0	0	0
Shandaken	39	8	0	2	0	0
Total	336	36	0	2	1	6
0.2-percent Annual Chance Flood Event						
Big Indian	77	5	0	0	0	0
Chichester	42	0	0	0	0	0
Mount Tremper	82	3	0	1	0	1
Phoenicia	229	30	0	0	3	11
Pine Hill	51	1	3	0	0	0
Shandaken	71	11	0	4	0	0
Total	552	50	3	5	3	12

Source: FEMA 2017, Ulster County, 2018; Microsoft 2018

Note: The 0.2-percent flood boundary was overlaid on the custom general building stock inventory; the structures with their centroids within hazard areas were totaled for each municipality.

Figure 5-7. Estimated General Building Stock Exposure to Flood Hazard Areas



The HAZUS-MH v4.2 model estimated potential damages to buildings in Shandaken for the 1- and 0.2-percent annual chance flood events. Table 5-15 summarizes these results. In total, HAZUS-MH v4.2 estimates \$37.8 million in potential building damages, which equates to approximately 3.2% of the total Town building stock replacement cost value for the 1-percent annual chance flood event. Potential damage estimated by HAZUS-MH v4.2 to the residential general building stock inventory associated with the 1-percent annual chance flood is approximately \$26.7 million, or 2.9% of the total residential building stock replacement cost value and 70.6 percent of the total potential loss for all occupancy classes. HAZUS-MH v4.2 estimates \$99.4 million in potential building damages, which equates to approximately 8.3% of the total Town building stock replacement cost value for the 0.2-percent annual chance flood event. Potential damage estimated by HAZUS-MH v4.2 to the residential general building stock inventory associated with the 1-percent annual chance flood is approximately \$71.9 million, or 7.7% of the total residential building stock replacement cost value and 72.3 percent of the total potential loss for all occupancy classes. Overall, there was an increase of \$16.7 million in potential loss as a result of the 1-percent annual chance flood event and an increase \$57.7 million in potential loss as a result of the 0.2-percent annual chance flood event since the 2013 FMP.

Table 5-14. Estimated General Building Stock Potential Loss to the 1-percent Annual Chance Flood Event

Zip Code	Total Replacement Cost Value	Total Estimated Loss	Estimated Building Loss	Estimated Contents Loss	% of Total RCV
1-percent Annual Chance Flood Event					
Big Indian	\$240,811,532	\$3,425,628	\$1,902,308	\$1,523,319	1.4%
Chichester	\$80,078,629	\$1,712,292	\$1,110,810	\$601,482	2.1%
Mount Tremper	\$155,607,209	\$6,454,943	\$4,449,827	\$2,005,116	4.2%
Phoenicia	\$408,924,106	\$16,473,555	\$9,236,955	\$7,236,600	4.0%
Pine Hill	\$128,728,079	\$1,711,667	\$1,150,497	\$561,170	1.3%
Shandaken	\$179,957,600	\$8,028,853	\$2,994,812	\$5,034,040	4.5%
Total	\$1,194,107,155	\$37,806,938	\$20,845,210	\$16,961,728	3.2%
0.2-percent Annual Chance Flood Event					
Big Indian	\$240,811,532	\$8,527,255	\$5,209,611	\$3,317,644	3.6%
Chichester	\$80,078,629	\$4,401,778	\$2,649,229	\$1,752,549	5.5%
Mount Tremper	\$155,607,209	\$13,736,481	\$8,810,126	\$4,926,355	9.0%
Phoenicia	\$408,924,106	\$51,127,119	\$28,223,856	\$22,903,263	12.5%
Pine Hill	\$128,728,079	\$5,680,190	\$3,791,900	\$1,888,290	4.4%
Shandaken	\$179,957,600	\$15,914,282	\$7,263,591	\$8,650,691	8.9%
Total	\$1,194,107,155	\$99,387,106	\$55,948,314	\$43,438,792	8.3%

Source: HAZUS-MH v4.2

Note: % - Percent

Table 5-15. Change in Estimated General Building Stock Potential Loss to the 1-percent Annual Chance Flood Event

Zip Code	2013 FMP		2018 FMP		Change in Exposure
	1-Percent Annual Chance Flood	% of Total 2013 FMP	1-Percent Flood Annual Chance Flood	% of Total 2018 FMP	Change in 1-Percent Annual Chance Flood Potential Loss
Big Indian	\$946,684	<1%	\$3,425,628	1.4%	\$2,478,944
Chichester	\$572,016	<1%	\$1,712,292	2.1%	\$1,140,276

Zip Code	2013 FMP		2018 FMP		Change in Exposure
	1-Percent Annual Chance Flood	% of Total 2013 FMP	1-Percent Flood Annual Chance Flood	% of Total 2018 FMP	Change in 1-Percent Annual Chance Flood Potential Loss
Mount Tremper	\$3,951,526	4.3%	\$6,454,943	4.2%	\$2,503,417
Phoenicia	\$14,136,990	4.9%	\$16,473,555	4.0%	\$2,336,565
Pine Hill	\$441,562	<1%	\$1,711,667	1.3%	\$1,270,105
Shandaken	\$2,782,619	2.4%	\$8,028,853	4.5%	\$5,246,234
Total	\$22,831,396	2.8%	\$37,806,938	3.2%	\$14,975,542

Source: HAZUS-MH v4.2

Table 5-16. Change in Estimated General Building Stock Potential Loss to the 0.2-percent Annual Chance Flood Event

Zip Code	2013 FMP		2018 FMP		Change in Exposure
	0.2-Percent Annual Chance Flood	% of Total 2013 FMP	0.2-Percent Flood Annual Chance Flood	% of Total 2018 FMP	Change in 0.2-Percent Annual Chance Flood Potential Loss
Big Indian	\$2,073,665	1.4%	\$8,527,255	3.6%	\$6,453,590
Chichester	\$1,624,603	2.2%	\$4,401,778	5.5%	\$2,777,175
Mount Tremper	\$7,366,566	8.1%	\$13,736,481	9.0%	\$6,369,915
Phoenicia	\$26,782,711	9.2%	\$51,127,119	12.5%	\$24,344,408
Pine Hill	\$737,901	<1%	\$5,680,190	4.4%	\$4,942,289
Shandaken	\$5,344,752	4.6%	\$15,914,282	8.9%	\$10,569,530
Total	\$43,930,197	5.0%	\$99,387,106	8.3%	\$55,456,909

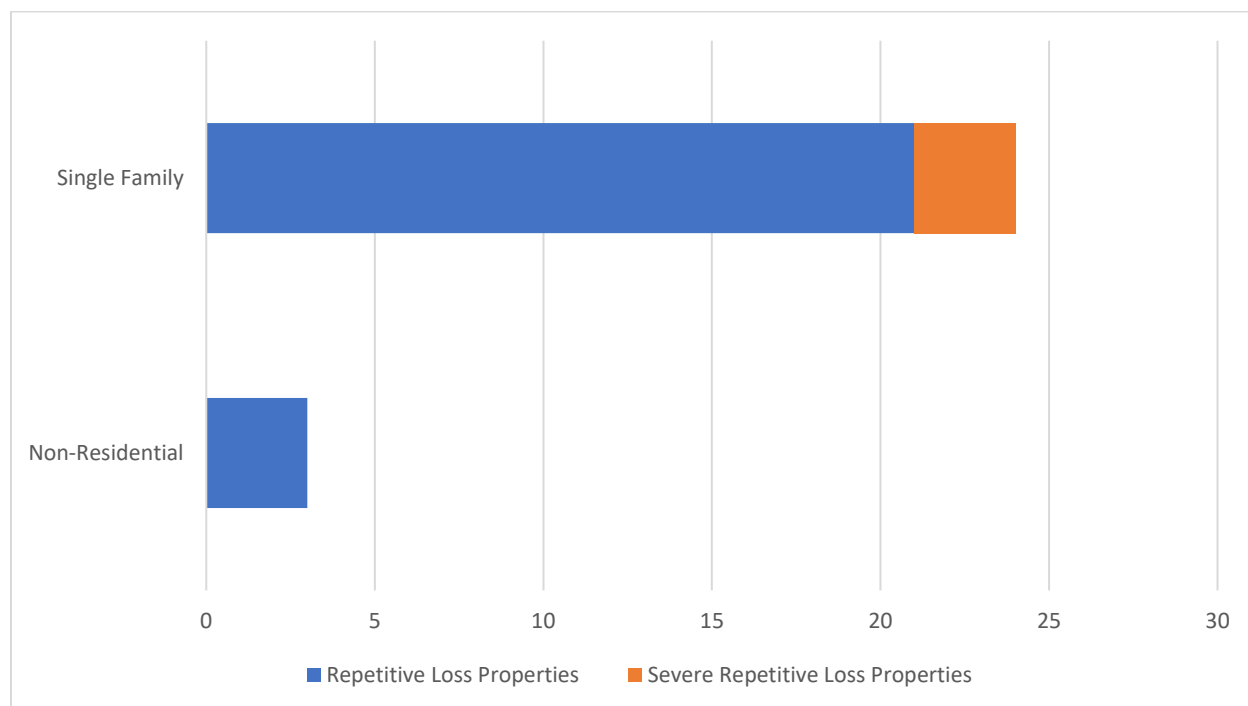
Source: HAZUS-MH v4.2

NFIP Policy, Claim and Repetitive Loss Statistics

FEMA Region 2 provided a list of NFIP policies, past claims, repetitive loss properties (RL), and severe repetitive loss properties (SRL) in the Town of Shandaken. According to FEMA, a RL property is a NFIP-insured structure that has had at least two paid flood losses of more than \$1,000 in any 10-year period since 1978. A SRL property is a NFIP-insured structure that has had four or more separate claim payments made under a standard flood insurance policy, with the amount of each claim exceeding \$5,000 and with the cumulative amount of such claims payments exceeding \$20,000; or at least two separate claims payments made under a standard flood insurance policy with the cumulative amount of such claim payments exceed the fair market value of the insured building on the day before each loss (FEMA 2018).

Figure 5-8 summarizes the NFIP policies, claims, and repetitive loss statistics for the Town of Shandaken. In total, 208 residents are NFIP policy holders, and there have been 274 claims totaling \$5.5 million. Of the 208 policies, 126 policies (60.6 percent of the total) are located in the 1-percent annual chance floodplain; this may indicate inaccuracies with floodplain mapping or stormwater/localized flooding issues that may not be reflected in the FEMA delineated floodplains. Single-family residences account for approximately 87.5 percent of the total RL properties in the Town (FEMA 2017). Of the 24 RL properties, 21 are “single-family” residences and 3 are “non-residential.” There are three severe repetitive loss properties in the county, all of which are single-family. Figure 5-9 shows NFIP RL and SRL properties in the Town.

Figure 5-8. Occupancy Class of Repetitive Loss Structures in the Town of Shandaken



Source: FEMA Region 2 2017

Note (1): Repetitive loss and severe repetitive loss statistics provided by FEMA Region 2 and are current as of 11/30/2017. Inventory was updated by Ulster County to remove mitigated properties.

RL Repetitive Loss

SRL Severe Repetitive Loss

Table 5-17. NFIP Policies, Claims and Repetitive Loss Statistics

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1,4)	# Policies in the 1-percent Flood Boundary (3)
Town of Shandaken	208	274	\$5,549,757	24	3	126

Source: FEMA Region 2, 2017

(1) Policies, claims, repetitive loss and severe repetitive loss statistics provided by FEMA Region 2, and are current as of 11/30/2017

Please note the total number of repetitive loss properties does not include the severe repetitive loss properties. The number of claims represents claims closed by 11/30/2017.

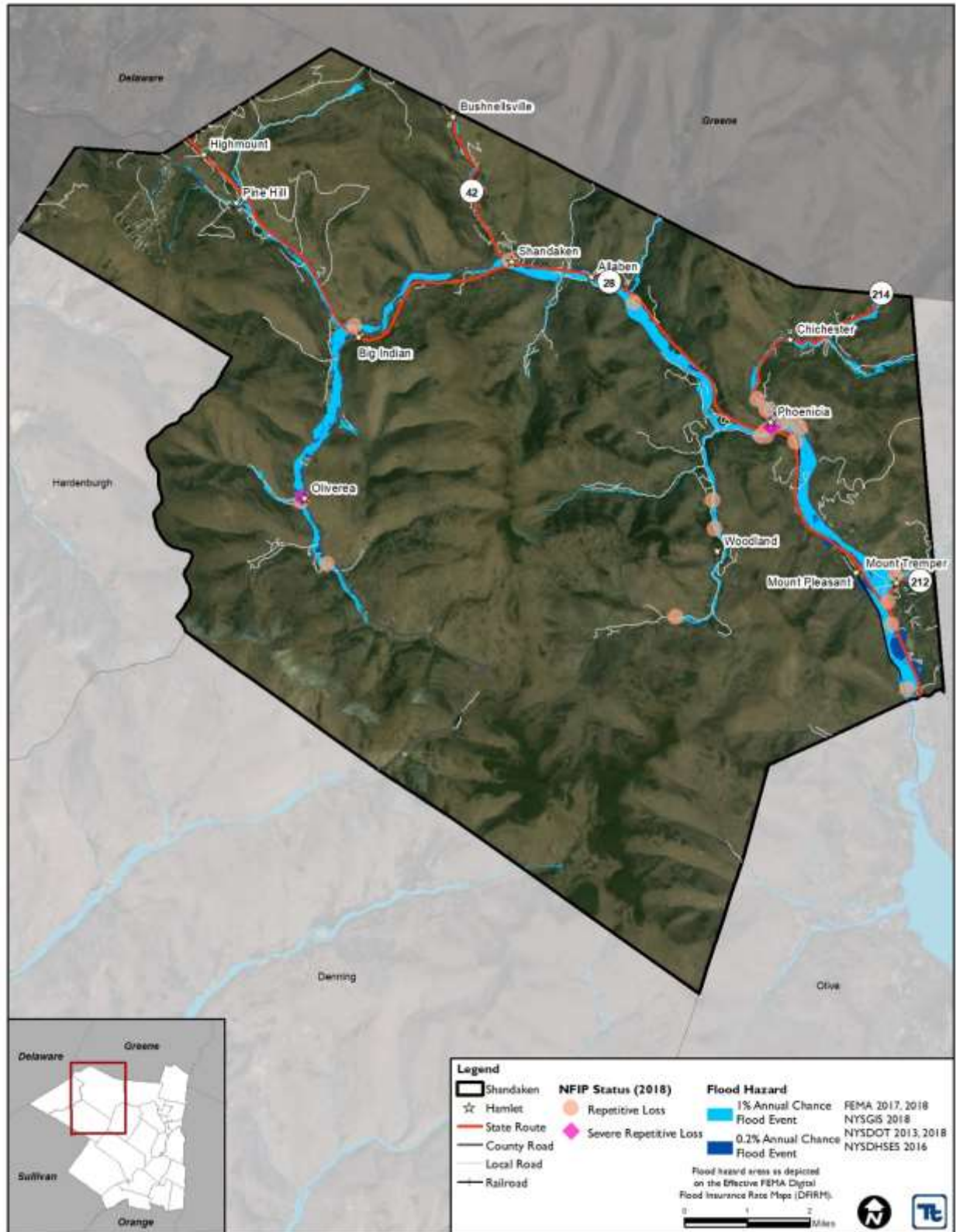
(2) Total building and content losses from the claims file provided by FEMA Region 2.

(3) The policies inside and outside of the flood zones is based on the latitude and longitude provided by FEMA Region 2 in the policy file.

(4) One property is vacant land as structure has been removed and will be addressed via an AW-501 form.

Notes: FEMA noted that where there is more than one entry for a property, there may be more than one policy in force or more than one GIS possibility. A zero percentage denotes less than 1/100th percentage and not zero damages or vulnerability as may be the case.

Figure 5-9. NFIP Repetitive Loss and Severe Repetitive Loss Properties



Repetitive Loss Area Analysis (RLAA)

Purpose

Per the 2017 Community Rating System (CRS) Coordinator's Manual, a repetitive loss area analysis (RLAA) is a mitigation plan for areas that have or are expected to experience repeated losses from flooding. During this analysis, detailed building information is collected through desktop analysis or field visits to develop an understanding of the exact causes of repetitive flood damage at those sites. The purpose of an RLAA is to generate mitigation solutions for individual buildings or areas, in contrast to a hazard mitigation or floodplain management plan, which examines community-wide flooding problems and solutions.

Even though the purpose of an RLAA is to bring about mitigation on individual buildings within a community, it sometimes takes a collective effort from local, state, and federal agencies to actually implement certain mitigation measures. This is particularly true for many techniques like elevation or acquisition of structures, if Federal Emergency Management Agency (FEMA) grant funding is utilized.

The Town of Shandaken will perform an RLAA to enhance the information in this plan to support targeted outreach and more effective floodplain management for the community. The repetitive loss area includes both repetitive loss properties, as determined by FEMA, and properties that may undergo repetitive flood damage but are not technically considered repetitive loss properties by the NFIP. Properties that may undergo repetitive flood damage but are not classified as NFIP RLs or SRLs can occur for a variety of reasons, including the following:

- Property owners may not have flood insurance. Only properties within the floodplain and with a federally-backed mortgage are required to carry flood insurance.
- Owners of a flooded property may choose not to file a claim, even if the owner has flood insurance.
- The flood damage may not meet the minimum \$1,000 threshold necessary for repetitive loss, but the property may still undergo recurring flood damage.

Benefits of an RLAA

Homeowners often want a solution to their repetitive flood problems because they must continually clean up and repair their homes and can even be displaced for a period of time. In response, communities usually provide advice and assistance to property owners who have been flooded or have drainage problems.

From a state and national perspective, mitigating repetitive loss properties makes economic sense and reduces the financial burden on the National Flood Insurance Fund (NFIF). Reducing repetitive flood claims can help strengthen the solvency of the NFIF. But more importantly, reducing damage to repetitively flooded buildings makes communities safer.

Under the CRS program, an RLAA can help increase mitigation opportunities on repetitively flooded buildings in your community, reduce future damage to them, and also provide credit under Activity 510 to help reduce NFIP insured flood insurance premiums.

RLAA Methodology

To be provided after the analysis is completed.

Figure 5-10. NFIP Repetitive Loss Areas – Town of Shandaken.

To be provided after the analysis is completed.

5.2.5 Impact on Critical Facilities

It is important to determine the critical facilities and infrastructure within the County that may be at risk to flooding, and who may be impacted should damage occur. Critical services during and after a flood event may not be available if critical facility structures are directly damaged or transportation routes to access these critical facilities are impacted. Roads that are blocked or damaged can isolate residents and can prevent access throughout the planning area to many service providers needing to get to vulnerable populations or to make repairs.

Major roadways that may be impacted by the 1-percent annual chance flood event include several state and county routes. Table 5-18 below displays the mileage of major roadways impacted by the 1- and 0.2-percent annual chance flood event. Figure 5-11 displays the percent of total roadways that will be impacted by the both flood events for local, county, and state routes. Approximately 17.6 miles of local roadways will be impacted by the 1-percent annual chance flood event, of which 3.2 miles are located in the floodway. Lengths of state and county routes located in the floodway were removed by Ulster County for the below calculations, because these lengths were bridges over the various waterways in the Town.

Table 5-18. Length of Major Roadways in Shandaken Impacted by the 1- and 0.2-percent Annual Chance Flood Event

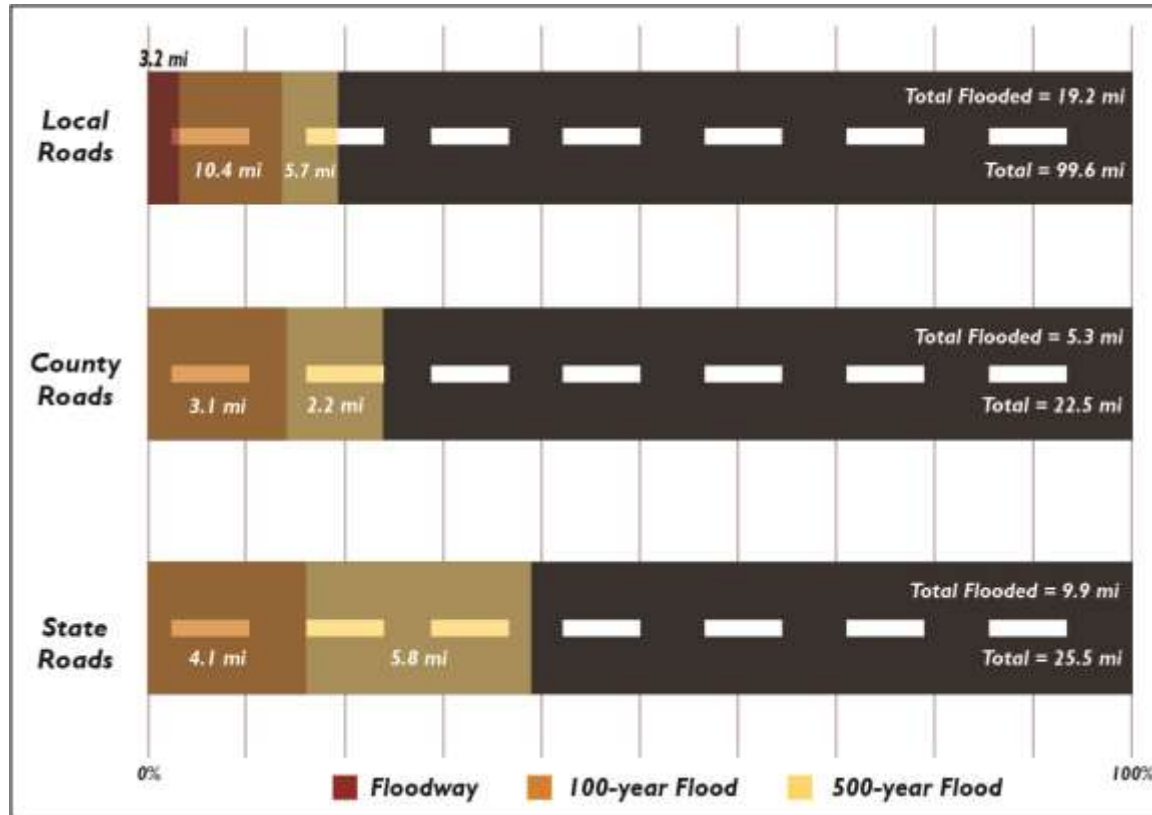
Road Name	Miles in the 1-percent Annual Chance Flood Boundary	Miles in the 0.2-percent Annual Chance Flood Boundary
County Route		
Bridge St	0.2	0.2
Creekside Dr	0.6	1.1
Main St	0.5	0.7
Olivera Rd	0.5	1.3
Plank Rd	1.5	2.1
Wittenberg Rd	<0.1	<0.1
State Route		
Route 28	1.2	5.2
Route 212	0.4	0.6
Route 214	1.6	2.4
Route 42	0.9	1.8

Source: Ulster County 2018

Note: 1. Miles in the 0.2-percent annual chance flood boundary are cumulative.

2. Mileage includes bridges (not all of which are overtopped by the 1% or 0.2% flood events).

Figure 5-11. Impacted Roadways in Shandaken for the 1- and 0.2-percent Annual Chance Flood Event



Critical facility exposure to the flood hazard was examined for this 2018 FMP update. In addition, HAZUS-MH v4.2 was used to estimate the flood loss potential to critical facilities exposed to the flood risk. Table 5-19 summarizes these results. Figure 5-12 and Figure 5-13 display the distribution of critical facilities in the 1- and 0.2-percent annual chance flood event boundaries.

Table 5-19. Critical Facility Types Located in the 1- and 0.2-Percent Annual Chance Event Floodplain and Estimated Damage

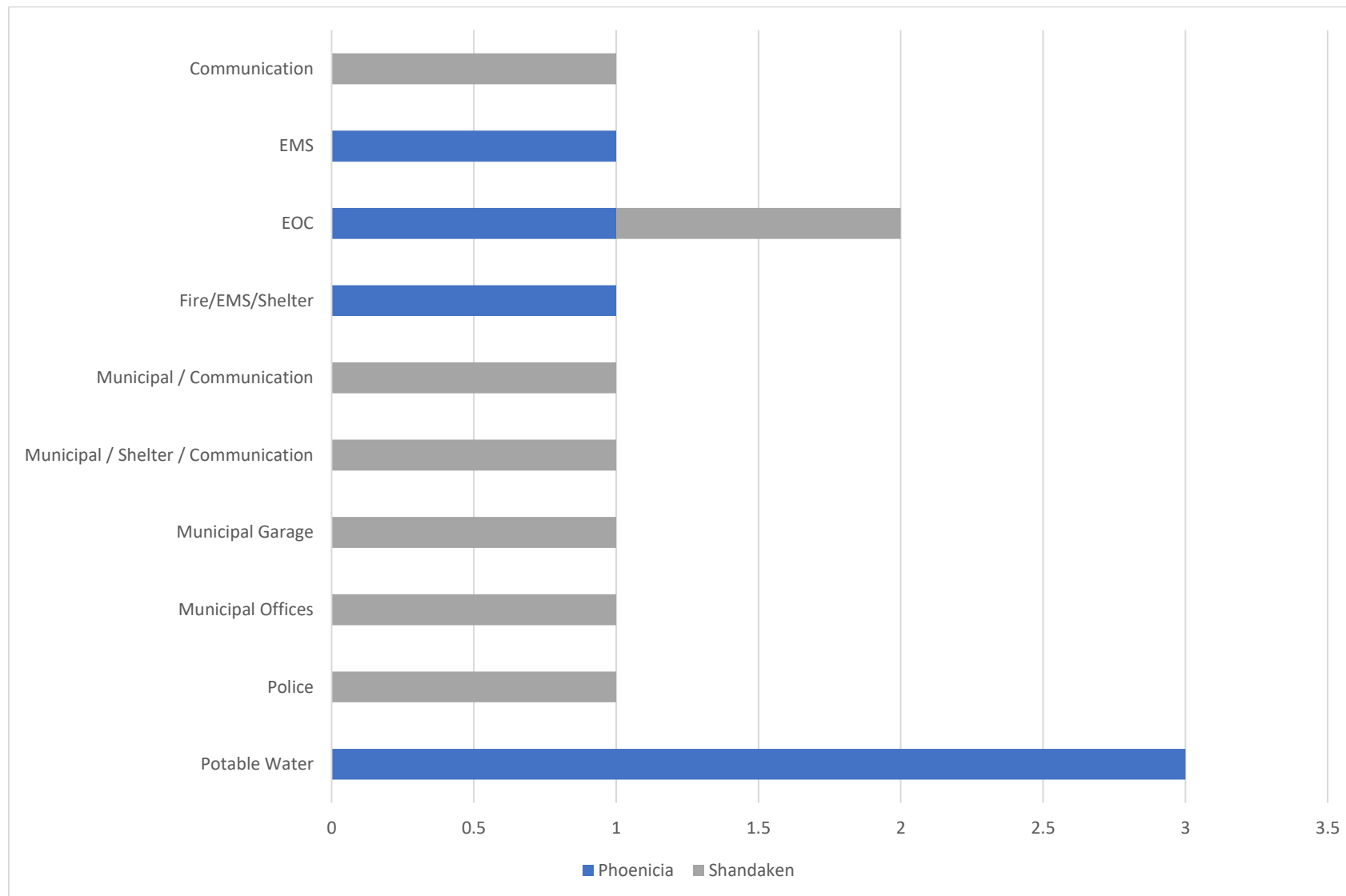
Facility Type	Number of Facilities Located in the 1-Percent Annual Chance Event	Average % of Total Value Damaged (1-percent Annual Chance Event)		Number of Facilities Located in the 0.2-Percent Annual Chance Event	Average % of Total Value Damaged (0.2-percent Annual Chance Event)	
		Structure	Content		Structure	Content
Communication	1	None Estimate	None Estimate	2	None Estimated	None Estimated
Dam	2	None Estimate	None Estimate	2	None Estimated	None Estimated
EMS	1	3.5	4.0	3	18.1	74.9
EOC	2	10.8	33.7	2	20.5	75.6
Fire/EMS/Shelter	1	9.8	19.3	1	28.0	99.9
Municipal / Communication	1	11.1	39.5	1	21.8	94.3
Municipal / Shelter / Communication	1	None Estimate	None Estimate	1	11.9	70.6
Municipal Garage	1	0.6	0.7	2	9.3	23.7
Municipal Offices	1	None Estimate	None Estimate	1	5.7	36.8



Facility Type	Number of Facilities Located in the 1-Percent Annual Chance Event	Average % of Total Value Damaged (1-percent Annual Chance Event)		Number of Facilities Located in the 0.2-Percent Annual Chance Event	Average % of Total Value Damaged (0.2-percent Annual Chance Event)	
		Structure	Content		Structure	Content
Police	1	None Estimate	None Estimate	1	9.9	19.5
Potable Water	3	17.8	-	3	None Estimated	None Estimated
School	0	None Estimate	None Estimate	1	None Estimated	None Estimated
Wastewater	0	None Estimate	None Estimate	1	4.7	-
Total/Average	15	11.1	21.8	21	15.8	64.1

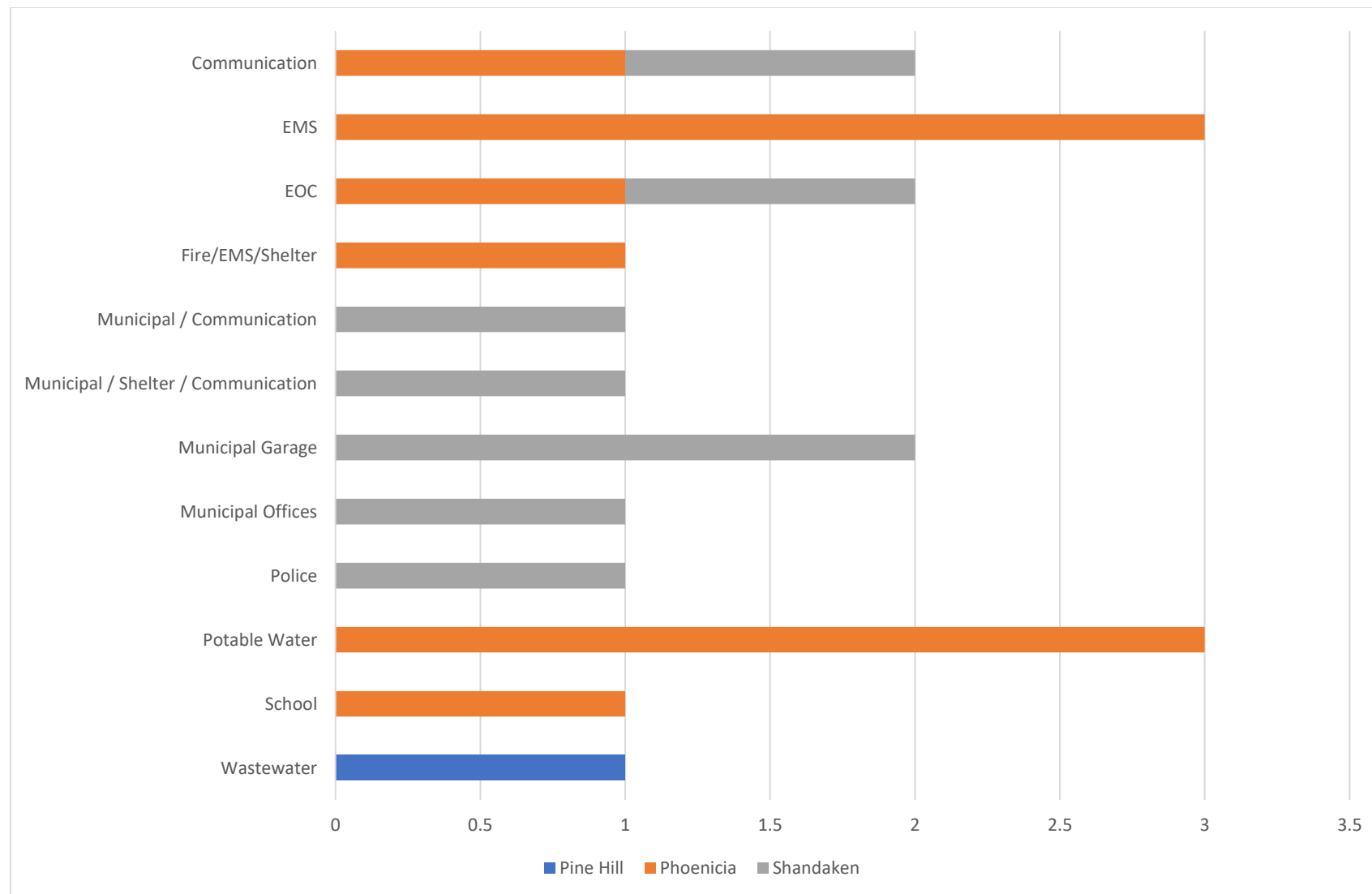
Source: Ulster County GIS & Mapping Services; FEMA 2017; HAZUS-MH v4.2

Figure 5-12. Distribution of Critical Facilities in the 1-Percent Annual Chance Flood Event Floodplain by Type and Municipality



Sources: FEMA 2017; Town of Shandaken

Figure 5-13. Distribution of Critical Facilities in the 0.2-Percent Annual Chance Flood Event Floodplain by Type and Municipality



Sources: FEMA 2017; Town of Shandaken

5.2.6 Impact on the Economy

Flood events can significantly impact the local and regional economy. This includes but is not limited to general building stock damages and associated tax loss, impacts to utilities and infrastructure, agricultural losses, business interruption, and effects on tourism.

In areas that are directly flooded, renovations of commercial and industrial buildings may be necessary, disrupting associated services. Refer to the section earlier which discusses direct impacts to buildings in the County.

Flooding can cause extensive damage to public utilities and disruptions to delivery of services. Loss of power and communications may occur and drinking water and wastewater treatment facilities may be temporarily out of operation. As presented in Figure 5-12, 15 critical facilities are exposed and potentially vulnerable to the 1-percent annual chance flood event.

Debris management may also be a large expense after a flood event. HAZUS-MH v4.2 estimates amount of debris generated during a flood event. The model breaks down debris into three categories: (1) finishes (dry wall, insulation, etc.); (2) structural (wood, brick, etc.); and (3) foundations (concrete slab and block, rebar, etc.). These distinctions are necessary because of the different types of equipment needed to handle debris. Table 5-20 summarizes the HAZUS-MH v4.2 debris estimates for the 1-percent annual chance flood event. Note: this table only estimates structural debris generated by flooding and does not include non-structural debris or additional potential damage and debris possibly generated by wind that may be associated with a flood event or storm that causes flooding.

Table 5-20. Estimated Debris Generated from the 1 and 0.2-Percent Flood Events

Zip Code	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
1-percent Annual Chance Flood Event				
Big Indian	805	315	291	198
Chichester	628	254	212	163
Mount Tremper	2,288	825	933	530
Phoenicia	2,668	1,056	885	727
Pine Hill	123	103	10	10
Shandaken	1,155	504	378	274
Total	7,667	3,056	2,709	1,901
0.2-percent Annual Chance Flood Event				
Big Indian	1,514	602	531	380
Chichester	1,248	501	429	317
Mount Tremper	4,576	1,531	1,921	1,124
Phoenicia	6,440	2,440	2,222	1,779
Pine Hill	379	241	77	60
Shandaken	3,637	979	1,587	1,071
Total	17,793	6,295	6,766	4,732

Source: HAZUS-MH v4.2

Differences between Flood Management Plan and Ulster County HMP (2017)

Several differences exist between the vulnerability assessments of this plan (FMP) and the 2017 Ulster County Hazard Mitigation Plan (HMP). In terms of hazard data, the 2017 HMP used the 2013 Preliminary FEMA Digital Flood Insurance Rate Map (DFIRM) flood maps for Ulster County. This plan uses the 2016 Effective FEMA DFIRM flood maps for Ulster County. Differences between these datasets, such as varying hazard extents, can cause differences between the reported overall exposure estimates.

Differences exist between the structure values used in both plans. The 2017 HMP used the improvement value at the parcel level from the 2014 Ulster County Real Property System tax assessor data. For this plan, a custom-building inventory was generated using 2018 tax assessor data and a Township-wide building footprint spatial layer. The improvement value is the assessed value of the structure that does not directly correlate to the cost of construction. The replacement cost value calculated for the custom-building stock provides a more accurate estimate of the construction costs of a structure; the costs that are needed to repair or replace the building post-flood event. To calculate the replacement cost value for each structure for the purposes of the FMP, the number of stories, square footage, occupancy type, and 2018 RS Means data were used. The RS Means is a nationally accepted reference on building construction costs that is published annually. The RS Means data takes into account occupancy class, regional factors, and materials and the cost to transport materials to the site. Additionally, multiple structures may be present on a single parcel that may not be represented in the improvement value. Using a Township-wide building footprint layer, the replacement cost value of each structure was calculated based on the provided attributes.

Differences also exist between the types of analysis used in both plans. An exposure analysis and statistical analysis using previous damages were used to assess Ulster County's vulnerability to flooding in the 2017 plan. The exposure analysis was conducted to determine the parcels and critical facilities and infrastructure located in the 1- and 0.2-percent annual chance flood event boundaries; an analysis was not conducted for the County's population. To determine potential losses, the annualized loss was estimated using the NOAA NCDC database to calculate the total flood damages for all events in Ulster County from 1996 to 2015; municipal level losses were derived based on each municipality's proportional improvement value in the floodplain. For this plan, an exposure analysis was conducted on the 2010 U.S. Census blocks for population, custom general building stock, parcels, and critical facilities for the 1- and 0.2-percent annual chance flood events. To estimate potential losses, HAZUS-MH v4.2 was used for the 1- and 0.2-percent annual chance flood events. Overall, this plan provides a more detailed and accurate assessment of risk for the Town.

5.2.7 Future Changes that May Impact Vulnerability

Understanding future changes that effect vulnerability in the county can assist in planning for future development and ensure establishment of appropriate mitigation, planning, and preparedness measures. The town considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

Projected Development

As discussed in Section 4, there are currently no areas targeted for future growth and development in the town. The town intends to discourage development within vulnerable areas or to encourage higher regulatory standards on the local level; Flood Mitigation Initiative FMI-22 aims to prevent inappropriate development in areas of high flood risk and foster uses that are compatible with the anticipated flooding conditions. Any development that does occur in the floodplain will be designed to local flood protection standards.

Projected Changes in Population

Since 2000, the population of Shandaken has continually decreased. Between 2000 and 2017, there was approximately a decrease of 388 people (U.S. Census: 3,235; 2013-2017 5-Year American Community Estimate: 2,847). Also, according to population projects from the Cornell Program on Applied Demographics, Ulster County as a whole will experience a continual population decrease through 2040 (approximately 6,000 people in total between 2017 and 2040). If population trends continue for the town, this decrease will reduce the overall vulnerability of the town's population over time. While less people will reside in the Town, those that remain will still be either directly impacted by flood events or indirectly impacted by flood events (i.e., isolated neighborhoods, flood-prone roadways, etc.).

Climate Change

As discussed earlier in this section and indicated in , climate change is resulting in an increase in the frequency of heavy rainfall, and as seen on the IDF curves above, the projected mean for precipitation over specified time periods will increase. Increases in precipitation may alter and expand the floodplain boundaries and runoff patterns, resulting in exposure of populations, buildings, and critical facilities and infrastructure that were previously outside the floodplain. This increase in exposure would result in an increased risk to life and health, an increase in structural losses, a diversion of additional resources to response and recovery efforts, and an increase in business closures affected by future flooding events due to loss of service or access.

Existing dams might not be able to retain and manage increases in water flow from more frequent, heavy rainfall events. Heavy rainfalls might result in more frequent overtopping of these dams and flooding of the County's assets in adjacent inundation areas. However, the probable maximum flood used to design each dam might be able to accommodate changes in climate.

5.2.8 Additional Data and Next Steps

The following may be considered to enhance the vulnerability assessment for the next HMP update:

- As additional FEMA Risk Mapping, Assessment, and Planning (Risk MAP) products become available, these may be used to further enhance this assessment (e.g. depth grids for additional recurrence intervals). Further, as additional climate change scenarios and depth grids are generated, these may also be incorporated into HAZUS-MH and potential losses calculated.
- Conduct detailed studies for the Approximate A-zone reaches for the East Branch Neversink River, Panther Kill, McKinley Hollow, Esopus Creek, and Birch Creek to determine the extent and water depths for the 0.2-percent annual chance flood event and other recurrence intervals.
- Review and update Ulster County's Real Property System (RPS) tax assessor data to ensure complete entries town wide. Not all tax entry attributes are complete with entries missing critical information for generating an accurate general building stock inventory, including number of stories, year built, and foundation type.

Specific mitigation actions addressing improved data collection and further vulnerability analysis is included in Section 6 of this plan.

Section 6 Mitigation Strategy

This section presents mitigation actions for the Town of Shandaken to reduce potential exposure and losses identified as concerns in the Risk Assessment portion of this plan. Shandaken Area Flood Assessment and Remediation Initiative (SAFARI) reviewed the Risk Assessment to identify and develop these mitigation actions, which are presented herein.

This section includes:

1. Background and past mitigation accomplishments
2. General mitigation planning approach
3. Town mitigation goals and objectives (CRS Step 6)
4. Town capability assessment
5. Identification, analysis, and implementation of potential mitigation actions for each hazard (CRS Step 7)
6. Proposed hazard mitigation actions (CRS Step 8)

Hazard mitigation reduces the potential impacts of, and costs associated with, emergency and disaster-related events.

Mitigation actions address a range of impacts, including impacts on the population, property, the economy, and the environment.

Mitigation actions can include activities such as: revisions to and enforcement of building codes, revisions to land-use planning, training and education, and structural and nonstructural safety measures.

This section addresses both mitigation actions that are specific to particular hazards, as well as those that apply to multiple hazards.

6.1 BACKGROUND AND PAST ACCOMPLISHMENTS

An overview of past efforts is provided as a foundation for understanding the mitigation goals, objectives, and actions outlined in this HMP. Vulnerabilities include:

FEMA defines **Goals** as general guidelines that explain what should be achieved. Goals are usually broad, long-term, policy statements, and represent a global vision.

FEMA defines **Objectives** as strategies or implementation steps to attain mitigation goals. Unlike goals, objectives are specific and measurable, where feasible.

FEMA defines **Mitigation Actions** as specific actions that help to achieve the mitigation goals and objectives.

- **Hamlets:** Phoenicia, Mt. Tremper, Oliverea, Shandaken, Chichester
- **Roads:** Brown Road, Oliverea Road, Deer Lane, in Oliverea; Woodland Valley Road, Main Street, and Bridge Street, High Street, Plank Road and Station Road in Phoenicia
- **Bridges:** Main Street Bridge and Bridge Street Bridge in Phoenicia, and multiple bridges in Pine Hill. (Historically, there has been no loss of life but significant damage to structures and municipal infrastructure including roads and utilities have been experienced.)

A list of flood inundation and erosion areas is provided below to indicate the areas of concern in the town.

Table 6-1. Inundation and erosion hazard areas (this table must be regularly updated to reflect changing stream conditions and available data).

Hamlet	Hazard Type	Issues	Priority
Phoenicia	Inundation	Main Street and Bridge Street (bridges), High Street (pump station), Plank Road, and Station Road	High
Chichester	Erosion	Stony Clove Creek (4 sites)	High
Mt. Pleasant/ Mt. Tremper	Inundation	Riseley and Mt Pleasant Roads	High
	Inundation	Route 212	High
Oliverea	Inundation	Brown Road, Oliverea Road, and Deer Lane	High
	Erosion	Brown Road, McKinley Hollow, Maben Hollow, Little Peck Hollow	High
Woodland Valley	Inundation	Woodland Valley Road	Low
	Erosion	Systemic; Fawn Hill Road, Panther Kill, Muddy Brook	Medium
Shandaken	Inundation	Route 42	High
	Erosion	Esopus Creek/ Bushnellsville Creek Flood Control Structure	High
Allaben	Inundation/Erosion	Fox Hollow and Wettje Road	Medium
Bushnellsville	Erosion	High channelized	Low
Big Indian			
	Inundation	Church Street	Low
Pine Hill	Inundation	Multiple Roads (bridges)	Low
	Stormwater	Retrofit	High
	Erosion	Various infrastructure: Rock walls and historic bridges	?
Outside Hamlet	Erosion	Route 28 at Shandaken Tunnel	Medium
Outside Hamlet	Erosion	Esopus Creek near Kinsey Road and Route 28	Low

Source: Town of Shandaken, 2018

* Post-flood cross-sections are needed to determine erosion risk related to sediment aggradation; there is a need to further explore sediment management areas throughout the watershed.

The Town, through previous and ongoing hazard mitigation actions, has demonstrated that it is pro-active in protecting its physical assets and citizens against losses from natural hazards.

Examples of previous and recent actions and projects include:

- **Stony Clove Creek:** Completion of channel modification in Phoenicia.

- Town wide: The Town mitigated, using FEMA HMGP funding, the buyout of 14 flood prone structures in vulnerable areas in 2016-17. Additionally, the Town is supporting the acquisition of another 14 vulnerable properties through a locally-funded buyout/relocation program.
- Levees/Other Flood Control Structures: The Town has requested the NYSDEC to evaluate the levee in Shandaken and is in the process of working with the NYSDOT, NYSDEC, and the USACOE to remove a levee in Mt Tremper.
- The Ashokan Watershed Stream Management Program, in conjunction with the Town of Shandaken, has funded the completion of a Local Flood Analysis in four hamlet areas: Phoenicia, Mt Tremper/Mt Pleasant, Shandaken, and Allaben. Implementation of recommendations outlined in these plans has begun, including:
- Removal of Ulster County's Mt Pleasant Bridge
 - Developing plans for a floodplain enhancement project at Bridge Street in Phoenicia
 - Relocation of the Town Hall/Office and Highway Department complex outside of the floodplain
 - Completed the up-sizing of several bridges and dozens of inadequate culverts since the 2013 plan was completed
 - Completed flood buyouts of more than a dozen substantially damaged buildings and support the acquisition of a dozen additional flood prone properties where buyouts are in progress.

In addition, the Town is contemplating ordinances for increased code requirements for structures in floodplain, is actively preparing a flood warning and response plan, and is preparing to apply to the Community Rating System (CRS) to provide incentive to reduce flood vulnerability and reduce National Insurance Flood Program (NFIP) premiums.

In 2016, the Town adopted the New York State's "Climate Smart Community" pledge, which included several key elements that aim to help the Town become proactive when addressing future flooding and climate change. Two of the provisions include implementing climate-smart land use and enhancing community resilience to climate change.

Additionally, Town officials have remained informed over the last several years in reviewing, understanding, and supporting the need for the climate change provisions made in the New York State Climate Risk and Resiliency Act (CRRRA). Similarly, the Town is supportive of the subsequent revision to New York's Smart Growth Public Infrastructure Policy Act (SGPIPA) and development of the draft "New York State Flood Risk Management Guidance" document. This guidance from the State will have local implications that are likely to result in a decline in future flood damages to critical infrastructure and losses to private and municipal property. These past and ongoing actions have contributed to the Town's understanding of its hazard preparedness and future mitigation action needs, costs, and benefits. These efforts provide a foundation for the SAFARI to use in developing this HMP.

6.2 GENERAL MITIGATION PLANNING APPROACH

The general mitigation planning approach used to develop this plan is based on four steps, which were used to support mitigation planning. These steps are summarized below and presented in more detail in the following sections.

- **Develop mitigation goals and objectives:** Mitigation goals were developed using the hazard characteristics, inventory, and findings of the risk assessment, and through the results of the public

outreach program. By reviewing these outputs and other municipal and state policy documents, objectives tying to these overarching goals were identified and characterized into similar themes.

- **Identify and prioritize mitigation actions:** Based on the risk assessment outputs, the mitigation goals and objectives, existing literature and resources, and input from the participating entities, alternative mitigation actions were identified. The potential mitigation actions were qualitatively evaluated against the mitigation goals and objectives and other evaluation criteria. The mitigation capabilities within the Town (regulatory, administrative and fiscal) were assessed and considered in the selection and prioritization of appropriate, feasible actions. These actions were then prioritized into three categories: high, medium, and low.
- **Prepare an implementation strategy:** High priority mitigation actions are recommended for first consideration for implementation, as discussed under each hazard description in the following sections. However, based on community-specific needs and goals and available funding and costs, some low or medium priority mitigation actions may also be addressed or could be addressed before some of the high priority actions.
- **Document the mitigation planning process:** The mitigation planning process is documented throughout this plan.

6.3 FLOOD MITIGATION PLANNING GOALS AND OBJECTIVES

This section presents the hazard mitigation mission statement, planning goals, and objectives identified to reduce or avoid long-term vulnerabilities to the identified hazards.

From the Mission Statement and goals, objectives were identified, and the objectives were used in the selection and prioritization of recommended mitigation initiatives. These planning components all directly support one another. Mitigation initiatives were prioritized based on meeting multiple objectives.

Mission Statement

The mission of the Town of Shandaken's Flood Mitigation Plan (the Plan) is to develop and promote appropriate Town policy and practices to protect and promote resilient recovery and minimize the impacts to the public, private property, public infrastructure, critical facilities and the environment from probable flood hazards.

Goals and Objectives:

The Town and the SAFARI developed these goals and objectives based on the risk assessment results, input received, and the existing authorities, policies, programs, resources, and capabilities within the Town, County and region. The mitigation goals serve as general guidelines that clarify desired hazard reduction outcomes. The goals represent a long-term vision for hazard reduction and the enhancement of mitigation capabilities.

The goals are compatible with the needs and goals expressed in other available community planning documents, including:

- New York State Hazard Mitigation Plan (2014)
- Ulster County Hazard Mitigation Plan (2017)
- Woodland Creek Stream Management Plan (2018)
- Beaver Kill Stream Management Plan (2015)
- Climate Smart Communities Program
- Shandaken-Hardenburgh NYRCR Plan

- Shandaken-Allaben Local Flood Analysis (2017)
- Phoenicia-Mt. Tremper Local Flood Analysis (2016)
- Comprehensive Plan-Town of Shandaken, (2005)
- Upper Esopus Stream Management Plan (2007)
- Stony Clove Stream Management Plan (2005)
- Broadstreet Hollow Stream Management Plan (2003)

Each goal has a number of corresponding objectives that further define the specific actions or implementation steps. Objectives were developed and/or selected by the SAFARI through its knowledge of the local area, review of past efforts, findings of the risk assessment, qualitative evaluations, and identification of mitigation options.

The overall goal of the Plan is to improve the Town's capability to prepare for, respond to, recover from, mitigate against and reduce vulnerability to flooding. The Town recognizes that New York has now adopted climate change projections for both sea level rise (coastal locations) and future stream flows (for riverine locations) with the purpose of reducing this vulnerability to future flooding, using climate-informed science. The plan identifies and encourages partnerships for coordinated implementation, funding, public awareness and the development of strategies for carefully planned mitigation efforts designed to protect the health, safety, quality of life, environment and economy of the Town of Shandaken.

The five mitigation goals with their respective objectives are presented below:

Goal 1. Protect Life and Property to Increase Resiliency

- *Objective 1-1:* Protect the ongoing operation of critical facilities and infrastructure to increase resiliency.
- *Objective 1-2:* Retrofit, purchase or relocate repetitive and severe repetitive loss assets in the Town.
- *Objective 1-3:* Encourage the establishment of policies, such as using a climate-informed science approach, to help ensure the prioritization and implementation of mitigation actions and/or projects designed to increase resiliency of critical facilities, services, and infrastructure.
- *Objective 1-4:* Implement mitigation actions that enhance the capabilities of the Town to better profile and assess exposure of floods.
- *Objective 1-5:* Better characterize flood/stormwater hazard events by conducting additional hazard studies and identify inadequate stormwater facilities and poorly drained areas and maintain or improve drainage or flood control systems.
- *Objective 1-6:* Develop, maintain, strengthen and promote enforcement of ordinances, regulations, plans and other mechanisms that facilitate flood mitigation and result in a higher level of natural flood risk reduction.
- *Objective 1-7:* Ensure that development is done according to modern and appropriate standards, including the consideration of flood hazard risk.
- *Objective 1-8:* Identify and pursue funding opportunities to develop and implement local flood mitigation activities.
- *Objective 1-9:* Address the specific needs of vulnerable populations

- *Objective 1-10:* Consider future projected hydraulic and hydrologic conditions, such as those recommended by New York State when developing policies, planning, and implementing mitigation actions.
- *Objective 1-11:* Seek and implement risk reduction projects that minimize or mitigate impacts to the environment and to increase the safety of residents and the public.
- **Goal 2. Increase Public Awareness and Preparedness**
- *Objective 2-1:* Develop and implement program(s) to better understand the public's level of individual and household preparedness.
- *Objective 2-2:* Develop and implement additional education and outreach programs to increase public awareness of hazard areas and the risks associated with flooding, and to educate the public on specific, individual preparedness activities.
- *Objective 2-3:* Promote awareness among homeowners, renters, and businesses about obtaining insurance coverage available for flooding.
- *Objective 2-4:* Develop and implement programs to inform vulnerable property owners of appropriate mitigation activities and available funding programs.
- *Objective 2-5:* Provide the public information on tools, partnership opportunities, funding resources, and current government initiatives to assist in implementing mitigation activities.
- *Objective 2-6:* Increase public awareness about potential, but projected, future extreme event conditions and the possible impacts that may have on the community.

Goal 3. Enhance Disaster Preparedness, Response and Recovery

- *Objective 3-1:* Encourage the establishment of policies to help ensure the prioritization and implementation of mitigation actions and/or projects designed to benefit critical facilities, services, and infrastructure.
- *Objective 3-2:* Coordinate and integrate hazard mitigation actions with existing local emergency operations plans.
- *Objective 3-3:* Identify the need for, and acquire, any special emergency services, training, equipment, facilities and infrastructure to enhance response capabilities for flooding.
- *Objective 3-4:* Review and improve, if necessary, emergency traffic routes; communicate such routes to the public and communities.
- *Objective 3-5:* Ensure continuity of governmental operations, emergency services, and critical facilities at the local level during and immediately after flood events.
- *Objective 3-6:* Maintain and expand shared services in acquiring, maintaining and providing emergency services and equipment.
- *Objective 3-7:* Integrate New York State's predicted future conditions when designing disaster preparedness, response and recovery plans.

Goal 4. Protect the Environment and Natural Resources

- *Objective 4-1:* Protect and restore natural lands and features that serve to mitigate losses (including wetlands, floodplains, stream corridors, hillsides and ridge lines). Such lands should be clearly mapped and identified for protection.

- *Objective 4-2:* Continue to preserve, protect and acquire open space, particularly in high hazard areas. Include flood hazard considerations in the prioritization strategy for land acquisition.
- *Objective 4-3:* Incorporate hazard considerations in land-use planning and natural resource management and encourage flood hazard mitigation measures that result in the least adverse effect on the natural environment.
- *Objective 4-4:* Consider using climate-informed science when determining potentially hazardous locations as well as areas that may be in need of additional protection.

Goal 5. Promote Mitigation Efforts through Existing Programs and Partnerships

- *Objective 5-1:* Maintain and expand shared services in acquiring, maintaining and providing emergency services and equipment.
- *Objective 5-2:* Strengthen inter-jurisdiction and interagency communication, coordination, and partnerships to foster flood hazard mitigation actions or projects.
- *Objective 5-3:* Maintain awareness of available funding and partnership opportunities
- *Objective 5-4:* Serve as a model for other communities.
- *Objective 5-5:* Perform ongoing administrative activities to support participation in the Community Rating System.

The Town of Shandaken Capability Assessment

A capability assessment is an inventory of a community's missions, programs and policies; and an analysis of its capacity to carry them out. This assessment is an integral part of the planning process. It identifies, reviews and analyzes local and state programs, policies, regulations, funding and practices currently in place that may either facilitate or hinder mitigation.

A capability assessment was prepared by the Town. By completing this assessment, the Town learned how or whether they would be able to implement certain mitigation actions by determining the following:

- Types of mitigation actions that may be prohibited by law;
- Limitations that may exist on undertaking actions; and
- The range of local and/or state administrative, programmatic, regulatory, financial and technical resources available to assist in implementing their mitigation actions.
- Action is currently outside the scope of capabilities (e.g. funding)

Table 6-2 presents legal and regulatory capabilities. Table 6-3 presents the administrative and technical capabilities. Table 6-4 presents fiscal capabilities, and Table 6-5 presents the community classifications for the Town.

Table 6-2. Legal and Regulatory Capabilities

Regulatory Tools (Codes, Ordinances., Plans)	Do you have this capability?	Local Authority (Y or N)	Prohibitions (State or Federal) (Y or N)	Higher Jurisdictional Authority (Y or N)	State Mandated (Y or N)	Code Citation (Section, Paragraph, Page Number, date of adoption)
1) Building Code	Y	N	N	N	N	New York State Code (IBC)
2) Zoning Ordinance	Y	N	N	N	N	Town, LOCAL LAW #2 December 1987, Chapter 116
3) Subdivision Ordinance	Y	Y	N	Y	Y	12/71 Subdivision Ordinance Section 105 Town Code
4) NFIP Protection Ordinance	Y	Y	Y	N	Y	10/3/2016 Local Law #1, Chapter 77
5) Growth Management	N	N	N	N	N	
6) Floodplain Management / Basin Plan	Y	Y	N	N	N	This plan is the floodplain management plan of record for Shandaken.
7) Stormwater Management Plan/Ordinance	Y	Y	Y	Y	Y	Under NYC DEP Watershed Rules and Regulations, Stormwater Protection Plans are required for all building in the town
8) Comprehensive Plan / Master Plan	Y	Y	N	Y	Y	July 2005
9) Capital Improvements Plan	N	N	N	N	N	
10) Site Plan Review Requirements	Y	Y	N	N	N	Chapter 116 Article 8, Local Law #2 of 1997
11) Open Space Plan	Y	N	Y	N	N	Catskill Park State Land Master Plan (2008)

Regulatory Tools (Codes, Ordinances., Plans)	Do you have this capability?	Local Authority (Y or N)	Prohibitions (State or Federal) (Y or N)	Higher Jurisdictional Authority (Y or N)	State Mandated (Y or N)	Code Citation (Section, Paragraph, Page Number, date of adoption)
12) Stream Corridor Management or Protection Plan	Y	N	N	N	N	Esopus Creek Corridor Management and Protection, adopted by Town in 2008.
13) Economic Development Plan	N	N	Y	Y	N	
14) Emergency Response Plan	Y	Y	Y	N	Y	Town has a flood emergency response plan.
15) Post Disaster Recovery Plan	N	N	N	N	N	
16) Post Disaster Recovery Ordinance eq.	N	N	N	N	N	
17) Real Estate Disclosure	Y	N	N	N	N	NYS real estate law
18) Highway Management Plan	N	Y	N	N	N	
19) COOP/COG Plan	N	Y	N	N	N	Continuity of Operations, Continuity of Government
20) Other [Special Purpose Ordinances (i.e., critical or sensitive areas)]	Y	Y	Y	Y	N	NYC Watershed Regulations; NYS DEC, Town Zoning 116-29 and 41, Standards Within a Flood Fringe Overlay District (as mapped by FEMA). 1993

Table 6-3. Administrative and Technical Capabilities

Staff/ Personnel Resources	Available (Y or N)	Department/ Agency/Position
1) Planner(s) or Engineer(s) with knowledge of land development and land management practices	Y	Shandaken Planning Board
2) Engineer(s) or Professional(s) trained in construction practices related to buildings and/or infrastructure	Y	Knowledgeable Town staff: Supervisor, Building Inspector and Highway Superintendent
3) Planners or engineers with an understanding of natural hazards	Y	Town and County Planning Boards, AWSMP
		Town
5) Surveyor(s) hired independently as needed	Y	Hired independently as needed
6) Personnel skilled or trained in "GIS" applications	Y	AWSMP, Ulster County Department of Planning
7) Scientist(s) familiar with natural hazards in the Town of Shandaken.	Y	AWSMP, NYSDEC
8) Emergency Manager	Y	Ulster County Emergency Coordinator; Town Civil Defense Coordinator, Fire Chiefs, Police, EMS; Incident Commander
9) Grant Writer(s)	Y	SHARP, RCAP Solutions, AWSMP, MARK Project, Town of Shandaken
10) Staff with expertise or training in FEMA benefit/cost analysis	N	NYSOEM provides support

This plan was prepared with input and under the supervision of the Town of Shandaken NFIP Floodplain Administrator who participated as a member of SAFARI and had access to all documents for review and comment throughout the planning process.

Table 6-4. Fiscal Capabilities

Financial Resources	Accessible or Eligible to use (Yes/No/Don't know)
1) Community Development Block Grants (CDBG)	Yes
2) Capital Improvements Project Funding	Yes, DWSRF for Pine Hill Water District
3) Authority to Levy Taxes for specific purposes	Yes: Fire Districts, Water Districts, Lighting, Library
5) Impact Fees for homebuyers or developers of new development/homes	No
6) Incur debt through general obligation bonds	Yes
7) Incur debt through special tax bonds	Yes
8) Incur debt through private activity bonds	No
9) Withhold public expenditures in hazard-prone areas	Yes
10) Government mitigation grant programs (e.g. NYSDEC, FEMA)	Yes
11) Other-Catskill Watershed Corporation (CWC)NRCS Emergency Watershed Protection (EWP), Ashokan Watershed Stream Management Program (AWSMP) grants	Yes

Table 6-5. Community Classifications

Program	Classification	Date Classified
Community Rating System (CRS)	NP	NA
Building Code Effectiveness Grading Schedule (BCEGS)	NP	NA
Storm Ready	NP	NA
Firewise	NP	NA
Public Protection (ISO) Classification	Class 7B	NA

The classifications listed above relate to the community's effectiveness in providing services that may impact its vulnerability to the natural hazards identified. These classifications can be viewed as a gauge of the community's capabilities in all phases of emergency management (preparedness, response, recovery and mitigation) and are used as an underwriting parameter for determining the costs of various forms of insurance. The CRS class applies to flood insurance while the BCEGS and Public Protection classifications apply to standard property insurance. CRS classifications range on a scale of 1 to 10 with class one (1) being the best possible classification, and class 10 representing no classification benefit. Firewise classifications include a higher classification when the subject property is located beyond 1000 feet of a creditable fire hydrant and is within 5 road miles of a recognized Fire Station.

- Criteria for classification credits are outlined in the following documents:
- The Community Rating System Coordinators Manual
- The Building Code Effectiveness Grading Schedule
- The ISO Mitigation online ISO's Public Protection website at <http://www.isomitigation.com/ppc/0000/ppc0001.html>
- The National Weather Service Storm Ready website at <http://www.weather.gov/stormready/howto.htm>
- The National Firewise Communities website at <http://firewise.org/>

6.4 IDENTIFICATION, PRIORITIZATION, ANALYSIS, AND IMPLEMENTATION OF MITIGATION ACTIONS

This subsection discusses the identification, prioritization, analysis and implementation of mitigation actions for the Town of Shandaken.

Mitigation Action Identification – Comprehensive Review of Mitigation Activities

On December 12, 2012, a Strengths, Weaknesses, Obstacles, and Opportunities workshop was conducted with stakeholders and the working group of SAFARI. The purpose of this session was to review information garnered from the risk assessment and the public involvement strategy to identify strengths, weaknesses, obstacles and opportunities in hazard mitigation within the Town through a facilitated brainstorming session on risks, vulnerabilities, and capabilities. All information shared during this session was documented and used to help screen a broad range of potential mitigation activities.

Mitigation Alternatives

By way of a facilitated session, the SAFARI committee developed a mitigation catalog which includes a comprehensive list of mitigation actions to be considered that met the following objectives:

- Use information obtained from the public involvement strategy;

- Use information provided in the risk and vulnerability assessment;
- Seek mitigation actions consistent with the goals and objectives of this local Plan;
- Identify mitigation actions that are within the capabilities of the Town.

The SAFARI committee updated the 2013 catalog of flood hazard mitigation alternatives through a facilitated process with Town staff and stakeholders involved in floodplain management. Sessions were held on September 11, 2018 and continued October 9, 2018 with interim email collaboration and survey input to update the documented local strengths, weaknesses, obstacles and opportunities from the 2013 planning process. This input was the basis for the alternatives considered in the 2018 plan as well as the mitigation initiatives selected for implementation.

The catalog represents the comprehensive range of alternatives considered for complying with Step 7 of the CRS 10-step process. The SAFARI reviewed this catalog in conjunction with the findings of public outreach efforts and the risk assessment results. The catalog was enhanced based on this review and then used by Committee to select hazard mitigation initiatives.

The catalog of flood hazard mitigation alternatives was developed to represent a broad range of alternatives to be considered for use in the planning area (CRS Step 7). The mitigation alternatives are listed in Table 6-6 through Table 6-9. The catalog presents alternatives that are categorized in two ways:

- By what the alternative would do:
 - Manipulate a hazard
 - Reduce exposure to a hazard
 - Reduce vulnerability to a hazard
 - Increase the ability to respond to or be prepared for a hazard
- By who would have responsibility for implementation:
 - Individuals
 - Businesses
 - Government.

Flood hazard mitigation initiatives recommended in this plan were selected from among the alternatives presented in the catalog. The catalog provides a baseline of mitigation alternatives that are backed by a planning process, are consistent with the goals and objectives, and are within the capabilities of the Town of Shandaken to implement. However, not all the alternatives meet all the selection criteria.

Table 6-6 Ongoing Capabilities

ONGOING CAPABILITIES				
Action Taken?	Timeline	Priority	Status	✓=Complete X=Deleted O=Ongoing
FMI-1—Continue to maintain compliance and good standing with the programmatic requirements of the National Flood Insurance Program.				
Yes	Ongoing	H	Continue to maintain good standing in NFIP	O

ONGOING CAPABILITIES				
FMI-2—Expand watershed and multi-stakeholder coordination efforts and seek inter-local agreements or other contractual relationships in support of achieving long-term comprehensive flood risk reduction solutions.				
Yes	Ongoing	L/M	Working with AWSMP and NYS agencies	O
FMI-3—Form a flood warning sub-committee of SAFARI to identify alternate methods of flood recognition for the Town of Shandaken and to expand on the warning system. Potential topics could include additional stream gage locations, support of gage automation at specific sites, installation of precipitation monitoring stations, formation of volunteer spotters corps.				
No	Short Term	M/H	Emergency notification system now in place for residents	O
FMI-4—Assist AWSMP to create a flood model to provide data on potential stream migration and sediment locations along waterways. This will provide a basis for future flood mitigation and streambank stabilization measures. Map the channel migration zones for all rivers in the region and the extent of high-quality riparian habitat.				
Yes	Short Term	L/M	Ongoing work with AWSMP to create model	O
FMI-6—Develop codes and standards for existing and new culverts/bridges in Town including bridges on privately owned property.				
Yes	Short Term	H	Partially completed as part of LFA process	O
FMI-8—Utilizing the best available data, science and technology, enhance the existing flood notification program, striving to identify a notification protocol that has real-time flood threat recognition capability.				
No	Short Term	M	Delayed because of focus on LFA and other priorities	X
FMI-9—Utilizing the best available data, science and technology, maintain and enhance the user-defined HAZUS-MH model that was constructed to support this planning effort, as data becomes available and utilize the DFIRM flood depth grids to calculate estimated potential future losses to structures and critical facilities.				
Yes	Short Term	L/M	Utilizing best available data	O
FMI-11—Finalize and adopt a town-wide Flood Response Plan.				
No	Short Term	L	Delayed because of focus on LFA and other priorities	X

ONGOING CAPABILITIES				
FMI-12—Work with the Town departments responsible for implementation and maintenance of the Town's current and future infrastructure to identify flood hazard mitigation projects that are eligible for hazard mitigation grants. Once projects are identified, pursue grant funding for those projects shown to be cost-effective.				
Yes	Short Term	L	Working with proper Town departments to ID projects. Partially completed during LFA process.	O
FMI-13— Establish a link between the Town of Shandaken Flood Hazard Mitigation Plan and the Ulster County All-Hazards Mitigation Plan. The Flood Hazard Mitigation Plan will become the flood hazard component of the Natural Hazards Mitigation Plan upon its next update. All future updates to the two plans will occur on the same planning cycle upon plan integration.				
Yes	Short Term	L	Participating with Ulster County plan update	✓
FMI-14—Draft a prioritized list of Town road segments and bridges that should be elevated above the 100-year floodplain and culverts that will fail under flood flow. Upgrade these structures if state or federal funds become available.				
Yes	Short Term	L	Working with Highway Department to complete this task. Partially completed as part of LFA process. Working with AWSMP to determine undersized bridges in Town.	O
FMI-15—Where feasible, consider the adoption of appropriate higher regulatory standards (including but not limited to freeboard, compensatory floodwater storage, lower substantial damage thresholds, setbacks and fill restrictions) as means to reduce future flood risk and support a no-adverse-impact philosophy of floodplain management.				
Yes	Short Term	L	Town adopted in November 2016 higher standards including: cumulative substantial impact threshold, critical facilities must be located outside of 500-Year Floodplain, and others.	✓
FMI-16— Maintain relationship with AWSMP.				
Yes	Long Term	L	Continue to work closely with AWSMP	✓
FMI-17—Support AWSMP's continued prioritization of riverine erosion hazard areas, especially hill slope failures and stream bank erosion areas in order to evaluate stream management feasibility.				
Yes	Short Term	L	Support AWSMP's prioritization of riverine hazards	✓
FMI-21— Require and archive elevation certificates for floodplain -related building and zoning permits.				
Yes	Short Term	H	Require all elevation certificates to be archived	✓

ONGOING CAPABILITIES				
FMI-22— Evaluate, adopt or amend local land use laws that prevent inappropriate development in areas of high flood risk and foster uses that are compatible with the anticipated flooding conditions.				
No	Short Term	H	Adopted new floodplain development ordinance (October 2016)	✓
FMI-24— Facilitate development of a flood damage reporting system to track types of flooding, their location and the associated costs. Database development should attempt to collect records on past floods to get started; all flooding damages should be reported even if localized. Program will require training, and administrative support to insure success.				
No	Short Term	L/M	Delayed because of focus on LFA and other priorities. Gathered info for use in LFA that will later be included in the database.	O
FMI-25— Continue to support the implementation, monitoring, maintenance, and updating of Flood Plan.				
Yes	Short Term	M	Support the maintenance, update, etc. of flood plan	✓
FMI-27— Support the continued improvement of the Upper Esopus Creek hydraulics and hydrology models.				
Yes	Short Term	M	Support improvement of models	✓
FMI-28— Support local sustainability of a watershed management organization and other working groups, e.g. SAFARI and Highway Management Group.				
Yes	Short Term	H	Support local sustainability and other working groups	✓
FMI-29— Continue to participate in the CWC Stormwater Retrofits Grant Program to address stormwater quality issues.				
Yes	Short Term	M	Participate in CWC Stormwater retrofits grant program	✓
FMI-30— Participate in future flood hazard mitigation funding programs at CWC and AWSMP.				
Yes	Short Term	M/H	Participate in CWC and AWSMP programs	✓
FMI-31—Support continued characterization of flooding and erosion hazards in the tributary streams to the Esopus that have not been previously assessed.				
Yes	Short Term	M	Support characterization of flooding/erosion hazard	✓

ONGOING CAPABILITIES				
FMI-32—Support AWSMP in providing streamside landowners and others detailed technical information on the establishment and maintenance of riparian buffers and Continue to Support/promote long term riparian buffer protection for municipal properties and infrastructure.				
Yes	Short Term	M	Support AWSMP/riparian buffers	✓
FMI-33— Make stream side landowners and local timber harvesters who practice forest harvest aware of the opportunity to participate in the NYC Watershed Forestry Program (WFP) to ensure that timber harvesting operations use appropriate methods to reduce or eliminate impacts to the riparian buffer and improve its condition whenever possible.				
Yes	Short Term	L	Encourage timber harvesting plan and participation in WFP. There is a local ordinance for timber harvesting enforced by the Town.	O
FMI-34— Encourage a community education campaign for recreational safety on the Esopus Creek. Support the placement of information kiosks at common put-in and take-out locations as a means to share pertinent information about the location of hazards.				
Yes	Short Term	L/M	Placing info kiosks at various put-in locations	O
FMI-36— Support periodic training sessions on flood related issues for municipal leaders, code enforcement staff, and planning boards.				
Yes	Short Term	M	Attended FHM training sessions provided by AWSMP and others	✓
FMI-37— Integrate geomorphology principles in all new town projects and routine maintenance activities related to the stream system. Support trainings in stream management for highway department staff and other resource managers.				
Yes	Short Term	M	Highway dept. attends geomorphology trainings and considers geomorphic issues when designing projects.	✓
FMI-39— Request NYSEG personnel at EOC for all disasters. Set up dedicated contacts from utilities including NYSEG, Verizon and Spectrum.				
Yes	Short Term	H	NYSEG now participates at EOC	✓
FMI-40— Conduct Town pre-disaster planning meeting(s), defining EOC roles and anticipated response.				
Yes	Short Term	H	Already do this as part of NIMS	✓
No	Short Term	M	Implemented November 2016 ("swift Reach")	✓

ONGOING CAPABILITIES				
FMI-44— Create/enhance/ maintain mutual aid agreements with neighboring communities for continuity of operations and eligibility for FEMA reimbursements.				
Yes	Short Term	M	Continue working with neighboring communities for mutual aid	✓
FMI-46— Pursue all pre-disaster funding through FEMA Section 404.				
Yes	Short Term	H	Looking into pre-disaster funding options to implement LFA mitigation recommendations	O
FMI-47— Pursue all post-disaster funding through FEMA Section 406.				
Yes	Short Term	H	Continue to pursue FEMA post-disaster funding	✓
FMI-48— Facilitate biannual notification to landowners who have special flood hazard areas (SFHA) located on their property.				
Yes	Short Term	L/M		✓
FMI-50— Support new town-wide weather data collection stations as part of the flash flood warning system.				
Yes	Short Term	M/H	Support town-wide weather collection stations	✓
FMI-52— Work with AWSMP on flood emergency preparedness for residents.				
Yes	Short Term	L	Work with AWSMP on flood emergency preparedness	✓
FMI-53— Ensure regularly scheduled releases of flood emergency info, e.g. periodic, not ad hoc.				
Yes	Short Term	H	mailings planned as part of CRS activities.	O
FMI-58— Work with regional agencies (i.e. County and NYS DHSES) to help develop damage assessment capabilities at the local level through such things as training programs, certification of qualified individuals (e.g. code officials, floodplain managers, engineers).				
Yes	Short Term/Ongoing	L/M	Town CEO, Supervisor, Highway Super, and Planning Chair are CFMs.	✓
FMI-59— Ensure that command staff, department heads and elected officials are up to date on their NIMS training through FEMA.				
Yes	Short Term/Ongoing	H	Up-to-date on NIMS training	✓

ONGOING CAPABILITIES				
FMI-60— Create strategy for pre-emergency parking to prevent storm isolation.				
FMI-64— Incorporate appropriate specialized individuals into town EOC staff (e.g. technical assistance from AWSMP).				
Yes	Short Term	H	Continue to find appropriate individuals	O
FMI-65—Identify properties that are potential candidates for elevation, relocation or buyout based on an evaluation of flood risks, project feasibility, and planned flood risk reduction capital projects. A list of targeted high-priority acquisitions should be prepared and annually updated. An example of a high-priority project would be a property identified by FEMA as a repetitive loss property. Once the list is established, pursue funding opportunities to implement the projects.				
Yes	Short Term/Ongoing	M	A number of properties identified as part of the LFA process.	✓
Yes	Short Term/Ongoing	H		
FMI-68—Using the best available data on flood risk, conduct outreach to property owners to alert them to the risks and ways to deal with them, to inform them about potential opportunities to mitigate the risks, and to assess their interest in participation should funding be available. Property owners who are interested in participating in one of these programs should be informed that having flood insurance might help qualify them for funding assistance.				
Yes	Ongoing	H	Continually talked about at various public and televised meetings.	O
FMI-69—Advocate for educational services and programs to town residents to explain the basics of stream processes and the effect that human influences have on streams.				
Yes	Short Term	H	Worked with AWSMP to offer stream process and similar trainings	✓
FMI-70—Continue to develop and implement an annual public outreach strategy that seeks to leverage public information resources and capabilities within the town.				
Yes	Ongoing	CRS Related	Ongoing as part of LFA process.	O
FMI-71— Add tab to Town website to provide information to watershed stakeholders. Upgrade site to allow landowners interaction such as reporting stream changes, problems etc.				
Yes	Short Term	L/M	Town has a dedicated FHM webpage	✓
FMI-72—Where streambanks are being restored, explore opportunities to reestablish floodplain connectivity to improve flood water retention while simultaneously creating or restoring floodplain habitat.				
Yes	Short Term	L	Work with AWSMP on establishing floodplain connectivity	✓

ONGOING CAPABILITIES				
FMI-74— Utilize wetland inventory as provided by DEC to preserve flood retention capacity in the basin.				
Yes	Short Term	L/M	Ensure that Planning Board, etc. are utilizing wetlands maps for site plan review.	O
FMI-75— Encourage and support AWSMP's physical stream monitoring program (e.g. cross sections, longitudinal profiles etc.) to assist in evaluating pre- and post-flood stream conditions.				
Yes	Short Term	H	Support AWSMP monitoring	✓
FMI-76— Encourage implementation of successful stream projects as verified by AWSMP'S stream monitoring program.				
Yes	Short Term	M/H	Encourage implementation of successful stream projects	✓
FMI-77— Encourage control of invasive species, particularly Japanese knotweed, during riparian construction projects.				
Yes	Short Term	L/M	Encouraged control of invasive species	✓
FMI-78— Manage vegetation on critical areas such as roadside ditches and steep slopes; encourage multi-agency and public collaboration.				
Yes	Short Term	L/M	Manage vegetation on critical areas. Purchased bale mulcher.	✓
FMI-79—Support Ulster County in implementing improved radio communication system for Town.				
Yes	Short Term	H	Support Ulster County improved radio communications	✓
FMI-80—Update the Town emergency response plan to reflect any changes to flood notification protocol within the Town.				
No	Short Term	L	No changes to the current Town procedures	X
FMI-85—Advocate an active monitoring program for large woody debris (LWD) that focuses upon the identification and removal of debris that poses a flood hazard to infrastructure and a threat to human welfare. Identify sites for clearing and snagging to prevent woody debris build up.				
Yes	Short Term	M	AWSMP Stream Access and Rec Working Group adopted LWD Protocol.	O

Selected Mitigation Initiatives

The Steering Committee determined that some initiatives from the flood hazard mitigation catalog could be implemented to provide flood hazard mitigation benefits. Table 10 lists the recommended initiatives, the lead agency for each, and the proposed timeline. The parameters for the timeline are as follows:

- Short Term = to be completed in 1 to 5 years
- Long Term = to be completed in greater than 5 years

Table 6-7. Mitigation Alternatives to Manipulate the Flood Hazard

Ongoing = currently being funded and implemented under existing programs. Mitigation Alternatives to Manipulate the Flood Hazard		
Personal Scale	Corporate Scale	Government Scale
<ol style="list-style-type: none"> 1. Clear stormwater drains and culverts 2. Institute low-impact development techniques on property 	<ol style="list-style-type: none"> 1. Clear stormwater drains and culverts 2. Institute low-impact development techniques on property 	<ol style="list-style-type: none"> 1. Partner with Ulster County, AWSMP and CWC for debris clearing money when debris clearing makes sense. 2. Utilize Colorado Protocol to determine to Debris Jam removal is required. 3. Implement LFA recommendations. 4. Maintain drainage system 5. Institute low-impact development techniques on property 6. Sediment management and debris removal and providing regional retention areas 7. Streambank protection 8. Stabilize streambanks to minimize downstream sediment deposition 9. Stormwater management regulations and master planning. 10. Strategize responsible land protection methods to maintain/restore natural floodplain functions

Table 6-8. Mitigation Alternatives to Reduce Exposure to the Flood Hazard

Mitigation Alternatives to Reduce Exposure to the Flood Hazard		
Personal Scale	Corporate Scale	Government Scale
<ol style="list-style-type: none"> 1. Locate outside of hazard area 2. Elevate utilities above base flood elevation 3. Institute low impact development techniques on property 	<ol style="list-style-type: none"> 1. Locate business critical facilities or functions outside hazard area 2. Institute low impact development techniques on property 	<ol style="list-style-type: none"> 1. Implement LFA recommendations. 2. Identify areas for relocation of structures out of the floodplain 3. Provide public messaging/communication of potential flood events to ensure population is not in imminent danger 4. Remove abandoned structures from the floodway 5. Locate or relocate critical facilities outside of hazard area 6. Acquire or relocate identified repetitive loss properties 7. Promote flood-compatible land uses in identified high hazard areas via techniques such as: community education; natural resource inventory; comprehensive planning; zoning provisions; floodplain protection ordinance; and the environmental review process. 8. Adopt appropriate land development criteria 9. Institute low impact development techniques on property

Table 6-9. Mitigation Alternatives to Reduce Vulnerability to the Flood Hazard

Mitigation Alternatives to Reduce Vulnerability to the Flood Hazard		
Personal Scale	Corporate Scale	Government Scale
<ol style="list-style-type: none"> 1. Retrofit structures (elevate structures above base flood elevation) 2. Elevate items within house above base flood elevation 3. Build new homes above base flood elevation 4. Flood-proof existing structures 	<ol style="list-style-type: none"> 1. Build redundancy for critical functions or retrofit critical buildings 2. Provide flood-proofing measures when new critical infrastructure must be located in floodplains 	<ol style="list-style-type: none"> 1. Participate in CRS 2. Increase size of undersized bridges and culverts 3. Relocate critical facilities out of the floodplain 4. Identify critical infrastructure such as those on single entry roads and prioritize for replacement or re-sizing. 5. Educate the public as to risks inside and outside of the mapped floodplain. 6. Install survey monuments to reduce cost of obtaining elevation certificates 7. Implement as-built regulatory requirements 8. Implement site review ordinances/requirements 9. Support the techniques and recommendations that are included in the NYS Community Risk and Resiliency Act and the subsequent Flood Risk Management Guidance document and model local laws to increase resiliency 10. - Bridge replacement program using climate informed science 11. - Redundancy for critical functions and infrastructure 12. - Adopt higher regulatory standards, such as: increased freeboard standards, cumulative substantial improvement or damage, lower substantial damage threshold; compensatory

Mitigation Alternatives to Reduce Vulnerability to the Flood Hazard		
Personal Scale	Corporate Scale	Government Scale
		<p>storage, non-conversion deed restrictions.</p> <p>13. Adopt “no-adverse impact” floodplain management policies that strive to not increase the flood risk on downstream communities.</p> <p>14. Update existing regulations to account for the impacts of climate change as flooding is becoming more frequent and severe.</p>

Table 6-10. Mitigation Alternatives to Increase Preparation Capability

Mitigation Alternatives to Increase Preparation Capability		
Personal Scale	Corporate Scale	Government Scale
<ol style="list-style-type: none"> 1. Buy flood insurance 2. Develop household mitigation plan, such as retrofit savings, communication capability with outside, 72-hour self-sufficiency during and after an event 3. Comply with NFIP requirements 	<ol style="list-style-type: none"> 1. Keep cash reserves for reconstruction 2. Support and implement hazard disclosure for the sale/re-sale of property in identified risk zones. 3. Solicit cost-sharing through partnerships with other stakeholders on projects with multiple benefits. 4. Develop a flood response plan 	<ol style="list-style-type: none"> 1. Utilize Town’s status as a Climate Smart Community to tap into State dollars for mitigation projects 2. Utilize base funding available from Cornell Coop Extension and CWC to match state and federal funds for solutions. 3. Identify areas that are in extreme danger and where seniors are located that may need assistance 4. Nurture relationships with all stakeholders through regular communications 5. Increase Town staff to manage the floodplain 6. Engage a larger array of stakeholders 7. Participate in CRS 8. Produce better hazard maps- Create flood hazard identification

Mitigation Alternatives to Increase Preparation Capability		
Personal Scale	Corporate Scale	Government Scale
		<p>maps that reflect future conditions including the probable impacts from sedimentation and climate change.</p> <ol style="list-style-type: none"> 9. Develop codes and standards for bridges and culverts 10. Increase radio communication capability in Town 11. Require appropriate municipal officials to get floodplain management education and certification. 12. Implement/participate in regional precipitation monitoring networks. 13. Provide technical information and guidance 14. Enact tools to help manage development in hazard areas (stronger controls, tax incentives, and information) 15. Incorporate retrofitting or replacement of critical system elements in capital improvement plan 16. Utilize post-disaster assistance 17. Warehouse critical infrastructure components 18. Develop and adopt a continuity of operations plan (COOP) 19. Maintain existing data and gather new data needed to define risks and vulnerability 20. Train emergency responders 21. Identify critical facilities/infrastructure that require early

Mitigation Alternatives to Increase Preparation Capability		
Personal Scale	Corporate Scale	Government Scale
		notification during flood responses 22. Create a levee failure response plan 23. Enhance flood threat recognition capability 24. Create a building and elevation inventory of structures in the floodplain 25. Develop and implement a public information strategy 26. Integrate floodplain management policies into other planning mechanisms within the planning area. 27. Consider the residual risk associated with structural flood control in future land use decisions 28. Enforce National Flood Insurance Program requirements 29. Capture/survey high water marks after flood events.

The list of potential mitigation actions identified for this planning process, include a range of options in line with the six types of mitigation actions including:

1. **Prevention:** planning and zoning, storm water management
2. **Property Protection:** retrofitting, insurance, relocation, elevation
3. **Public Education and Awareness:** maps, outreach projects, technical assistance and training
4. **Natural Resource Protection:** erosion control, wetlands protection, floodplain protection
5. **Emergency Services:** flood warning, flood response, critical facilities protection
6. **Structural Projects:** stream channel modifications, storm sewers, bridge or culvert sizing

Though this exercise, the SAFARI committee was able to identify a baseline of appropriate mitigation actions backed by a planning process, consistent with the goals and objectives of the planning area, and within the capabilities of the Town. Many of the strategies identified, such as community outreach, could be applied to multiple hazards. Actions that were not selected by the Town were not selected based on the following:

- Action is not feasible
- Action is currently outside the scope of capabilities
- Action is not in line with established community goals and vision
- Action is not considered cost-effective
- Action is already being implemented

Mitigation Actions

On January 8, 2019, the SAFARI conducted a meeting to update the project status of the 2013 mitigation strategy based on the updated catalog. The summary of progress for each action is provided in Table 6-10 below. Ongoing and new projects as relevant to the Town are presented in Table 6-11.

Mitigation actions are activities designed to reduce or eliminate losses resulting from natural hazards.

A series of mitigation actions were identified by the Town. These actions are summarized in Table 6-10 along with the hazards mitigated, goals and objectives met; lead agency, estimated cost, potential funding sources and the proposed timeline are identified. The parameters for the timeline are as follows:

- Short Term = To be completed in 1 to 5 years
- Long Term = To be completed in greater than 5 years
- Ongoing = Currently being funded and implemented under existing programs.

Table 6-11. Action Plan – Flood Mitigation Initiatives

Action Plan—Flood Mitigation Initiatives (FMI)						
Lead Department	Possible Funding Sources or Resources	Estimated Project Cost	Time Line	Objectives	Mitigation Category	Priority
FMI-1 (5)—Invest in flood prediction and forecast modeling to support all facets of the Town of Shandaken floodplain management program, including but not limited to flood hazard identification, flood threat recognition in support of flood notification programs, climate change adaptation, and risk assessment.						
Town of Shandaken Supervisor	Municipal Operating Budget/ Grants/AWSMP	Medium	Short-term	1-4, 3-1, 3-3	Prevention	L
FMI-2 (7)—Create an inventory and establish a priority list for culvert replacement that takes into account flood depth reduction and future losses avoided.						
Town of Shandaken DPW	Municipal Operating Budget /	Low	Short-term	1-1, 1-3, 3-1	Prevention	H
FMI-3 (10)—Develop a post-flood disaster action plan that establishes protocols for the Town such as substantial damage determination, the recording of perishable data (such as high-water marks), grant support, staffing, continuity of operations, and recovery.						
Town of Shandaken Emergency Management Works	Municipal Operating Budget / Grant /Public	Medium	Short-term	1-1, 1-4, 3-1	Prevention	H
FMI-4 (11)—Update and adopt a town-wide Flood Response Plan						
Town of Shandaken Supervisor/Emergency Management	Grants	Low	Short-term	1-9, 2-2, 3-3, 3-5	Prevention	H
FMI-5 (18)—Participate in the Community Rating System (CRS) to further manage flood risk and reduce flood insurance premiums for NFIP policyholders. This shall start with the submission to FEMA-DHS of a Letter of Intent to join CRS, followed by the completion and submission of an application to the program once the community's current compliance with the NFIP is established.						
Town of Shandaken Supervisor/DPW/FPA	Municipal Operating Budget	Medium	Short-term	1-1, 1-3, 2-2, 2-3, 2-4, 2-5, 5-5	Prevention	H
FMI-6 (23)— Integrate a strong emphasis on stream corridor management in the municipal comprehensive plan, site plan review laws, zoning and other appropriate local ordinances.						
Town of Shandaken Supervisor/Planning	Municipal Operating Budget	Low	Short-term	1-6, 4-3, 5-2	Prevention	L/M
FMI-7 (25)— Continue to support the implementation, monitoring, maintenance, and updating of Flood Plan.						
Town of Shandaken Supervisor/DPW/FPA	Municipal Operating Budget	Low	Short-term	all	Prevention	M
FMI-8 (26)— Update the Town of Shandaken's general building stock inventory in HAZUS-MH with the new assessor's data which was not available in electronic format at the time this Plan was written.						
Town of Shandaken Supervisor/DPW/FPA	Municipal Operating Budget	Low-Medium	Short-term	1-3, 3-1	Prevention	L/M

Action Plan—Flood Mitigation Initiatives (FMI)						
Lead Department	Possible Funding Sources or Resources	Estimated Project Cost	Time Line	Objectives	Mitigation Category	Priority
FMI-9 (38)— Continue to work on improving municipal communications network to provide complete coverage of the Town. Ensure redundancy of Town communications capabilities. Review annually.						
Town of Shandaken Emergency Services, Ulster County	Municipal Operating Budget, HLS Grants/EMPG/SHS P	Low	Short-term	3-3, 3-5, 5-2	Prevention	H
FMI-10 (41)— Streamline procedure for updating County Emergency Management of emergency activities and infrastructure damages (power, phone, road closures etc.)						
Town of Shandaken Town Supervisor//Emergency Services	Municipal Operating Budget/EMPG/SHS P	Low	Short-term	3-3, 3-5, 5-2	Prevention	H
FMI-11 (42)— Ensure dedicated phone line for town emergency management communications.						
Town of Shandaken Town Supervisor/Emergency Services	Municipal Operating Budget/EMPG/SHS P	Low	Short-term	3-3	Prevention	H
FMI-12 (45)— Identify and develop agreements with entities that can provide support with FEMA/SOEM paperwork after disasters; ensure qualified damage assessment capabilities and personnel – Improve post-disaster capabilities – damage assessment; FEMA/SOEM paperwork compilation, submissions, digital record-keeping.						
Town of Shandaken Town Supervisor/Emergency Services	Municipal Operating Budget, FEMA grants/EMPG/SHSP	Low	Short-term	5-2	Prevention	L
FMI-13 (49)— Enable command center call-in capability to Birch Creek, Stony Clove, Woodland Valley, Allaben and any newly established USGS gages. Ensure that call in capability is maintained on existing gages (i.e. Coldbrook) during storm events.						
Town of Shandaken Town Supervisor/FPA/AWSMP	Municipal Operating Budget/EMPG/SHS P	Medium	Short-term	1-4, 1-8, 3-3, 5-2	Prevention	H
FMI-14 (51)— Explore funding for town-wide weather stations.						
Town of Shandaken Town Supervisor/FPA	Municipal Operating Budget, CWC funds/AWSMP/ OTHERS	Low	Short-term	1-8	Prevention	M/H
FMI-15 (54)— Maintain generators; hard wire installation at all town buildings especially EOC and all fire houses						
Town of Shandaken Town Supervisor/DPW/Emergency Services	Municipal Operating Budget/EMPG/SHS P	Medium	Short-term	1-1, 3-3, 3-5, 1-11	Emergency Services	H



Action Plan—Flood Mitigation Initiatives (FMI)						
Lead Department	Possible Funding Sources or Resources	Estimated Project Cost	Time Line	Objectives	Mitigation Category	Priority
FM-16 (55)—Floodproof or relocate critical town facilities required to be operable during flood events.						
Town of Shandaken Town Supervisor//FPA	Municipal Operating Budget/FEMA, HLS grants	High	Short-term	1-1, 1-2, 1-8, 1-11	Prevention	L/M
FMI-17 (56)— Create, and conduct an annual inventory of, an emergency equipment box including lap tops, cell phones, walkie talkies, portable battery charger, list of emergency equipment and plan of attack should be on the computer and thumb drives. Explore funding – list items, cost out, apply for FEMA planning money.						
Town of Shandaken Town Supervisor/FPA/Emergency Services	Municipal Operating Budget/ FEMA, EMPG, HLS grants	Low-medium	Short-term	1-1, 3-3, 3-5	Prevention	M
FMI-18 (57)— Improve preparedness activities for care of town-sheltered dogs. Construct an emergency kennel on higher ground.						
Town of Shandaken Emergency Services	Municipal Operating Budget/ASPCA grants	Low	Short-term	3-3, 5-2	Emergency Services	M
FMI-19 (60 & 83)— Create strategy for pre-emergency parking to prevent storm isolation including designation of emergency parking locations to accommodate evacuee vehicles in town..						
Town of Shandaken Town Supervisor/Emergency Services	Municipal Operating Budget	Low	Short-term	3-2, 3-4	Prevention	L/M
FMI-20 (61)— Create priority list of emergency evacuation zones and a notification and action procedure.						
Town of Shandaken Town Supervisor/Emergency Services	Municipal Operating Budget/EMPG/SHS P	Low	Short-term	3-2, 3-4	Emergency Services	H
FMI-21 (62)— Identify and explore sheltering at government and non-government locations.						
Town of Shandaken Town Supervisor/Emergency Services	Municipal Operating Budget	Low	Short-term	3-2, 3-4	Emergency Services	L/M
FMI-22 (65b)—Implement public outreach to floodprone property owners to document interest in participating in acquisition or elevation projects.						
Town of Shandaken Town Supervisor/FPA	HMGP/ Municipal Operating Budget	Low	Short-term, Ongoing	2-2, 2-4, 2-5, 5-5	Property Protection	L/M
FMI-23 (66)—To support initiative # FMI-1, undertake a Repetitive Loss Area Analysis to determine the following:						
<ul style="list-style-type: none"> • Repetitive losses not captured by flood insurance data • Causes of the repetitive flooding • Assets impacted by the repetitive flooding (this would include assets such as livestock, out-buildings and rescue costs not already identified by FEMA) • Possible alternatives to remediate the repetitive flooding 						

Action Plan—Flood Mitigation Initiatives (FMI)							
Lead Department	Possible Funding Sources or Resources	Estimated Project Cost	Time Line	Objectives	Mitigation Category	Priority	
Town of Shandaken Town Supervisor, FPA	Department Budgets, Grants	Medium	Long-term, depends on funding	1-3, 1-5	Property Protection	L	
FMI-24 (67)— Pursue demolition of vacant/abandoned structures in town that are subject to environmental hazards such as mold and becoming flood debris.							
DPW CEO	Grants	Medium	Long-term	1-2, 1-6, 1-11	Property Protection	M	
FMI-25 (73)— Support the creation of and assist in utilizing a document that describes appropriate best stream management practices in the Ashokan watershed for emergency stream work.							
Town of Shandaken Town Board/AWSMP	Municipal Operating Budget/AWSMP	Low	Short-term	1-5, 1-7, 4-1	Natural Resource Protection	L/M	
FMI-26 (81)— Provide follow-up Community Emergency Response Team (CERT) coordination.							
Town of Shandaken Emergency Services	EMPG/DHDP	Low-Medium	Short-term	3-1, 3-3	Emergency Services	L	
FMI-27 (82)—. Address evacuation by planning, developing, and providing signage and information regarding evacuation routes							
Town of Shandaken Emergency Services	Fees and Grants/EMPG/SHS P	Medium	Short term	3-4	Emergency Services	L/M	
FMI-28 (84)—Coordinate/integrate and maintain a swift water rescue team with Ulster County Sheriff and local fire company							
Town of Shandaken Emergency Services	Municipal Operating Budget/AFG	Low-medium	Short-term	3-3	Emergency Services	M	
FMI- 29 (11)—Update and adopt a town-wide Flood Response Plan.							
Town of Shandaken Supervisor	AWSMP/Municipal Operating Budget	Low	Short-term	1-9, 2-2, 3-3, 3-5	Prevention	H	
FMI-30- Develop and distribute floodplain best management practices newsletters to residents and businesses to flood-vulnerable population.							
Town of Shandaken Supervisor	AWSMP/Municipal Operating Budget	Low	Short-term	1-9, 2-2, 3-3, 3-5	Prevention	H	
FMI-31—Implement upgrades to Phoenicia Municipal Water System including a secondary main crossing Esopus Creek, back-up pumps.							
Town of Shandaken Town Board	USDA-RD, NYSOCR	High	Short-term	1-9, 3-5, 3-7, 1-11	Structural	H	
FMI-32—Support upgrades to Fire District including back-up generators and flood mitigation activities including possible relocation.							
Individual Departments	Fire HMA, CWC, FASNY	Low	Short-term	1-9, 3-5, 3-7, 1-11	Structural, Prevention	H	
FMI-33--Support and implement upgrades to ambulance buildings including back-up generators, expansion of housing of personnel and equipment, and flood mitigation activities including possible relocation.							
Town of Shandaken Town Board	Municipal Operating Budget	Low	Short-term	1-9, 3-5, 3-7, 1-11	Structural, Prevention	H	
FMI-34--Old Mt Tremper Bridge Removal							
Ulster County DPW	Catskill Watershed Corp.	High	Short-term	1-11	Structural	M	
FMI-35--Replacement of Bridge Street Bridge and Floodplain Enhancement							



Action Plan—Flood Mitigation Initiatives (FMI)							
Lead Department	Possible Funding Sources or Resources	Estimated Project Cost	Time Line	Objectives	Mitigation Category	Priority	
Ulster County DPW, Catskill Watershed High	Town of Shandaken Corp., AWSMP, NYS DHSES/FEMA, NYDEP, Ulster County DPW		Long-term	1-1, 1-11, 3-4, 3-5, 4-1	Structural	M	
FMI-36--Plank Road Bridge Replacement							
Ulster County DPW, Catskill Watershed High	Town Supervisor Corp., AWSMP, Ulster County DPW		Long-term	1-1, 1-11, 3-4, 3-5, 4-1	Structural	M	
FMI-37--Review and correct via AW-501 forms the FEMA Repetitive Loss (RL) list prior to submitting application to CRS							
Town of Shandaken CRS Coordinator/FPA	Town Operating Budget	Low	Short-term	1-6, 5-2, 5-5	Prevention	H	
FMI-38--Prioritize mitigation projects for local flood vulnerable roads (via flood vulnerable roadway analysis) and identify projects to ensure road viability and continuity of operations during 1% flood events.							
Ulster County Dept. of Environment	Ulster County/NYSERDA	Low	Short-term	1-1, 1-4, 1-11, 5-2	Prevention	M	
FMI-39—Develop and implement an ordinance to address the improvement of the bridge replacement program using climate informed science							
Town of Shandaken Town Board	Municipal Operating Budget	Low	Short-term	1-10, 3-7, 4-4, 5-4	Prevention	H	
FMI-40—Include the identification of base funding available from Cornell Coop Extension and CWC to match state and federal funds for flood mitigation solutions in the job description and responsibilities of the Town of Shandaken Floodplain Administrator.							
Town of Shandaken Floodplain Administration (FPA)	Municipal Operating Budget	Low	Short-term	5-2, 5-3, 5-4	Prevention	H	
FMI-41—Provide an annual update of the identification of areas where vulnerable populations may be exposed danger during flood events and that may need assistance and document.							
Town of Shandaken clerk and civil defense coordinator	Municipal Operating Budget	Low	Short-term	1-5, 1-9	Prevention	H	
FMI-42—Create and implement a public information strategy to nurture relationships with all stakeholders through regular communications							
Town of Shandaken Clerk	Municipal Operating Budget	Low	Short-term	2-1, 2-2, 2-3, 2-4, 2-5, 2-6	Public Education and awareness	H	
FMI-43--Capture/survey high water marks after flood events.							
AWSMP, Town of Shandaken FPA	AWSMP Operating Budget	Low	Short-term	1-4	Prevention	M	
FMI-44—Retain a contractor to conduct a full hydraulic assessment for the County-owned Fox Hollow Road bridge over Esopus Creek to ensure that the bridge opening is adequately sized and that the new bridge spans the channel and floodplain when the bridge is scheduled for replacement.							
Shandaken Town Board	AWSMP	Medium	Short-term	1-1, 1-10, 1-11, 3-4, 3-5, 4-1	Prevention	H	



Action Plan—Flood Mitigation Initiatives (FMI)						
Lead Department	Possible Funding Sources or Resources	Estimated Project Cost	Time Line	Objectives	Mitigation Category	Priority
FMI-45- Retain a contractor to conduct a full hydraulic assessment for the Town-owned bridge over Fox Hollow Creek -When this bridge is scheduled for replacement, or if it were to be damaged during a flood, it is recommended that a full hydraulic assessment be conducted to ensure that the replacement bridge is adequately sized.						
Town of Shandaken Highway Dept.	AWSMP, Municipal Operating Budget	Medium	Short-term	1-1, 1-10, 1-11, 3-4, 3-5, 4-1	Prevention	H
FMI-46— Inspect the County-owned Creekside Drive (County Route 47) bridge over Bushnellsville Creek for sediment aggradation at least every 2 years and also immediately following flood events. Based on hydraulic analyses, maintenance actions may be warranted if 1 foot of aggradation were to occur at the bridge opening. In the event the channel aggrades 2 feet above present conditions, maintenance actions to remove the aggradation are strongly advised						
Ulster County DPW	County Operating Budget	Low	Short-term	1-4, 1-11, 4-1	Natural Resource Protection	H
FMI-47—Support the relocation of existing structures out of the FEMA-designated floodway where there is owner interest and programmatic funding available, Areas where structures are located within the floodway include the following:						
a. Homes along the left bank of Esopus Creek, just upstream of the Fox Hollow Road bridge						
b. Abandoned structures along the right bank of Esopus Creek, just downstream of the Fox Hollow Road bridge						
c. At the Shandaken town hall facility along the left bank of Esopus Creek, the Highway Department garage and dog pound (relocation of critical facilities is noted as an action item in the Ulster County Multi-Jurisdictional Natural Hazard Mitigation Plan)						
d. Homes along the left bank of Esopus Creek, just downstream of the town hall facility						
Town of Shandaken	FPA FEMA NYCDEP, CWC	HMA, Medium	Short-term	1-2, 1-11, 5-2	Property Protection	H
FMI-48—Implement further evaluation of the flood control levee that currently lines the left bank of the Bushnellsville Creek and Esopus Creek confluence which was breached in 2011, resulting in significant damage. Since repairs were made in 2011, the levee has experienced erosion at the downstream end.						
NYSDEC with support from Town of Shandaken Supervisor	NYS, AWSMP	Medium	Short-term	1-1, 1-11	Structural	M
FMI-49 --(FMI-82)- Establish policy, effective signage, and road closure barriers to reduce risks associated with the flooding by temporarily closing floodprone town roads during flooding events.						
Town of Shandaken Supervisor and DPW	Municipal Operating Budget	Low	Short-term	1-9, 3-2, 3-4, 3-5	Prevention	L
FMI-50—Review feasibility of floodplain enhancements in Mt. Tremper along the Esopus Creek channel near the bend just downstream of the Emerson Resort. This would involve lowering the elevation of the right bank and left bank floodplain and removal of the existing levee. Construction of the floodplain enhancement would require removal of sections of Mount Pleasant Road and Riseley Road and relocation of some of the homes along these roads.						
Town of Shandaken Supervisor	Catskill Watershed Corp., AWSMP, NYS DHSES/FEMA, NYDEP, Ulster County DPW	Medium	Short-term	1-9, 1-11, 3-4, 3-5	Structural	M
FMI-51--Support State efforts in the Mt. Tremper area to reduce flood risks, such as the expansion of Route 28 Bridge over the Esopus and the elevation of State Route 212.						

Action Plan—Flood Mitigation Initiatives (FMI)						
Lead Department	Possible Funding Sources or Resources	Estimated Project Cost	Time Line	Objectives	Mitigation Category	Priority
Town of Shandaken Supervisor, SAFARI	Municipal Operating Budget	Low	Short-term	1-8, 1-9, 1-11, 3-4, 3-5, 4-1, 4-3, 5-2	Prevention	H
FMI-52--Support Ulster County in efforts to stabilize and reduce flood risks to residents along County Route 47						
Town of Shandaken Supervisor, SAFARI	Municipal Operating Budget	Low	Short-term	1-8, 1-9, 1-11 5-2	Prevention	H
FMI-53--Anchoring of Fuel Tanks: Sources of man-made pollution should be reduced or eliminated through the relocation or securing of fuel oil and propane tanks.						
Town of Shandaken Supervisor, SAFARI	CWC	Low	Short-term	1-8,1-11, 5-2	Prevention	H
FMI- 54(48)— Facilitate biannual notification to landowners who have special flood hazard areas (SFHA) located on their property and provide best management practices and FEMA fact sheets.						
Town of Shandaken Supervisor, SAFARI	Municipal Operating Budget	Low	Short-term	2-2, 2-3, 2-5, 5-5	Education and Awareness Programs	H

HMA-Hazard Mitigation Assistance Program
NYSEFP_NY State Environmental Facilities Corporation Grants
NYDRC-New York Department of Environmental Conservation Grants.
ASPCA-Association for the Prevention of Cruelty to Animals Grants
AWSMP –Ashokan Watershed Stream Management Program
EMPG-Local Emergency Management Performance Grant
SHSP-State Homeland Security Grant Program
PASP-Public Safety Answering Point Consolidation, Improvements, and Enhancements Grant
AFG-Assistance to Firefighters Grant
HMGP-Hazard Mitigation Grant Program
FASNY=Firemen's Association of the State of NY
NYSOCR NYS Office of Community Renewal,
USDA-RD-USDA-Rural Development

Benefit/Cost Review

Section 201.6.c.3iii of 44CFR requires the prioritization of the action plan to emphasize the extent to which benefits are maximized according to a cost/benefit review of the proposed projects and their associated costs. The Town was asked to weigh the estimated benefits of a project versus the estimated costs to establish a parameter to be used in the prioritization of a project.

This benefit/cost review was qualitative; that is, it did not include the level of detail required by FEMA for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) grant program. This qualitative approach was used because projects may not be implemented for up to 10 years, and the associated costs and benefits could change dramatically in that time. Each project was assessed by assigning subjective ratings (high, medium, and low) to its costs and benefits, described in Table 6-7.

Costs: The project cost for each mitigation initiative was reasonably estimated (including preliminary engineering, engineering, design, construction). Costs are presented as follows: Low = < \$10,000; Medium = \$10,000 to \$100,000; High = > \$100,000. Where actual project costs could not be reasonably established at this time, a best estimate was provided:

- Low = Possible to fund under existing budget. Project is part of or can be part of an existing on-going program.

- **Medium** = Could budget for under existing work-plan but would require a reapportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
- **High** = Would require an increase in revenue via an alternative source (i.e., bonds, grants, fee increases) to implement. Existing funding levels are not adequate to cover the costs of the proposed project.

Benefits: Mitigation benefits are future damages and losses that would be eliminated and/or reduced by implementing the proposed mitigation project. When possible, benefits (e.g., physical damages, loss of service or function, emergency management costs, etc.) associated with the project were identified. The benefits value noted (in dollars) is the expected avoided damages and is presented as: Low = < \$10,000; Medium = \$10,000 to \$100,000; High = > \$100,000. Where benefits are not quantifiable, a best estimate was provided:

- **Low:** Long term benefits of the project are difficult to quantify in the short term.
- **Medium:** Project will have a long-term impact on the reduction of risk exposure to life and property, or project will provide an immediate reduction in the risk exposure to property.
- **High:** Project will have an immediate impact on the reduction of risk exposure to life and property.

Table 6-12. Project Assessment

Costs	
High	Project cost is =>\$100,000 or if unknown, existing funding levels are not adequate to cover the costs of the proposed project, and implementation would require an increase in revenue through an alternative source (e.g., bonds, grants, and fee increases).
Medium	Project cost is \$10,000 to \$100,000 or if unknown, the project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
Low	The project cost is <\$10,000 or if unknown, the project could be funded under the existing budget. The project is part of or can be part of an existing, ongoing program.
High	Project mitigation benefits are => \$100,000 or if unknown, the project will have an immediate impact on the reduction of risk exposure to life and property.
Medium	Project mitigation benefits are \$10,000 to \$100,000 or if unknown, the project will have a long-term impact on the reduction of risk exposure to life and property or will provide an immediate reduction in the risk exposure to property.
Low	Project mitigation benefits are< \$10,000 or if unknown, the long-term benefits of the project are difficult to quantify in the short term.

Using this approach, projects with positive benefit versus cost ratios (such as high over high, high over medium, medium over low, etc.) are considered cost-beneficial and are prioritized accordingly. For some of the County initiatives identified, the Town may seek financial assistance under FEMA's HMGP or PDM programs. Both programs require detailed benefit/cost analysis as part of the application process. These analyses will be performed when funding applications are prepared, using the FEMA BCA model process. The SAFARI committed to implementing mitigation strategies with benefits that exceed costs. For projects not seeking financial assistance from grant programs that require this sort of analysis, the SAFARI reserves the right to define "benefits" according to parameters that meet its needs and the goals and objectives of this plan.

Prioritization:

Section 201.c.3.iii of 44 CFR requires an action plan describing how the actions identified will be prioritized. The SAFARI, along with their contract consultant, developed a prioritization methodology for the Plan that meets the needs of the Town while at the same time meeting the requirements of Section 201.6 of 44 CFR. The mitigation actions identified were prioritized according to the criteria defined below.

- **High Priority:** A project that meets multiple plan goals and objectives, benefits exceed or equal cost, has funding secured under existing programs or authorizations, or is grant-eligible, and can be completed in 1 to 5 years (short-term project) once project is funded.
- **Medium Priority:** A project that meets at least one plan goal and objective, benefits exceed or equal costs, funding has not been secured and would require a special funding authorization under existing programs, grant eligibility is questionable, and can be completed in 1 to 5 years once project is funded.
- **Low Priority:** A project that will mitigate the risk of a hazard, benefits exceed or equal costs, funding has not been secured, and project is not grant-eligible and/or timeline for completion is considered long-term (5 to 10 years).

It should be noted that these priority definitions are considered to be dynamic and can change from one category to another based on changes to a parameter such as availability of funding. For example, a project might be assigned a medium priority because of the uncertainty of a funding source. This priority could be changed to high once a funding source has been identified such as a grant. The prioritization schedule for this Plan will be reviewed and updated as needed annually through the plan maintenance strategy described in Section 7 of this Plan.

Table 6-8 presents the results of applying the prioritization methodology presented to the set of mitigation actions identified by the Town, and includes the following prioritization parameters:

- Number of goals/objectives met by the initiative
- Benefits of the project (high, medium, or low)
- Cost of the project (high, medium, or low)
- Do the benefits equal or exceed the costs?
- Is the project grant-eligible?
- Can the project be funded under existing programs and budgets?
- Priority (high, medium, or low)
- The Town's mitigation action implementation strategy includes:
 - Mitigation actions for individual and multiple hazards
 - Mitigation goals/objectives supported by each action.
 - Implementation priority
- Potential funding sources for the mitigation action (grant programs, current operating budgets or funding, or the agency or jurisdiction that will supply the funding; additional potential funding resources are identified).
- Estimated budget for the mitigation action (financial requirements for new funding or indication that the action is addressed under current operating budgets)

- Time estimated to implement and complete the mitigation action
- Existing policies, programs, and resources to support implementation of the mitigation action (additional policies, programs, and resources identified)

Specific mitigation actions were identified to prevent future losses; however, current funding is not identified for all these actions at present. The Town has limited resources to take on new responsibilities or projects. The implementation of these mitigation actions is dependent on the approval of the local elected governing body and the ability of the community to obtain funding from local or outside sources. Where such actions are high priorities, the community will work together with NYSOEM, FEMA and other Federal, State and County agencies to secure funds.

In general, mitigation actions ranked as high priorities will be addressed first. However, medium or even low priority mitigation actions will be considered for concurrent implementation. Therefore, the ranking levels should be considered as a first-cut, preliminary ranking and will evolve based on input from the Town departments and representatives, municipal government departments and representatives, the public, municipal government departments and representatives, NYSOEM, and FEMA as the Plan is implemented.

Table 6-13. Prioritization of Mitigation Initiatives

Mitigation Action #	# of Objectives Met	Benefits	Costs	Do Benefits equal or exceed Costs? (Y/N)	Is project Grant eligible? (Y/N)	Can project be funded under existing programs/budgets? (Y/N)	Priority
FMI-1 (5)	3	M	M	Y	Y	Y-AWSMP*	L
FMI-2 (7)	3	H	L	Y	N	Y	H
FMI-3 (10)	3	M	M	Y	Y	Y	H
FMI-4 (11)	4	M	L	Y	Y	N	H
FMI-5 (18)	7	M	M	Y	N	Y	H
FMI-6 (23)	3	L	L	Y	N	Y	L/M
FMI-7 (25)	ALL	M	L	Y	N	Y	M
FMI-8 (26)	2	M	L/M	Y	N	Y	L/M
FMI-9 (38)	3	H	L	Y	Y	Y	H
FMI-10 (41)	3	M	L	Y	Y	Y	H
FMI-11 (42)	1	H	L	Y	Y	Y	H
FMI-12 (45)	1	M	L	Y	Y	Y	L
FMI-13 (49)	4	M	M	Y	Y	Y	H
FMI-14 (51)	1	M	L	Y	Y	Y	M/H
FMI-15 (54)	4	H	M	Y	Y	Y	H
FMI-16 (55)	4	H	H	Y	Y	Y	L/M
FMI-17 (56)	3	H	L/M	Y	Y	Y	M
FMI-18 (57)	2	M	L	Y	Y	Y	M
FMI-19 (60&83)	2	H	L	Y	N	Y	L/M
FMI-20 (61)	2	H	L	Y	Y	Y	H
FMI-21 (62)	2	M	L	Y	N	Y	L/M
FMI-22 (65b)	4	H	L	Y	Y	Y	L/M
FMI-23 (66)	2	H	M	Y	Y	Y	L
FMI-24 (67)	3	H	M	Y	Y	N	M



Mitigation Action #	# of Objectives Met	Benefits	Costs	Do Benefits equal or exceed Costs? (Y/N)	Is project Grant eligible? (Y/N)	Can project be funded under existing programs/budgets? (Y/N)	Priority
FMI-25 (73)	3	M	L	Y	Y	Y	L/M
FMI-26 (81)	2	M	L/M	Y	Y	N	L
FMI-27 (82)	1	M	M	Y	Y	N	L/M
FMI-28 (84)	1	M	L/M	Y	Y	Y	M
FMI-29 (11)	4	L	L	Y	Y	Y	H
FMI-30	4	L	L	Y	Y	Y	H
FMI-31	4	H	H	Y	Y	N	H
FMI-32	4	M	L	Y	Y	N	M
FMI-33	4	H	L	Y	N	Y	H
FMI-34	1	H	H	Y	Y	N	M
FMI-35	5	H	H	Y	Y	N	M
FMI-36	5	H	H	Y	Y	N	M
FMI-37	3	L	L	Y	N	Y	H
FMI-38	4	L	L	Y	Y	Y	M
FMI-39	4	L	L	Y	N	Y	H
FMI-40	3	L	L	Y	N	Y	H
FMI-41	2	L	L	Y	N	Y	H
FMI-42	6	L	L	Y	N	Y	H
FMI-43	1	L	L	Y	Y	Y	M
FMI-44	6	H	M	Y	Y	N	H
FMI-45	6	H	M	Y	Y	Y	H
FMI-46	3	M	L	Y	N	Y	H
FMI-47	3	H	M	Y	Y	N	H
FMI-48	2	M	M	Y	Y	Y	M
FMI-49 (82)	4	L	L	Y	N	Y	L

Mitigation Action #	# of Objectives Met	Benefits	Costs	Do Benefits equal or exceed Costs? (Y/N)	Is project Grant eligible? (Y/N)	Can project be funded under existing programs/budgets? (Y/N)	Priority
FMI-50	4	M	M	Y	Y	N	M
FMI-51	8	L	L	Y	N	Y	H
FMI-52	4	L	L	Y	N	Y	H
FMI-53	3	L	L	Y	Y	N	H
FMI-54	4	L	L	Y	N	Y	H

Notes: H = High. L = Low. M = Medium. N = No. N/A = Not applicable. Y = Yes. TBD = To Be Determined.

HMGP-Hazard Mitigation Grant Program

PDM-Pre-Disaster Mitigation Program

AWSMP-Ashokan Watershed Stream Management Program

*"Yes" indicates the strategy is likely to fall within the objectives of the 2014-2019 SMIP grant program. Does not indicate a project will automatically be funded.

6.5 COMPLETED ACTIONS:

COMPLETED OR DELETED ACTIONS	COMMENT
FMI-11—Finalize and adopt a town-wide Flood Response Plan.	2012 plan adopted but will be updated when funds are available.
FMI-15—Where feasible, consider the adoption of appropriate higher regulatory standards (including but not limited to freeboard, compensatory floodwater storage, lower substantial damage thresholds, setbacks and fill restrictions) as means to reduce future flood risk and support a no-adverse-impact philosophy of floodplain management.	??
FMI-19— Determine if a Community Assistance Visit (CAV) or Community Assistance Contact (CAC) is needed, and schedule if needed.	Town is scheduling a CAV visit
FMI-20—Inventory monuments; obtain recommendations from local surveyors for sites for additional monuments in the area to reduce the costs of elevation certificates.	Monuments placed and recorded by local surveyors. Ongoing project. Consistently looking for additional locations to monument.

Section 7 Plan Maintenance Procedures

This chapter presents a plan maintenance process that includes the following (CRS Step 10):

- A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan over a 5-year cycle
- A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate
- A discussion on how the community will continue public participation in the plan maintenance process.

The plan maintenance strategy is the formal process that will ensure that the flood hazard mitigation plan remains an active and relevant document and that The Town of Shandaken maintains its eligibility for applicable funding sources. It includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every five years. The strategy also describes how public participation will be integrated throughout the plan maintenance and implementation process. It explains how the mitigation strategies outlined in this plan will be incorporated into existing planning mechanisms and programs, such as comprehensive land-use planning processes, capital improvement planning, and building code enforcement and implementation. The plan's format allows sections to be reviewed and updated when new data become available, resulting in a plan that will remain current and relevant.

7.1 MONITORING, EVALUATING, AND UPDATING THE PLAN

The procedures for monitoring, evaluating, and updating the plan are provided below.

7.1.1 Shandaken Area Flood Assessment and Remediation Initiative (SAFARI) Planning Committee

SAFARI is a total volunteer body that oversaw the development of the Plan and made recommendations on key elements of the plan, including the maintenance strategy. This committee had a broad composition of stakeholders including municipal officials, residents, federal, state, and local agencies. It was the committee's position that an oversight committee with representation similar to that of SAFARI should have an active role in the Plan maintenance strategy. Therefore, it is recommended that SAFARI remain a viable body involved in key elements of the Plan maintenance strategy. The preparation of future updates of this plan will be benefited by keeping this committee intact.

The principal role of SAFARI in this plan maintenance strategy will be to review the annual progress report and provide input to the Town of Shandaken Planning Board on possible enhancements to be considered at the next update. It will be the role of SAFARI to review the progress report in an effort to identify issues needing to be addressed by future plan updates.

7.1.2 Monitoring

The SAFARI Committee shall be responsible for monitoring progress on and evaluating the effectiveness of the FMP as well as documenting annual progress.

Understanding that individual commitments change over time, each department/agency and its representatives are responsible for informing the Town of Shandaken CRS Coordinator of any changes in representation by

formal letter. The CRS Coordinator will strive to keep the SAFARI Committee makeup as a uniform representation of planning partners and stakeholders within the planning area. The CRS Coordinator shall maintain the current membership of the Planning Committee in publicly accessible Town records.

The SAFARI Committee representatives shall be expected to document the following, as needed and as appropriate:

- Flood-related hazard events and losses occurring in the Town, including their nature and extent, and the effects that flood mitigation actions have had on impacts and losses
- Progress on the implementation of mitigation actions, including efforts to obtain outside funding for mitigation actions
- Any obstacles or impediments to the implementation of actions
- Additional mitigation actions believed to be appropriate and feasible
- Public and stakeholder input and comment on the plan

7.1.3 Evaluating

The committee will continue to meet once a quarter to evaluate the status of actions and discuss flood mitigation topics such as changes in vulnerability, project funding opportunities, etc.

The formal evaluation of the FMP is an assessment of whether the planning process and actions have been effective, if the FMP goals are being reached, and whether changes are needed. The FMP will be evaluated on an annual basis to determine the effectiveness of the programs, and to reflect changes that may affect mitigation priorities or available funding. This will be provided in the form of annual progress reports prepared and made publicly available to document action status each year.

Annual Progress Report

The minimum task of the ongoing annual planning committee meeting will be the evaluation of the progress of its individual action plan during a 12-month performance period. This review will include the following:

- Summary of any flood hazard events that occurred during the performance period and the impact these events had on the planning area
- Review of mitigation success stories
- Review of continuing public involvement
- Brief discussion about why targeted strategies were not completed
- Re-evaluation of the action plan to determine if the timeline for identified projects needs to be amended (such as changing a long-term project to a short-term one because of new funding)
- Recommendations for new projects
- Changes in or potential for new funding options (grant opportunities)
- Impact of any other planning programs or initiatives that involve flood-related hazard mitigation.

The planning team has created a template for preparing a progress report (see Appendix D). Based on this template, the Planning Committee will then prepare a formal annual report on the progress of the plan. This report should be used as follows:

- Posted on the Town Flood Mitigation website page dedicated to the FMP
- Provided to the local media through a press release
- Presented to the Town of Shandaken Town Board to inform them of the progress of mitigation initiatives implemented during the reporting period

- Provided as part of the CRS annual re-certification package. The CRS requires an annual recertification to be submitted by October 1 of every calendar year for which the community has not received a formal audit. To meet this recertification timeline, the Planning Committee will strive to complete progress reports between June and September each year.

Annual progress reporting is credited under CRS Step 10.

7.1.4 Updating

The Town of Shandaken intends to update the FMP on a five-year cycle from the date of initial plan adoption (CRS Step 10). This cycle may be accelerated to less than five years based on the following triggers:

- A Presidential Disaster Declaration that impacts the planning area
- A hazard event that causes loss of life
- A comprehensive update of the Town's Master Plan.

It will not be the intent of future updates to develop a complete, new FMP for the planning area. The update will, at a minimum, include the following elements:

- The update process will be convened through a steering or planning committee.
- The hazard risk assessment will be reviewed and, if necessary, updated using best available information and technologies.
- The action plan will be reviewed and revised to account for any initiatives completed, dropped, or changed and to account for changes in the risk assessment or new policies identified under other planning mechanisms (such as the comprehensive plan).
- The draft update will be sent to appropriate agencies and organizations for comment.
- The public will be given an opportunity to comment on the update prior to adoption.
- The Town of Shandaken Town Board will adopt the updated plan.

It is the Town's intention to fully integrate this FMP into the Ulster County Hazard Mitigation Plan at some time. This will allow for a uniform update cycle for both plans and eliminate redundant planning.

7.1.5 Plan Implementation

The effectiveness of the flood hazard mitigation plan depends on its implementation and incorporation of its action items into existing local plans, policies and programs. Together, the action items in the Plan provide a framework for activities that The Town of Shandaken can implement over the next 5 years. The planning team and SAFARI have established goals and objectives and have prioritized mitigation initiatives that will be implemented through existing plans, policies, and programs.

The Town of Shandaken SAFARI committee will have lead responsibility for overseeing the plan implementation and maintenance strategy. Plan implementation and evaluation will be a shared responsibility among all agencies identified as lead agencies in the mitigation action plan.

7.1.6 Continuing Public Involvement

The public will continue to be apprised of the plan's progress through the Town of Shandaken website and by providing copies of annual progress reports to the media. The website will not only house the final plan, it will become the one-stop shop for information regarding the plan and plan implementation. Copies of the plan will be distributed to the Town of Shandaken library. Upon initiation of future update processes, a new public

involvement strategy will be initiated based on guidance from SAFARI. This strategy will be based on the needs and capabilities of the Town of Shandaken at the time of the update. At a minimum, this strategy will include the use of local media outlets within the planning area.

7.1.7 Incorporation into Other Planning Mechanisms

The information on hazard, risk, vulnerability, and mitigation contained in this plan is based on the best science and technology available at the time this plan was prepared. The Town of Shandaken Comprehensive Plan is considered to be an integral part of this plan. Town of Shandaken, through adoption of a flood damage protection ordinance, has planned for the impact of flooding. The plan development process provided the opportunity to review and expand on policies in these planning mechanisms. The comprehensive plan and the flood hazard mitigation plan are complementary documents that work together to achieve the goal of reducing risk exposure. An update to a comprehensive plan may trigger an update to the flood hazard mitigation plan.

The Town of Shandaken will create a linkage between the flood hazard mitigation plan and the comprehensive plan by identifying a mitigation initiative as such and giving that initiative a high priority.

Other planning processes and programs to be coordinated with the recommendations of the flood hazard mitigation plan include the following:

- Ulster County All Hazard Mitigation Plan
- Emergency response plans
- Capital improvement programs
- Municipal codes
- Community design guidelines

Some action items do not need to be implemented through regulation. Instead, these items can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation. As information becomes available from other planning mechanisms that can enhance this plan, that information will be incorporated via the update process.